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(Eds.)

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Coping with Global Environmental Change, Disasters and Security

Threats, Challenges, Vulnerabilities and Risks

Springer

Hexagon Series on Human and Environmental Security and Peace **Vol. 5**

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Coping with Global Environmental Change, Disasters and Security

Threats, Challenges, Vulnerabilities and Risks

With Forewords by Achim Steiner, Under-Secretary General of the United Nations and Executive Director of UNEP; Professor Dr. Konrad Osterwalder, Under-Secretary General of the United Nations and Rector, United Nations University; Jean-Francois Bureau, Assistant Secretary General for Science and Public Diplomacy of NATO; Her Excellency Ambassador Professor Dr. Joy Ogwu, Permanent Representative of Nigeria to the United Nations and former Foreign Minister of Nigeria; His Royal Highness, Prince Hassan Bin Talal of Jordan

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Foreword

Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks is the fifth volume in the *Hexagon Series on Human and Environmental Security* and Peace and it completes the *Global Environmental and Human Security Handbook for the Anthropocene*.

This handbook addresses scientific issues of utmost importance for UNEP. In calling for a 'Fourth Green Revolution' the concluding chapter endorses the Global Green New Deal/Green Economy Initiative (GEI) launched during the unfolding financial and economic crisis of late 2008: At the time, few may have thought that it would gain such rapid traction.

However, it is estimated that around 15 per cent of more than $3 trillion-worth of stimulus funds are green in nature, with that rising to around 80 per cent in the Republic of Korea. Within a relatively short space of time, terms such as Green Economy and Green Growth have become common parlance in many capital cities and at key international gatherings, including G8 and G20 summits and ministerial sessions of the OECD.

The urgency of the challenges facing all economies, from climate change to ecological losses, allied to the need to deliver growth, overcome poverty and generate employment, are more apparent with every passing year and every new decade. The Green Economy is taking root in diverse economies and geographical locations, all allied by a common need.

More than two dozen governments have requested the UN Environment Programme's (UNEP) assistance and advice how best to tailor a transition to a low carbon, resource efficient Green Economy within national development strategies and economic planning. In China, UNEP is collaborating with the Ministry of the Environment and relevant institutions to produce a series of sectoral green economy studies, which will feed into the country's five year development plan.

A Green Economy Initiative for Africa is in preparation and studies are underway in Eastern Europe, the Caucasus and Central Asia looking at the prospects for promoting organic agriculture. In West Asia, priority sectors for catalyzing a Green Economy have emerged following discussions in countries including Bahrain, Dubai and Jordan to Kuwait, Lebanon and Saudi Arabia.

These exciting opportunities dovetail with the acceleration of Technology Needs Assessments under the framework of the UN Framework Convention on Climate Change (UNFCCC). The assessments are being supported by the Global Environment Facility. Up to 45 countries are to be assisted in prioritizing technologies for both mitigation and adaptation to climate change, as well as investigating and overcoming potential legal, financial, policy and other barriers to their uptake.

The first wave of 15 countries have been selected ranging from Cote D'Ivoire and Mali in Africa; Bangladesh, Cambodia and Indonesia in Asia to Argentina and Guatemala in Latin America and Georgia in Europe. With more carbon dioxide in the atmosphere now than at any time in the past 650,000 years, it's evident that these types of measures are imperative to deal with the growing climate crisis.

The Green Economy could be the biggest innovation project in history breaching the divide as the economic models of the 20th century look less and less able to serve a planet of six billion, rising to nine billion by 2050.

This book, looking at global environmental change, details threats to our future wellbeing and our security. We live in a rapidly evolving world. Sixty per cent of the world's largest urban areas, with a population of over 5 million, are located within 100 km of the coast. The current climate footprint from buildings is equivalent to 8.6 billion tons of CO_2 a year, and predicted to almost double to 15.6 billion tons of CO_2 by 2030. Every year an estimated $2 to $5 trillion is lost-almost without notice or comment from the global economy, as a result of the degradation and destruction of the planet's nature-based resources.

The public is looking to its leaders and its policy-makers for solutions. It's time to combine policy choices that work long-term, combined with supportive market mechanisms to "green" our economies, lifestyles and jobs. Together we can perhaps provide a route to sustainable development that to date has eluded human-kind. In investment terms, it a low risk, high and sustainable growth investment portfolio for the planet.

So I welcome this volume on *Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks* and its 95 peer-reviewed chapters as an eye-opener to both the challenges but also the opportunities of our age. I hope that private foundations and donors can ensure that its important ideas, debates and essential reading find their way equally onto the library book shelves of the South as well as the nations of the North.

Nairobi, in June 2010

Achim Steiner
UN Under-Secretary General and
Executive Director,
UN Environment Programme (UNEP)

Foreword

This 5th volume of the Hexagon Series on Human and Environmental Security and Peace on *Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks contributes to the task* of the United Nations University to advance knowledge for human security, peace, and development. Written by over 100 experts, it addresses the conceptual linkages between the four key goals of the United Nations system of security, peace, development and the environment.

It also completes the embedded three volumes on *Global Environmental and Human Security Handbook for the Anthropocene* (GEHSHA) within the Hexagon Series.

This book addresses in 95 chapters key environmental and human security issues from the perspective of many disciplines, cultures and world regions. It reviews the ongoing conceptual debate on security threats, challenges, vulnerabilities and risks. It analyses military and political hard and soft security dangers and concerns and assesses economic, social, environmental and human security issues especially in the Middle East, North Africa and Asia. It also includes selected results of a summer academy organized by the Munich Re Foundation and the Institute for Environment and Human Security of the United Nations University (UNU-EHS) on urban centres and agglomerations as vulnerability hot spots. Senior UNU-EHS scientists write on strategies for coping with social vulnerability and resilience building during and after the occurrence of hazard events.

Altogether 28 chapters deal with adaptation to and coping with Global Environmental Change focusing on climate change, soil degradation and desertification, water management and food and health security issues. An additional 16 chapters address scientific, international, regional and national political coping strategies, policies and measures. Finally, the remaining seven chapters deal with remote sensing, vulnerability mapping and indicators of environmental security challenges and risks, with improved early warning of conflicts and hazards and propose a 'political geoecology' for the Anthropocene and a new 'Fourth Green Revolution'.

Of the eight editors of this major scientific reference book, two women from Mexico and Kenya and six men from Europe and North Africa, three have been or are associated with UNU-EHS. This book contributes to the mission of the United Nations University system "to resolve the pressing global problems of human survival, development and welfare that are the concern of the United Nations, its Peoples and Member States" by relying on the knowledge generated by the social sciences and humanities as well as natural sciences based on a "holistic approach to the complex problems that affect human security and development".

This unique compilation of global scholarship is thought provoking, analytical and very comprehensive. It deserves many readers from all walks of life. It, like the other issues of the Hexagon Series, should be available for those seeking in depth knowledge of the complexities and security implications of the linked social-environmental system we live in.

Tokyo, May 2010

Konrad Osterwalder
Rector, United Nations University
Under-Secretary-General of the
United Nations

Foreword

"Coping with Global Environmental Change, Disasters and Security Threats, Challenges, Vulnerabilities and Risks" is a burning issue today.

Climate change is a threat to vital resources and can provoke major social, economic and political problems. As such, it has major security dimensions and could act as a "threat multiplier" by increasing conflict and instability in several regions.

This was already the subject of a workshop that was co-sponsored in 2005 by NATO's Public Diplomacy Division. The book collates the results and recommendations of this workshop and constitutes a reference to security issues in this field. It raises awareness on global environmental change and its impact on security not only among high-level officials, scientists, but also among citizens. The topics of concern include: environmental security concepts and debates; climate change and security; energy; water; food and health security for the 21st century.

In addition, it will help to identify a roadmap for future multi-disciplinary research to better understand the vulnerability and instability driven by global environmental change.

NATO is looking at the work and discussion related to climate change with great interest. Hence, global climate change is mentioned as a global threat to security in NATO's long-term study on Future Security Environment conducted by Allied Command Transformation.

As an integral part of public diplomacy activities, NATO's Science for Peace and Security (SPS) Programme contributes to security, stability and solidarity among NATO and partner countries, including Mediterranean Dialogue countries, by facilitating cooperation, networking and capacity-building. The main objectives of NATO's SPS Programme are to promote the application of the best technical expertise to problem-solving.

Environmental security has been identified as a key priority for NATO's Partner and Mediterranean Dialogue countries and, in 2008, NATO members agreed that the Science Security Forum would address this issue in-depth by bringing together internationally-recognized experts. The Forum clearly demonstrated the close link between global security concerns and environmental issues related to climate change, management of shared water resources and energy security.

Indeed, public diplomacy has an important role to play in taking the end results of these deliberations to the public in order to explain how these threats impact on human security.

Brussels, January 2010

Jean-François Bureau
NATO Assistant Secretary General for Public Diplomacy
Chairman, Science for Peace and Security (SPS) Committee

Foreword

Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks is the fifth volume in the *Hexagon Series on Human and Environmental Security* and Peace. It completes the *Global Environmental and Human Security Handbook for the Anthropocene*. I am pleased that one of the coeditors is a Kenyan and 16 contributors to the volume are from various parts of Africa, including Egypt, Tunisia, and Mauritania (North Africa), and Nigeria, Ghana, Niger, and Burkina Faso (West Africa). This situation ensures that the diverse security challenges in Africa and how they have been confronted are adequately addressed in the book.

This scientific peer-reviewed volume contributes to crucial global dialogue and learning, based on topical new evidence from several disciplines. In the 20th century, Africa has suffered severely from the effects of global environmental change resulting from desertification, drought, famine, floods and heat waves. Millions of Africans have either been killed or forced to flee their homes.

The fourth IPCC Assessment Report of 2007 estimates that climate change will have several negative impacts on Africa, especially regarding access to clean water, sufficient food, stable health conditions, ecosystem resources, and security of settlements. It further estimates that many semi-arid areas in North and Southern Africa, will become severely water-stressed, and by 2020, between 75 and 250 million people are projected to experience increased water stress. During the same period, yields from rain-fed agriculture in some African countries could be reduced by up to 50 per cent, thus affecting food security and exacerbating malnutrition. Indeed, several African mega-deltas, due to large populations and high exposure to sea level rise, storm surges, and river flooding, will suffer from the impacts of global environmental and climate change. Although Africa has historically contributed little to climate change, the limited adaptive capacity of the countries on the continent has increased the impact of climate change on the continent.

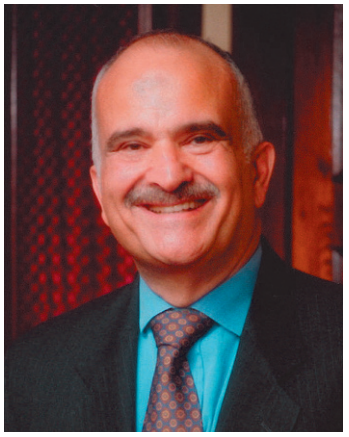
This book, with 95 chapters, reviews the conceptual debate on security threats, challenges, vulnerabilities and risks. It analyses military and political hard and soft security dangers and concerns in West Africa and assesses environmental and human security issues in North Africa. The main parts deal with the challenges of coping with Global Environmental Change, focusing on climate change, soil degradation and desertification, water management, food and health security issues. It also deals with scientific, international, regional and national political remediation strategies, policies and measures. One chapter discusses early warning systems for conflicts in East Africa and two chapters propose a 'political geoecology' for the Anthropocene and a new 'Fourth Green Revolution'.

This huge volume of excellent scholarship from all parts of the world helps to sensitize, not only policy makers but also enable the young generation of professors and students globally but specifically, in the most affected countries in the South. It calls for proactive and concerted action and for a global science partnership to reduce the most debilitating

impact of the projected trends in ëbusiness as usualí strategies. This book deserves many readers in all parts of the world, even in the countries where university and research libraries are unable to afford such books. It is my sincere hope that this high-quality, multidisciplinary study and reference book, and its key messages will be made available to university and research libraries through the support of private foundations and public donors. The young generation in the South that must cope with these challenges to their security in the 21st century must be availed of this book. I wish the book-aid project success for the benefit of university libraries and research institutes and their readers in Africa, Asia and Latin America.

New York, May 2010

Ambassador Prof. Dr. Joy Ogwu
Permanent Representative of the
Federal Republic of Nigeria to the
United Nations



Foreword

Environmentally induced population displacement resulting from climate change is now indisputable. Simultaneously, as noted by the UN High Commissioner for Refugees, António Guterres, it is becoming increasingly difficult to categorize people as displaced by any single cause: conflict, economic marginalization, environmental degradation, climate change, or any other factor, since their fate may be the result of a combination of all or any of the above. The statistics in the report that follow are alarming: 300,000 deaths and 300 million severely affected each year by climate impacts today; currently, 100 billion US dollars of economic losses annually and over 20 million persons displaced; and as so often is the case, it is the poor that are worst affected, with 99 per cent of climate change casualties taking place in developing countries (Global Humanitarian Forum, 2009).

This is a human tragedy on a massive scale. It is also a major threat to global security and could result in global catastrophe costing millions of lives in climate induced wars and natural disasters. Yet governments procrastinate. This is frustrating for the many of us who know that solutions are available – now. But it requires a move away from the failed unilateral strategies of the past.

The world is facing what amounts to an existential crisis in which we are all wholly interconnected – in everything but policy. The West Asia-North Africa region, the intermediary meeting point of Eurasia, home to the greatest concentration of energy reserves, and one of the most populous, poorest, and arguably, most volatile regions of the world, is at the centre of this global crisis. Yet, with approaches inspired by vision and integrity, which place people at the centre, it can also offer solutions.

The international community has a vital role here. Rather than seek to balance power and influence in the region, global security would be better served by fostering collaboration and inclusion in policy and attitude at every level.

In practical terms, this means forging partnerships which bind the region together while looking outwards across the 'energy ellipse' (from the Caucasus to the Straits of Hormuz) and beyond to enable regional stabilization.

It has been universally agreed that we cannot remain dependant on finite fossil fuels, and that the development of alternative energy applications via multilateral consent and cooperation is a way forward.

A regional community employing modern technology could use the region's deserts to develop clean energy. The jobs created in the fields of water desalination and solar energy, together with their service industries, would go some way towards meeting growing demands for employment – estimated by the World Bank as some 100 million new job opportunities required by 2020. Sustainable governance of shared resources would enable us to replace fossil fuels, help in solving ours and

Europe's energy crisis, reduce carbon emissions, slow climate change, and maximize the carrying capacity of the trans-border area.

Our composite security needs can only be addressed by humanizing globalization. The ambitious trans-regional cooperation, envisaged in the DESERTEC project's high tension grid network that would connect European national grids with the WANA region, would foster a new chapter in terms of international energy trade for 'clean, renewable energy'; could secure international energy stability between the EU-Mediterranean countries and hopefully reinvigorate the Barcelona Process. It could provide the impetus for the establishment of not only a much needed community for energy, water, and climate security for the Mediterranean riparian regions of Europe, the Middle East and North Africa, but in due course for a water and energy authority to oversee both the oil rich countries and those of the hinterland. Resource scarcity, resource wealth, and human resource wealth could thus be transformed from a source of conflict into points of cooperation.

It is with this vision of stabilizing the region on the basis of a thematic and integrated approach that puts people, human dignity, and preventive security at the forefront that I recommend this volume of work on *Coping with Global Environmental Change* and hope it will galvanize decision makers into addressing the challenges we face right now.

Amman, January 2010

HRH Prince El Hassan bin Talal
The Hashemite Kingdom of Jordan

Dedication by the AFES-PRESS Board

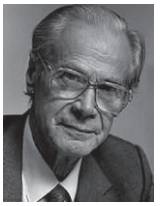
This book is dedicated to a founding mother and two founding fathers
of the first generation of international peace research

Prof. Dr. Elise Boulding

*6 July 1920 in Oslo (Norway) + 24 June 2010 in Needham, MA (USA)

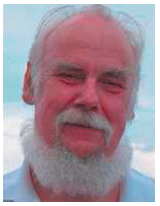
Prof. of Sociology, Dartmouth College, NH (USA)
Secretary General of IPRA (1988–1990)

Prof. Dr. John W. Burton



*2 March 1915 in Melbourne +23 June 2010 in Canberra

Signer of the UN Charter in June 1945 San Francisco
Civil Servant, international relations specialist and academic teacher



Prof. Dr. Håkan Wiberg

*12 June 1942 in where in Sweden + 3 July 2010 in Copenhagen

Professor of Sociology, University of Lund (1981–2007)
Director, Copenhagen Peace Research Institute (COPRI, 1988–2001)

And as a representative for the women of the world who experienced the horror of war in the 20th century and who conveyed the values of a more peaceful world to their children, we wish to honour here

Irma Brauch

*27 December 1920 in Neuhausen/Erzg. + 21 August 2010 in Mosbach

A mother who inspired her son to become a peace researcher and who created an atmosphere that facilitated the emergence of this handbook

While the three scientists inspired us by their intellectual contributions to peace research Irma Brauch conveyed her devotion to a world without war, human humiliation and injustice and thus to the values and goals of peace research by hosting in her home the AFES-PRESS board, several receptions during international workshops as well as peace researchers, colleagues and friends from all parts of the world with her own homemade cooking and especially with her special cheese cake.

The Board of
Peace Research and European Security Studies (AFES-PRESS) e.V.

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Prof. Dr. Úrsula Oswald Spring (Mexico)
Prof. Dr. John Grin (The Netherlands)
Prof. Dr. Czeslaw Mesjasz (Poland)
Thomas Bast (Germany)
1 September 2010 (Antiwar day)

We the eight editors from seven countries

from Europe, Africa and Latin America:

Hans Günter Brauch (Germany),
Úrsula Oswald Spring (Mexico),
Czeslaw Mesjasz (Poland),
John Grin (The Netherlands),
Patricia Kameri-Mbote (Kenya),
Béchir Chourou (Tunisia),
Pal Dunay (Hungary),
Jörn Birkmann (Germany),

dedicate this volume to

our children or godchildren

representing all children of the globe –

who will experience

during the 21st century

whether

the messages of these

joint scientific efforts will become reality.

For

András, Anna,

Barbara, Chloe,

Hanna, Hela, Ian, Janusz,

Melanie, Micha, Natalia, Nathan

Omar, Serena Eréndira, Slim, Sophia Neira, Ulrike

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Max Planck Institute for Chemistry
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- *Figure 26.2:* Climate change and food security in the Mediterranean space and changes in agricultural yields until 2020, 2050 and 2080. *Source:* WBGU (2006a).
- *Figure 26.3*: Framework for a causal analysis of migration dynamics. *Source*: Brauch (2000/2001: 111).
- *Figure 26.4*: The best regions for *Concentrated Solar Power* (CSP). *Source:* Jonathan Walters, World Bank: "MENA Concentrated Solar Power", presentation for the Conference on the Mediterranean Solar Plan, Valencia, 11-12 May 2010; at: <http://www.mediterraneansolarplan-conference.es/uploads/documentos/documentos_Jonathan_Walters_World _Bank_9769228b.pdf>. This talk is in the public domain.

The following tables (26.1, 26.2, 26.3, 26.4, 26.5, 266, 26.7, 26.8) were compiled by the author based on publicly available data. For these tables (26.10, 26.11, 26.12) the sources are in the public domain, while for the remaining tables permission was obtained from the copyright holders or are available for scientific purposes.

- *Table 26.9*: Impact of climate change on water availability, drought and flood occurrence in Europe for various time slices and under various scenarios based on the ECHAM4 and HadCM3 models. *Source*: IPCC (2007a: 550).
- *Table 26.13*: Cereal balance for MENA countries. *Source*: Bruinsma (2003). The copyright holder is FAO.
- *Table 26.14*: Increase in number of migrants in Spain (1975-2005). *Source*: Population Division of the DESA of the United Nations: *Trends in Total Migrant Stock. The* 2005 *Revision*; at: <http://esa.un.org/ migration> (16 October 2006).
- *Table 26.15*: Migrants from five North African countries to five South European EU states. *Source*: Fargues (2006: 24-25) based on Fargues (2005).

The references in box 26.1 were taken from a public document of the European Commission that is in the public domain.

In chapter 27, *Jenniver Sehring and Ernst Giese* reproduced a figure that is in the public domain:

- *Figure 27.2:* Impact of climate change on environmental risks in the Fergana valley, Uzbekistan. *Source*: Philippe Rekacewicz (UNEP/GRID/Arenal 2005); at: <http://maps.grida.no/go/graphic/climate_change_and_natural_disaster_impacts_in_the_ferghana_valley>. Printed with permission.

In chapter 29, *Mark Pelling* has developed a table he co-authored with colleagues further in

- *Table 29.3*: Six aspects of human vulnerability to climate change. *Source*: Based on Satterthwaite, Huq, Pelling, Reid and Lankao (2008).

In chapter 31, *Mabel C. Marulanda, Omar D. Cardona* and *Alex H. Barbat* used for the compilation of their tables data of the *DesInventar* database of IDEA, ERN-Colombia and of the World Bank that are either in the public domain and do not require permission:

- *Table 31.1*: Number of small and medium disasters in Colombia (1971-2002). *Source*: *DesInventar* database, La RED (2004).
- *Table 31.2*: Gross figures of effects as a result of small and moderate disasters. *Source*: *DesInventar* database, La RED (2004).
- *Table 31.3*: Effects per local event on average. *Source*: DesInventar database, La RED (2004).
- *Table 31.4*: Comparison between the effects due to small and extreme disasters. *Sources*: *DesInventar* database, La RED (2004), and report on small disasters for National Department of Planning, ERN-Colombia (2005).
- *Table* 31.5: Estimated cost of losses and damage caused by small disasters, in 1,000 US$. *Source*: Based on the methodology of the IDB-IDEA Programme of Indicators, IDEA (2005a/b).
- *Table 31.6*: Losses of extreme hazard events, in current million dollars and in percentage of GDP. *Source*: Extreme events, report on small disasters for National Department of Planning, ERN-Colombia (2005).
- *Table 31.7*: Accumulated losses of small disasters in million US$ and percentage of the agricultural GDP. *Source*: For the estimate the GDP of the last year of each period was taken using data by the Word Bank (2003).
- *Table 31.8*: Accumulated losses from small disasters in million US$ and percentage of construction GDP. *Source*: For estimates, the GDP was taken of the last year of each period using data of the Word Bank (2003).
- *Table 31.9*: Accumulated losses of small disasters in million US$ and percentage of GDP of Colombia. *Source*: For estimates, the GDP was taken of the last year of each period using data of the Word Bank (2003).

In chapter 32, *Carmen Lacambra* and *Kaveh Zahedi* developed several figures (32.1, 32.2) and compiled several tables based on data that are in the public domain or on their previous publications. They appreciate the permission of the copyright holder to use the following photos from the archives of the newspaper *El Universal*:

- *Figure 32.3*: Occurrence of natural disaster events in Latin America and the Caribbean by decade (1900-99). *Source*: Chaveriat (2000: 29, chart 1.3).
- *Figure 32.5*: Claiming land in a mangrove swamp in Cartagena (Colombia). *Source*: Photo: Correa, *El Universal* (14 November 2008); at: <http://www.eluniversal.com.co/>.
- *Figure 32.6*: Deteriorated mangrove in Cartagena (Colombia). *Source*: Archive, *El Universal* (September 2008).

They also compiled several tables (32.2, 32.3) based on data from the Desinventar database and on other cited sources that do not require permission.

- *Table 32.5*: Status of coral reefs in Central and South America. *Source*: Modified from Wilkinson (2004).
- *Table 32.6*: 20 indicators more frequently reported to be used in vulnerability analyses. Indicators are presented in order and according to frequency of use. *Sources*: Brooks/Adger/Kelly (2005); Blaikie/Cannon/Davis/Wisner (1994); Mancilla (1996); Cardona (2003); Adrianto/Matsuda (2002); Alcantara-Ayalam (2002); Briguglio (2003); UNEP (2005); Chang (2004); Bush/Neal/Young/Pilkey (1999); FAO (2001).
- *Table 32.8*: Characteristics of the region's coastal areas. *Sources*: Alonso/Ramirez/Diaz/Segura/Castillo/Chatwin (2007: 31); Chatwin (2007); CIA Factbooka; CIEb;

DANE (2005)c INE (2001)d; INEC-Costa Rica (2000)e; INEC-Ecuador (2001)f; INEC-Nicaragua (2005)g; Ministerio de Economia – El Salvador (2007)h; PNUMA (2003); Restrepo/Kjerfve (2004); Rodriguez/Windevoxhel (1998:11); WRI (2003).

In chapter 33, *Monalisa Chatterjee* compiled five tables that are based on the author's own field research in Mumbai.

In chapter 34, *Reena Singh* designed two figures based on her own household survey and adapted a third figure of UN Habitat that is in the public domain:

- *Figure 34.1*: Causes and Implications of Inadequate Water and Sewerage in Urban Areas *Source*: Designed by the author, adapted from UN Habitat (2003: 103).

Furthermore, she compiled three tables based on her own survey data and on information that is in the public domain:

- *Table 34.1*: Trends in population growth, water, and sewerage in Delhi. *Source*: CPCB (2004: 14).

In chapter 35, *Nanda Kishor* used a map of Hyderabad that is in the public domain:

- *Figure 35.2*: The three sites of displacement in the mega city of Hyderabad: 1) MMTS station Lakdikapool; 2) Cyberabad Info Tech park; and 3) the International Airport. *Source:* Corporate Infobase Ltd. and Municipal Corporation of Hyderabad; at: <http://www.ghmc.gov.in/hyd/hydmap.asp>.

He also compiled a table based on data of the World Bank (35.1) that are in the public domain and he reproduced a table for which permission was obtained from the copyright holder.

- *Table 35.2*: Presence of resettlement and rehabilitation policies in India. *Source*: Cernea (1996).

In chapter 36, *Xiaomeng Shen*, reproduced two figures and compiled one table that are either in the public domain and for which she obtained permission from the copyright holder:

- *Figure 36.1:* Gross domestic product of the Changjiang River Basin (2000). *Source*: Shi (2003: 108).
- *Figure 36.2*: Retention areas in Wuhan. *Source*: Wuhan Chengshi Guihuaju (2003).
- *Table 36.1*: Overview of the ten flood events with most people killed. *Source*: Université Catholique de Louvain, Brussels, Belgium, EM-DAT: The OFDA/CRED International Disaster Database; Created on: 2 June 2009. Data version: v12.07; at: <www.em-dat.net>.

Three tables (36.1, 36.2, 36.3) are based on EM-DAT, the OFDA/CRED International Disaster Database; Created on: 2 June 2009 that is maintained by CRED of the Université Catholique de Louvain, Brussels, Belgium and for the fourth she obtained permission of the copyright holder.

- *Table 36.4*: Overview of the five freshwater flood events with most people killed. *Source*: Jonkman (2005: 158).

In chapter 38, *Ebru A. Gencer* acknowledges that this chapter relies on her Ph.D. thesis that was published as: Gencer, Ebru, 2008: *Natural Disasters, Vulnerability, and Sustainable Development: Examining the Interplay, Global Trends and Local Practices in Istanbul* (Saarbrücken: Vdm Verlag Dr. Müller, 2008).

She illustrated her chapter with her own photographs (figure 38.8, 38.10) and of a previous paper (38.9). Several figures (38.1, 38.2, 39.3, 39.4, 39.6, 39.7) are in the public domain and for the remaining two figures and one table she obtained permission from the copyright holder:

- *Figure 38.5*: Distribution of intensities after a Mw=7.5 Earthquake. *Source*: Erdik, Durukal, Biro, Siyahi and Akman (2001).
- *Figure 38.9*: Selected districts in project. *Source*: Author's adaptation of *Expected Earthquake Shaking Map of the Istanbul Metropolitan Area*, in: *International Urban Planning Studio: Disaster Resistant Istanbul.* Final Report (New York: Columbia University, Graduate School of Architecture, Planning and Preservation, Urban Planning Program). *Source*: NEHRP Soil Classification Map for Istanbul 1997.
- *Table 38.1*: Selected demographic data of Istanbul and of the three project districts. *Sources*: Data from the State Institute of Statistics (SIS) Census Results (TCBDE 2002); IMM Statistics for Istanbul (BB); SIS News Bulletin (TCBDE 1997); Bekar (2002); Yapi (2006a); and IEMP (Gülersoy/Eyidoğan/Gülkan/Türkoğlu/Erkut/Tezer 2003): 119; Ökten/Şengezer/ Dinçer/Batuk/Koç/Gül/Evren/Seçkin/Çekiç/Emem (2003): 276).

In chapter 39, *Adeniyi Sulaiman Gbadegesin, Felix Bayode Olorunfemi* and *Usman Adebimpe Raheem* have reproduced two maps that are in the public domain (39.1, 39.3). The written permission to reproduce two photos by David Simon was granted on 9 October 2009:

- *Figure 39.2*: Inappropriate construction of residential buildings on urban wetlands, Bariga, Lagos. *Source*: Photo by D. Simon (2007: 22).
- *Figure 39.3*: Houses in Bariga on stilts over Lagos Lagoon. *Source*: Photo by D. Simon (2007: 26).

The authors compiled ten tables that are based on data that are either in the public domain (39.1, 39.2, 39.3, 39.4, 39.5, 39.8, 39.9) or based on their own research (39.6, 39.7, 39,10). In three boxes they reproduced excerpts from newspaper and journal articles within the fair use:

- *Box 39.1*: People under siege: "We are Dying". *Source*: TELL Magazine (19 April 2004: 49).
- *Box 39.2*: Panic as Toxic Smoke Covers Lagos. *Source*: Vanguard (13 October 2005: 46).
- *Box 39.3*: Climate Change Risks and Response in the megacity of Lagos. *Source*: Mehrotra, Natenzon, Omojola, Folorunsho, Rosenzweig and Rosenzweig (2009).

In chapter 40, *Debarati Guha-Sapir* and *Femke Vos*, have used 16 figures, 13 tables and 1 box that are all based on the EMDAT developed and maintained by CRED at the Université Catholique de Louvain, Brussels, Belgium, EM-DAT.

In chapter 41, *Steffen Bauer* reproduced two figures from the WBGU's (2007, 2008) report on *Security Risk Climate Chang*e to which he was actively contributing. These figures are in the public domain.

In chapter 42, Jürgen Scheffran modified a figure he previously published with a colleague:

- *Figure 42.6*: Conflicting and cooperative relationships between two actors making efforts to achieve value goals according to given action rules. *Source*: Modified from Scheffran/Hannon 2007: 82.

In chapter 44, *Carlo Buontempo, Jens Kristian Lørup, Michael Sanderson, Michael Butts, Erika Palin, Rachel McCarthy, Richard Jones, Richard Betts* and *Mamdouh Antar* used a NASA satellite image (44.1) that is in the public domain and other figures of the Met Office Hadley Centre (44.2, 44.3, 44.4, 44.5, 44.6) under the terms of the British Crown Copyright.

- *Figure 44.1*: This satellite image shows the northern portion of the Nile which is being modelled as part of the case study. At the apex of the delta is the Egyptian capital city

of Cairo. *Source*: Courtesy NASA/JPL-Caltech; at: <http://www.jpl.nasa.gov/imagepolicy/>.
- *Figure 44.2*: The rainfall comparison between the regional climate model output and the driving GCM. *Source*: Met Office Hadley Centre. ©British Crown Copyright.
- *Figure 44.3*: Schematic layout of the project. *Source*: Met Office Hadley Centre. ©British Crown Copyright.
- *Figure 44.4*: Comparison between one of the five regional climate model simulations (left) and the climatology (CRU) for June, July and August. *Source*: Met Office Hadley Centre © British Crown copyright.
- *Figure 44.5*: Monthly temperature and precipitation for different ensemble members. *Source*: Met Office Hadley Centre. ©British Crown Copyright.
- *Figure 44.6*: Rainfall percentage difference (blue +100 per cent and above red -100 per cent) between two different projections. *Source*: Met Office Hadley Centre. ©British Crown Copyright.

In chapter 45, *Mohamed El Raey* reproduced several satellite images by NASA (45.1, 45.2), figures of the US Mapping Agency (45.4) and of Egyptian government institutions (45.8, 45.9) that are in the public domain and figures of his co-authored publications (46.6, 45.7) and of his colleagues (46.5, 45.13) with their permission. For the following remaining figures written permission was obtained:
- *Figure 45.3*: Contour map of the Nile delta region indicating areas of the delta below sea-level (in red), the 2m contour and below in yellow. *Source*: Sestini (1991) with modifications by El Raey.
- *Figure 45.8*: A map of Alexandria districts and Lake Maryut. The water surface of the lake is kept at 2.8m below sea-level by a set of pumping stations at El Mex. *Source*: This official map is in the public domain.
- *Figure 45.9*: The main topographic features of Alexandria City indicating major ridges or hills (in dark black) and tunnels in between. *Source*: Abdel Hakim, Sobhy (1958); *Alexandria City* (Alexandria Library 1958).
- *Figure 45.10*: Land cover and land use of Alexandria City as observed based on an analysis of satellite images. *Source*: Al Hosaini (2006).
- *Figure 45.11*: Percentage land-use to be affected by scenarios of sea-level rise in Alexandria. *Source*: Al Hosaini (2006).
- *Figure 45.12*: Loss of employment in each district of Alexandria City by various scenarios of sea-level rise. *Source*: Al Hosaini (2006).
- *Figure 45.14*: The location of the city of Port Said on the tip of Suez Canal, surrounded by water bodies and indicating high vulnerability of the city to potential impacts of sea-level rise. *Source*: Sestini (1991: 547).
- *Figure 45.15*: Distribution of groundwater salinity in ppm in the Nile delta region in the year 2000. *Source*: Gaamea (2000) cited in Frihy (2003).

The data used in table 45.1 rely on (UNDP 2005) and in table 45.2 on a co-authored previous publication (El Raey/Fouda/Nasr 1997).

In chapter 46, *Hans Juergen Boehmer* included four photographs that were taken by himself (46.2) and his colleagues Jutta Pscherer (46.1, 46.3b), Dieter Mueller-Dombois (46.3a) and Manfred Denich who gave their written permission.
- *Figure 46.1*: Montane rain forest on the island of Hawaii, Kilauea area, ca. 1200 m above sea level. *Source*: Photograph by Jutta Pscherer (2002).
- *Figure 46.3*: Dieback of the foundation species *Metrosideros polymorpha*, montane rain forest, Mauna Kea, island of Hawaii. *Sources*: a) aerial photograph by Dieter Mueller-Dombois (1972); b) Jutta Pscherer (2002).

- *Figure 46.4*: Managed montane rain forest with indigenous coffee shrubs (*Coffea arabica)*, Kayakela Forest, Kafa zone, south-west Ethiopia. *Source*: Photograph by Manfred Denich (2004).

In chapter 47, *Hans Günter Brauch* and *Úrsula Oswald Spring* have reproduced two figures (47.1, 47.2) of their publication for UNCCD (Brauch/Oswald Spring 2009) and they obtained permission to use the following three maps:

- *Figure 47.3*: Country progress in reducing the global hunger index (percentage decrease in 2009 GHI compared with 1990 GHI. *Source*: IFPRI (2009: 12). Reproduced with permission from the International Food Policy Research Institute.
- *Figure 47.4*: Armed conflicts (1989-2008). *Source*: UCDP/PRIO Armed Conflict Dataset v5-2009; at: <http://www. prio.no/CSCW/Datasets/Armed-Conflict/UCDP-PRIO/>.
- *Figure 47.5*: World map of Environmental Conflicts (1980-2006). *Source*: WBGU (2008: 32). This map is in the public domain.

Furthermore, they compiled table 47.1 based on information of EM-DAT: The OFDA/CRED International Disaster Database developed and maintained by the Université Catholique de Louvain - Brussels – Belgium and in table 47.2 they referred to four scenarios for combating desertification from the Millennium Ecosystem assessment (MA 2005a: 11).

In chapter 48, *Uri Safriel*, acknowledges that this chapter is partly based on a lecture delivered at the conference "Desertificacion y Seguridad Ambiental: consecuencias y prevención", 9–11 March 2006 in Madrid that was published as: "Alternative livelihoods for attaining dryland sustainability", in: Rubio, Jose L.; Andrew, Vincent (Eds.): *Human and socioeconomic consequences of desertification* (Las Palmas: Universidad de Las Palmas de Gran Canaria, Servicio de Publicaciones y Difusion Cientifica de la ULPGC, 2009): 161 – 190. Figures 48.1, 48.4 and 48.10 are in the public domain and in figure 48.7 the author used his own photo. He is grateful to the copyright holders for permission to use the following figures or to adapt them for this chapter. Figures 48.8 and 48.9 were adapted from figures under the fair use provision:

- *Figure 48.8*: Scheme of aquaculture-agriculture hybrid. *Source*: Adapted from Rothbard/Peretz (2002); permission was granted by the copyright holder.
- *Figure 48.9*: Aquaculture sites in Egypt. *Source*: Adapted from Salem (2006); at: <http://www.fao.org/figis/servlet/static?dom=countrysector&xml=naso_egypt.xml>.

The author appreciates the permission of the copyright holder to use these two photos:

- *Figure 48.5*: Landscape manipulation for water harvesting supporting afforestation in an arid dryland (Negev Desert, Israel). *Source*: Photo by Keren Kayemet Le'Israel (JNF).
- *Figure 48.6*: Commercially provided colonies of bumblebees for pollination within a greenhouse in Israel's semi-arid region. *Source*: BioBee (2006); at: <http://www.bchothouse.com/greenhouse-3.html>.

In chapter 49, *Zafar Adeel* acknowledges the permission to use this copyrighted material in

- *Figure 49.1*: Sand dune encroachment, like this example in an Algerian village, is misconceived to be the only type of desertification, ignoring the broader examples of persistent declining natural resource provisioning. *Source*: Photo by © Photo by Houcine Khatteli. The author never replied to the request for permission.
- *Table 49.1*: The number of migrants in selected countries, shown also as a fraction of the global number of migrants and national population. *Source*: Adapted from Renaud, Bogardi, Dun and Warner (2007).

In the following figures and tables the author adapted material from previous publications of which he is a either co-author or that is in the public domain:

- *Figure 49.2*: Key statistics for dryland countries (excluding OECD or developed countries). Drylands are classified according to the climatic conditions as *dry sub-humid*,

semi-arid, *arid* or *hyper-arid*; this classification is based on the values of the Aridity Index, which is the long-term mean of the ratio of an area's mean annual precipitation to its mean annual potential evapotranspiration. *Source*: Safriel and Adeel (2005).
- *Table 49.2*: Comparison of economic and social indicators in developing dryland countries. *Source*: Column 2: Adeel/Safriel/Niemeijer/White/de Kalbermatten/Glantz/Salem/Scholes/Niamir-Fuller/Ehui/Yapi-Gnaore (2005); column 3-5: UNDP (2007).
- *Box 49.1*: WTO's Agreement on Agriculture. *Source*: Adapted from the Millennium Ecosystem Assessment (Hassan/Scholes/Ash 2005).

In chapter 50, *Ismail Abd El Galil Hussein* used the following figures and tables based on material by the government of Egypt or the UN that is in the public domain:
- *Figure 50.1*: Map with the aridity index of Egypt. *Source*: Ministry of Agriculture and Land Reclamation. Desert Research Center (DRC), RS & GIS Unit, Mataria, Cairo.
- *Figure 50.2*: Agro-ecological zones of Egypt.
- *Figure 50.3*: Egyptian population (1897-2017). *Source*: Ministry of Water Resources and Irrigation.
- *Figure 50.4*: Water share in Egypt per capita/m3 (1897-2010). *Source*: Ministry of Water Resources and Irrigation.
- *Table 50.2:* Population density in several governorates of Egypt in 2009. *Source*: Annual Report 2009 (Cairo: Central Agency for Public Mobilization and Statistics).
- *Table 50.3*: Changes of the population size (in thousands) and of the urban population in Egypt (1950-2050) for the medium variant. *Source*: UN (2009, 2008); at: <http://esa.un.org/unpp/p2kodata.asp>.

Figure 50.5 is a photo by Ismail Abd El Galil Hussein and for table 50.1 the copyright holder could not be traced:
- *Table 50.1*: Percentage of hyper-arid, arid, semi-arid, and humid drylands in the Arab world. *Source:* Meigs (1953: 203- 209).

In chapter 51, *Tulio Arredondo Moreno* and *Elisabeth Huber-Sannwald* used the following figures, tables and boxes that are either in the public domain or were drafted or compiled by the authors for which no permission is needed:
- *Figure 51.1*: Administrative Districts in Mexico, 1990. *Source*: OECD (1998: 38).
- *Table 51.2*: Total human population growth between 1910 and 2004 in the arid lands of Northern Mexico. *Source*: INEGI (2004).
- *Table 51.3:* Hydrologic regions with corresponding total concessioned volume of water, average availability, pressure on the watershed (percentage of water used in relation to disponibility) and degree of pressure (above 40 per cent corresponds to strong pressure). *Source*: CNA (2007).
- *Table 51.4*: Area and percentage of land belonging to ejidos in each of the states from Northern Mexico for the year 2001. *Source*: INEGI VIII censo ejidal (2004: <http://www.inegi.org.mx/inegi/default.aspx?s=est&c=15688&pred=1>).
- *Table 51.6*: Population growth in Mexico under rural and urban conditions for the past 50 years and projections to the year 2030. *Source*: INEGI (2000) and CNA (2007).
- *Box 51.1*: Drought periods in Mexico associated with social phenomena. *Source*: The text was written by the authors.

Permission was obtained from the copyright holders to use the following material:
- *Figure 51.2*: Map of Mexico's Arid Zones and Deserts of Northern Mexico. Arid and semi-arid regions are enclosed within zone 1. *Source*: Flores-Villela (1993: 264).
- *Figure 51.3*: Four characteristic arid ecosystem types in the Chihuahua Desert.
- *Figure 51.4*: Estimated changes in yield and the stage of grain filling in corn during El Niño years. *Source*: Conde/Ferrer/Araujo/Gay/Magaña/Pérez/Morales/Saturnino (1999).

- *Figure 51.5*: Distribution of areas suitable for corn production in Mexico. *Source:* Flores/Araujo/Betancourt (2003).
- *Figure 51.6*: Image showing the 'water boxes' of the 'entarquinamiento' system, during the process of being flooded and emptied. *Source*: Photo was taken by Jacinta Pelerm Viqueira/Martin Ssanchez Rodriguez/Elvia Lopez Pacheco/Jose Luis Pimentel Equihua/Herb Eling.
- *Table 51.1*: Area dominant land cover types in Northern Mexico in 2000. *Source*: INEGI (2004); Palacio/Bocco/Velásquez/Mas/Takaki-Takaki/Victoria/Luna-González/Gómez-Rodríguez/López-García/Palma-Muñoz/Trejo-Vázquez/Peralta-Higuera/Prado-Molina/Rodríguez-Aguilar/Mayorga-Saucedo/González-Medrano (2001).
- *Table 51.5*: Years of observed and recorded droughts for the Northern States of Mexico. *Source*: Carrillo-Arronte cited by Contreras-Servín (2005: 123).
- *Table 51.7*: Proportional land surface of Northern Mexico affected by drought and projections under future scenarios of climate change (CCC and GFDL-R30 models). *Source*: Hernández-Cerda/Torres-Tapia/Váldez-Madero (2003).
- *Table 51.8*: Collapse of corn prices in relation to costs of agriculture inputs between 1981 and 1994. Estimated to corn prices of 1994. *Source*: Becerra-Moreno (1998).
- *Box 51.2*: Water boxes in La Comarca Lagunera. *Source*: Eling/López-Pacheco/Palerm-Viqueira/Pimentel-Equi-hua/Sánchez-Rodríguez (2001); Palerm-Viqueira/Sánchez-Rodríguez (2002).
- *Box 51.3*: The GGAVATT (*Grupo Ganadero para la Validación y Transferencia de Tecnología*) model to implement sustainable farming technology in the aridlands of Northern Mexico. *Source*: Sánchez-Arroyo (2000).
- *Box 51.4*: Dryland Development Paradigm. *Source*: Reynolds/Stafford-Smith/Lambin/Turner II/Mortimore/Batterbury/Downing/Dowlatabadi/Fernández/Herrick/Huber-Sannwald/Jiang/Leemans/Lynam/Maestre/Ayarza/Walker (2007).

In chapter 52, *Pietro Laureano* acknowledges the use of figure 52.1 from his previous publication (Laureano 2001: 372) that is in the public domain:

- *Table 52.1*: Characteristics of modern and traditional knowledge. *Source*: Laureano (2005).

In chapter 53, *Monique Mainguet, Frédéric Dumay, Lahcen Kabiri* and *Boualem Rémini* have reproduced in the following 11 figures (53.3 to 53.13) photos that were taken by Monique Mainguet and Frédéric Dumay. They acknowledge the use of the following material that is in the public domain:

- *Figure 53.1:* Map of Morocco with location of the Study Area. *Source:* <http://www.voyages-tourisme.com/maroc/grande-carte-maroc.jpg>.

For the following figures permission has been obtained from the copyright holders.

- *Figure 53.2:* Map of the Location of the Oases of Tafilalet in the Moroccan Sahara. *Source:* Michelin 959: Morocco 1: 1 000 000. Reproduced with permission of the copyright holder.

In chapter 54, *Andres Miguel Garcia Lorca* drafted seven of the 12 figures himself and he also compiled table 54.1. The remaining five figures are based on sources that are in the public domain (figure 54.8) for which no permission is needed.

- *Figure 54.8*: Increase of foreigners in Almeria. *Source*: Census-Foreign Yearbook.
- *Figure 54.9*: Demographic growth in Almeria. *Source*: National Institute of Statistics of Spain.
- *Figure 54.10*: Increase of registered foreigners in Spain, Andalusia and in Almeria. *Source*: Census 2006.
- *Figure 54.11*: Increase of resident foreigners. *Source*: Ministry of Interior.

- *Figure 54.12*: Cluster of the agricultural model of Almeria. *Source*: Cajamar Foundation (2004: 25).

In chapter 55, *Jorge García Gómez, Francisco López-Bermúdez* and *Juan Manuel Quiñonero Rubio* drafted four figures based on Spanish official sources that are in the public domain.

- *Figure 55.1*: Average rainfall in the Region of Murcia, by decade (1863-2008) in mm. *Source*: *Regional Statistics* (Murcia: Regional Ministry of Economy and Treasury, 2008).
- *Figure 55.2*: Desertification risk in Spain. *Source*: National Ministry of Rural and Marine Environment (MARM).
- *Figure 55.3*: Evolution of the Population in the Region of Murcia (1900-2008). *Source*: National Institute of Statistics (INE) of Spain (1900-2008).
- *Figure 55.4*: Evolution of the GVA at market prices for the agricultural sector in the Region of Murcia. *Source*: National Institute of Statistics (INE) of Spain (2009).

Permission was obtained to use the following satellite images:

- *Figure 55.5*: New urban settlements in traditional farming or forest areas. *Sources*: The 1956 aerial photo, taken from a USAF flight, is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping; and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).
- *Figure 55.6*: The images (1956, 1997 and 2007) are located in the coastal area near the city of Cartagena. *Sources*: The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping; and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).
- *Figure 55.7*: Intensification of farming activities in traditional dry-farming areas. In this sequence (1956, 1997 and 2007), located near the town of Fuente Álamo, the change to more intensive farming activities is shown. *Sources*: The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).
- *Figure 55.8*: Irrigation development. Development of irrigation farming in Rambla de *Las Moreras*, Murcia (1956, 1987, 2003). *Sources*: The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1987 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2003 is from Regional Ministry for Agriculture and Water based on Quickbird satellite images.

In chapter 56, *Jacob Granit* reproduced in box 56.1 text of the *Nile Basin Initiative* (NBI) that is in the public domain and the text in box 56.2 was written by the author.

- *Box 56.1*: The Nile Basin Initiative (NBI): Management and development efforts in a transboundary basin. *Source:* See at: <http://www.nilebasin.org/> (23 March 2009).
- *Box 56.2*: The Baltic Sea - the ecosystem that 'flipped'. *Source:* The author.

In chapter 57, *Zhanyi Gao and Yaqiong Hu* designed the following figures and compiled the following tables based on their own research:

- *Figure 57.3*: Framework for grain production and the analysis of the development of irrigation. *Source*: Developed by the authors.

For the following graphics they used official material and documents that are in the public domain and for which no permissions are needed:

- *Figure 57.2*: Growth of grain production with the increase of the irrigated area in China. *Source*: MWR *Statistic Bulletin on China's Water Activities* (2000-2008).
- *Table 57.1*: Changes of the population size (in thousand), population density and of the urban population in China (1950-2050) for the medium variant. *Source*: UN (2009, 2008); at: <http://esa.un.org/unpp/p2kodata.asp>.
- *Table 57.2*: Achievement in the Agricultural Production of the People's Republic of China from 1950 to 2008. *Source*: UN (2009, 2008); at: <http://esa.un.org/unpp/p2kodata.asp>; National Bureau of Statistics of China (2001, 2008) at: <http://www.stats.gov.cn/tjgb/> and <http://www.cpirc.org.cn/tjsj/tjsj_cy_detail.asp?id=304>.
- *Table 57.3*: Population Projection in China (unit: billion people) for 2010 and 2020. *Sources*: UN (2001, 2009); China Population and Development Research Center (2000).
- *Table 57.8*: Flood and drought affected areas in China. *Source*: PRC (2009).
- *Box 57.1*: Modifications of the Chinese water law. *Source:* PRC (1 October 2002).
- *Box 57.2*: References to irrigation in the law on agriculture. *Source*: PRC (1 March 2003).

For the following figures they obtained the permission of the copyright holder:

- *Figure 57.1*: Rivers of China. *Source*: © Heilig, G.K. (1999): *ChinaFood. Can China Feed Itself?* (Laxenburg: IIASA, 1999) [CD-ROM Vers. 1.1].
- *Figure 57.4:* Evolution of world grain production (1950-1995). *Source*: Philippe Rekacewicz, UNEP/GRID-Arendal based on data from the Worldwatch Institute (1996); at: <http://maps.grida.no/go/graphic/evolution_of_the_world_grain_production_comparison_world_europe_china_africa> and at: <http://maps.grida.no/go/graphic/evolution_of_the_world_grain_production_comparision_with_china_and_united_states>.
- *Figure 57.5*: Precipitation distribution and irrigation zones. *Source*: Gao (2006).
- *Figure 57.6*: Structure of the irrigation management system. *Source*: Li Daixin (2002).
- Table *57.4*: Grain demands at target years. *Source*: Gao and Wang (2008).
- Table *57.5*: Required grain under different grain selfsufficiency rates. *Source*: Gao and Wang (2008).
- Table *57.6*: Requirement for the irrigation area in 2010. *Source*: Gao and Wang (2008)
- Table *57.7*: Requirement for the irrigation area in 2020. *Source*: Gao and Wang (2008).

In chapter 58, *Mohammed Rahman Zillur* and *Kuntala Lahiri-Dutt* designed the following figures (58.6, 58.7, 58.8) based on their own research findings. For the following graphics they used official material and documents that are in the public domain and for which no permissions are needed:

- *Figure 58.1*: Possible Climate Change Related Impacts in Tropical Asia. *Source*: IPCC (1998: 392). Reprinted with permission of the IPCC.
- *Table 58.1*: Socio-economic impacts of sea-level rise (IPCC 1996a: 306). *Source*: Reprinted with permission of the IPCC.
- *Table 58.2*: Synthesized results of case studies on Bangladesh and Egypt on 1-m sea-level rise in 1990 US$. *Source*: IPCC (1996a: 308).
- *Table 58.3*: Potential land loss and population exposed in Asian countries to sea-level rise. *Source*: IPCC (2001a: 569).

For these figures they obtained the permission of the copyright holder:

- *Figure 58.2*: Flood types in Bangladesh. *Source*: Ahmad, Warrick, Ericksen and Mirza (1996: 13). With kind permission of Springer Science and Business Media.
- *Figure 58.3*: Five main types of climate-related natural events for Bangladesh. *Source:* Ericksen, Ahmad and Chowdhury (1996: 264). With kind permission of Springer Science and Business Media.

- *Figure 58.4*: Urbanization in Bangladesh. *Source*: Ericksen, Ahmad and Chowdhury (1996: 239). With kind permission of Springer Science and Business Media.
- *Figure 58.5*: Migration in Bangladesh. *Source*: Ericksen, Ahmad and Chowdhury (1996: 245). With kind permission of Springer Science and Business Media.

Chapter 59 by *Kanupriya Harish* and *Mathews Mullackal* was illustrated in figures (59.1-59.6, 59.8-59.26) with 25 photos taken by *Kanupriya Harish* and with a map produced by the Jal Bhagirathi Foundation (59.27) that also provided the text for Box 59.1 to 59.3. For one figure permission was obtained from the copyright holder:

- *Figure 59.7*: Growth of human population. *Source*: Dhir, R.P. 2004: "Ecological fluxes in the Thar Desert", in: Narain, Pratap; Kathju, S.; Kar, Amal; Singh, M.P.; Praveen-Kumar Eds.): *Human Impact on Desert Environment* (Jodhpur, India: Arid Zone Research Association of India and Scientific Publishers): 1-11.

In chapter 60, *Abdelkader Dodo, Mohamedou Ould Bab Sy* and *Jihad Channem* included eight figures and one table of which all but one was produced by OSS, the organizations for which these three authors work. For the remaining figure the copyright was obtained:

- *Figure 60.2*: Isohyets glide between the two periods before and after 1968. *Source*: Centre Regional AGRHYMET (Niamey, Niger).

Úrsula Oswald Spring documented chapter 62 with box 62.2 based on her own research and she based figure 62.4 and tables 62.4 to 62.8 on sources that are in the public domain:

- *Table 62.4*: GM seed market of cotton in the USA in 2005. *Source*: USDA (2005).
- *Table 62.5*: Summary of the status and trends in major bioprospecting industries. *Source*: Millennium Ecosystem Assessment (2005: 109).
- *Table 62.6*: Compounds of natural products and semi-synthetic modifications approved in the USA. *Source*: Millennium Ecosystem Assessment (2005: 110).
- *Table 62.7*: Minimal obligations to import, customs on imported maize and imports. *Source*: Banco de Comercio Exterior (Foreign Trade) for the years 2000 to 2008.
- *Table 62.8*: World inventory of maize stock (million tons). *Source*: USDA (2007).
- *Table 62.9*: International maize prices in Mexico. *Source*: INEGI (January 2007).

For the following graphics permissions were obtained from the copyright holder:

- *Figure 62.1*: Genetically modified plants (in Mha). *Source*: GMO Compass of Genius GmbH, Darmstadt (Germany); at: <http://www.gmo-compass.org/eng/news/> (15 February 2008).
- *Figure 62.2*: Global areas of GM crops in million hectares (1996-2004). *Source*: ISAAA (2007); at: <http://www.isaaa.org/resources/publications/briefs/37/executivesummary/ default. html>.
- *Figure 62.3*: Countries with GM-crops in 2006. *Source*: ISAAA (2006).
- *Figure 62.4*: GM Pollution, accidents, and collateral effects of GM in the world. *Sources:* GeneWatch, UK; Greenpeace International (2006: 35).
- *Table 62.1*: Evolution of agricultural development. *Source*: Adapted from van der Walt (2000) and FAO (2002; 2005: 6- 7).
- *Table 62.2*: Areas and types of GM seeds worldwide. *Source*: ISAAA (2007), Brief No. 37; at: <http:// www.isaaa.org/resources/publications/briefs/37/executivesummary/default.html>.
- *Table 62.3*: Frequency of gene flow from out-crossing. *Source*: Eastham and Sweet (2002: 9).
- *Table 62.10*: Global and regional risks and benefits from transgenic food crops for Africa, Latin America, and Asia. *Source*: Adapted from a study by the University of Michigan (2006).

- *Box 62.1*: Most common biological threats posed by GM crops. *Source*: IUCN Programme (2000: 17-19).

Issa Martin Bikienga illustrated chapter 63 with a figure (63.6: Locust Invasion affecting the Sahel Countries. *Source*: FAO; at: <http://www.fao.org/DOCREP/006/J2517E/J2517E00. HTM# bkf>) and a table (63.1: Population Change and Projection for the Sahel Countries (1950-2050). *Source:* UN, Populations Division, 2006 Revision; at: <http://esa.un.org/ unpp/>) that are in the public domain and with figures for which permission was granted by EM-DAT, The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium:

- *Figure 63.1*: Number and Occurrence of Drought/Famine Disasters by Country (1974-2003).
- *Figure 63.2*: Number and Occurrence of Flood Disasters by Country (1974-2003).
- *Figure 63.3*: Worldwide Epidemic Occurrence (1974-2003). *Source*: EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels, Belgium.
- *Figure 63.4*: Total Number of Deaths and of People Affected by Natural Disasters per 100,000 inhabitants (1974-2003).
- *Figure 63.5*: Disaster Type Proportions by UN Sub-Regions (1974-2003).

In chapter 64, *Sreeja Nair* used five figures for which copyright was obtained:

- *Figure 64.1*: Mode of interaction in anarchy, hierarchy and heterarchy. *Source*: Eoyang/Berkas (1999: 5); at: <www.chaos-limited.com/EvalinCAS.pdf>.
- *Figure 64.2*: Conceptual linkages between vulnerability, resilience and adaptive capacity. *Source*: Cutter/Barnes/Berry/Burton/Evans/Tate/Webb (2008: 600).
- *Figure 64.3*: Co-management: fostering linkages between stakeholders at all levels. *Source*: Adger/Arnell/Tompkins (2005: 6); at: <http://www.ecologyandsociety.org/vol10/iss2/art9/>.
- *Figure 64.4*: Cross-scale interaction between institutions. Circles indicate potential points of entry for cooperating individuals or institutions. Black arrows and open arrows indicate hypothetical pathways. *Source*: Cash/Moser (2000: 115).
- *Figure 64.5*: Structure of multi-level government in India. *Source:* Rao, G. (2000: 11); at: <http://www.imf.org/external/pubs/ft/seminar/2000/fiscal/rao.pdf>.

Cecilia Conde illustrated chapter 65 with eight figures of which several figures were based on her research and on her previous co-authored publications and photographs by her colleague:

- *Figure 65.2*: Map of the two study areas in Tlaxcala and Veracruz, Mexico. *Source*: Elaborated by the geographer Raquel Araujo, postgraduate student (unpublished).
- *Figure 65.3*: Focus Group in Coatepec, Veracruz. Presentation on climate impacts. *Source*: Photo by Beatriz Palma (2008).
- *Figure 65.4*: Focus Group in Coatepec, Veracruz. Review of the map of natural resources and land use. *Source*: Photo by Beatriz Palma (2008).
- *Figure 65.5*: Example of the base scenario for mean temperature (in July). *Source*: See at: <http://www.atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=77 &Itemid=74> (1 September 2009).
- *Figure 65.6*: Example of climate change scenario, EHCAM5 model, A2 emission scenario, and horizon 205. Mean temperature (in July). *Source*: <http://www.atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=77&Itemid=74> (1 September 2009).

- Figure *65.7*: Projected changes in temperature (A) and precipitation (B), for Tlaxcala (2020 and 2050), using 3 GCM (G: GFDL; H: Hadley; E: ECHAM) outputs and two SRES scenarios (A2 and B2). *Source*: Conde, Ferrer and Orozco (2006).
- Figure *65.8*: Projected changes in temperature (A) and precipitation (B), for Veracruz (2020 and 2050), using 3 GCM (G: GFDL; H: Hadley; E: ECHAM) outputs and two SRES scenarios (A2 and B2). *Source*: Conde, Vinocur, Gay, Seiler and Estrada (2008).

One map is in the public domain:

- *Figure 65.1*: Federal states of Mexico and the study area in Tlaxcala (No. 29 in the list of states) and Veracruz (No. 30 in the list of states). *Source*: OECD (1998: 3).

Tanja Wolf, Glenn McGregor and *Anna Paldy* illustrated chapter 67 with three figures and two tables based on data by the Central Statistical Office in Budapest (figure 67.1; table 67.2), on own maps by Tanja Wolf (figure 67.2, 67.3) and one table based on a previous co-authored publication by Anna Paldy (table 67.1) for which no permissions were needed.

In chapter 68, *Jörn Birkmann* reproduced eight figures for which permissions were obtained:

- *Figure 68.1*: The basic concept of human ecology and the relationship between Society, Man and Environment (nature) through the lens of a differential theory perspective. *Source*: Egner (2008: 135) based on Luhmann (1988).
- *Figure 68.2*: The Sahel-Syndrome. *Source*: WBGU (1996: 141).
- *Figure 68.3*: Linkages between Ecosystem Services and Human Well-Being. *Source*: MA (2005: VI) and Leemans (2009: 56).
- *Figure 68.4*: The Disaster Risk Cycle. *Source:* Cutter/Gall (2008: 356) based on FEMA (2007).
- *Figure 68.5*: The hunger-famine process or chain. *Source*: Watts and Bohle (1993: 43ff.).
- *Figure 68.6*: Coping and adaptation as well as impact and change. *Source*: Own figure based on Birkmann, Buckle, Jäger, Pelling, Setiadi, Garschagen, Fernando and Kropp (2009: i.p.).
- *Figure 68.7*: The actual inundation in Galle and the 100 metre buffer-zone. The proposed 100 Meter Buffer Zone (red line) based on own calculations. *Source*: Naßl/Voigt (2006) and actual inundation due to the tsunami in Galle, Sri Lanka (Hettiarachchi/Wijeratne 2006).
- *Figure 68.8*: Key stakeholders and their structure in the post-tsunami process. *Source*: Own figure based on Amarasinghe (2005) and Hettige (2007).

In chapter 69, *Katherina Marre* and *Fabrice Renaud* summarized their field research in 22 tables based on the Statistical Office of Sri Lanca (tables 69.1-69.16) and the authors own field research (tables 69.17-69.22). They included four figures of which three were produced by the authors based on their own research and on public sources while the images in figure 69.1 are in the public domain:

- *Figure 69.1*: Landsat DEM (resolution 90 m) showing the topography in both districts. *Source*: The data for this digital elevation model (DEM) was provided by the International Water Management Institute; at: <http://www.iwmidsp.org> and processed by the authors with ArcGIS. The DEM data stem from the United States Geological Survey (USGS) that are in the public domain.

In chapter 70, *Juan Carlos de Villagran* adapted two figures based on sources that are in the public domain (70.1, 70.2) and added one designed by the author (70.3). He also compiled five tables based on scientific data of OFTA/CRED (70.1, 70.3) and official resources (70.2, 70.4) that are in the public domain and obtained permission for:

- *Table 70.5*: Main results of the evaluation of the Quinquennium for the Reduction of Vulnerability (2000-2004). *Source*: Novelo/Smith (2004: 3-6).

Finally he wrote the text for boxes 70.1 and 70.2, the latter based on data by the IPCC (1998, 2007: 892-896, 2007a: 583-607).

In chapter 71, *Koko Warner* reproduced two figures based on a previous co-authored publication and a third on Hurricane Katrina for which permission was obtained:

- *Figure 71.1*: Shocks disrupt economic performance over time. *Source*: Freeman/Warner (2001: 27), reprinted with permission.
- *Figure 71.2*: The number of people in poverty increases if the poor suffer disproportionately from catastrophic events. *Source*: Freeman/Warner (2001: 32). Reprinted with permission.
- *Figure 71.3*: Places of displacement following Hurricane Katrina. *Source*: Epodunk website, 2007: "Places of Displacement Following Hurricane Katrina"; at: <http://www. epodunk.com/top10/diaspora/destination-map.html> (21 March 2007). Reprinted with permission.

In chapter 72, *Úrsula Oswald Spring* used two figures (72.1, 72.2) that are based on official Mexican sources that are in the public domain and obtained permission for three figures:

- *Figure 72.3*: World population, international migrants, and refugees (1960-2005). *Source*: Designed by Guillermo Peimberg of UNAM/CRIM based on data of UN Population Division (2007); at: <http://esa.un.org/ unmigration/>.
- *Figure 72.4*: Native Mexican residents in the USA. *Source*: Estimations by CONAPO based on *Current Population Survey* 1994-2007, elaborated by F. Lozano, CRIM, 2009.
- *Figure 72.5*: Long-term trend in the global number of natural disasters (1975-2005). *Source*: EM-DAT: The OFDA/CRED International Disaster Database, Université de Louvain, Brussels, Belgium; at: <http://www.em-dat.net>.

Further, three tables were compiled by the author based on public sources (72.1, 72.2) and she summarized three alternative visions to understand and combat discrimination (70.3).

In chapter 74, *Rik Leemans, Martin Rice, Ann Henderson-Sellers* and *Kevin Noone* compiled one table (74.1) and developed and designed six figures based on the scientific literature (74.1) and projects (74.5, 74.6) and obtained permission for:

- *Figure 74.4*: Schematic representation of the structure and activities of the Challenge Program on Climate Change, Agriculture and Food Security (CCAFS). *Source*: CGIAR Alliance/ESSP (2008).

In chapter 75, *Louise von Falkenhayn, Andreas Rechkemmer* and *Oran R. Young* in sections 75.4.1 to 75.5. rely on Rechkemmer, A.; von Falkenhayn, L. 2009: "The human dimensions of global environmental change: Ecosystem services, resilience and governance", in: *European Physical Journal. Special Topics,* 167, 3-17. The permission to reuse this material was granted by Springer Rights and Permissions; Springer-Verlag Heidelberg, 3 May 2010. Figures 75.1 and 75.2 were designed by IHDP and figure 75.3 is in the public domain.

- *Figure 75.3*: Dynamics and Stability in Ecosystem Services. *Source*: Millennium Ecosystem Assessment (2005).

In chapter 78, *John A. Church, Ghassem R. Asrar, Antonio J. Busalacchi* and *Carolin E. Arndt* compiled five figures based on photos, figures and images that are in the public domain.

- *Figure 78.1*: Human well-being and local economies are severely affected by droughts and floods. *Sources*: Photos clockwise from top left: J. Isaac: <FAO/13702/J.Isaac>; NASA: <www.travelblog.org/Rich>; SanSan Samuel: <www.freedigitalphotos.net/>, J.

Barker Free Digital Photo; Texas Forest Service by Jan Amen. These photos are in the public domain.

- *Figure 78.2*: Illustrative examples of WCRP accomplishments. Clockwise from top left: Projection of global averaged temperature for the 21st century as prepared for the IPCC (IPCC 2007); WCRP *World Ocean Circulation Experiment* (figure prepared by the WCRP-GEWEX Global Precipitation Climatology Project); Schematic observed and predicted evolution of global ozone (UNEP/WMO Scientific Assessment of Ozone Depletion: WMO 2006). These figures are in the public domain.
- *Figure 78.3*: Satellite observations and in situ measurements. *Sources*: ESA; Argo; www.ISRIC.org/V. van EngelenSOTER; JAMSTEC Earth Simulator Center. These satellite images are in the public domain.
- *Figure 78.4*: A schematic of the flow of the climate information system. *Source*: This figure was developed by K. Trenberth (2008: 18) and slightly modified by G. Asrar.
- *Figure 78.5*: Climate adaptation solutions. *Sources*: <Treehuggerwww.PlayPumps.org>; International Federation of Red Cross and Red Crescent Societies (IFRC); UK Environment Agency; at: <www.WIKIMEDIA.org> by J. Gao. These images are in the public domain.

In chapter 79, *Martin Parry, Osvaldo Canziani, Jean Palutikof* and *Clair Hanson* included five figures with graphics and images produced by Working Group II of the IPCC that are all in the public domain:

- *Figure 79.1*: Change in glacier extent on Mt. Kilimanjaro (1912-2003). *Source*: IPCC (2007a: 440; modified from Cullen/Mölg/Kaser/Hussein/Steffen/Hardy 2006).
- *Figure 79.2*: Global impacts projected for changes in climate (and sea level and atmospheric carbon dioxide where relevant) associated with different amounts of global average surface temperature change in the 21st century. *Source*: IPCC (2007a: 66, Technical Summary).
- *Figure 79.3*: Regional impacts projected for changes in climate (and sea level and atmospheric carbon dioxide where relevant) associated with different amounts of global average surface temperature change in the 21st century. *Source*: IPCC (2007a: 67, Technical Summary).
- *Figure 79.4*: Sensitivity of wheat yield in mid- to high latitudes. Responses indicate cases without adaptation (light grey dots) and with adaptation (dark grey dots). The studies analysed here include a range of precipitation changes and CO2 concentrations (from IPCC 2007a: 286).
- *Figure 79.5*: Estimated millions of people per annum at risk globally from coastal flooding. Light grey bars: numbers at risk without sea-level rise; dark grey bars: numbers at risk with sea-level rise (from IPCC 2007a: 75; Technical Summary).

In chapter 80, *Peter Bosch* and *Bert Metz* included four figures with graphics and one table produced by Working Group III of the IPCC that are all in the public domain:

- *Figure 80.1*: Stabilization scenario categories and their relationship to equilibrium global mean temperature change above pre-industrial temperatures in °C. *Source*: IPCC (2007b: 228).
- *Figure 80.2*: Emission pathways of mitigation scenarios for alternative categories of stabilization levels (category I to VI defined in table 80.1). *Source*: IPCC (2007b: 199).
- *Figure 80.3*: Comparison between global economic mitigation potential and projected emissions increase in 2030. *Source*: IPCC (2007b: 625-635).
- *Figure 80.4*: Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. *Source*: IPCC (2007b: 632).

- *Table* 80.1: Characteristics of stabilization scenarios published after 2000. *Source*: IPCC (2007b: 198).

In chapter 82, *Veerle Vandeweerd, Yannick Glemarec* and *Vivienne Caballero* included ten figures and eight boxes produced by UNDP that are all in the public domain:

- *Figure 82.1*: Delivery of UNDP Environmental Finance Services. *Source*: UNDP (2009a: 8).
- *Figure 82.2*: Support Levels for Global Environmental Change Responses. *Source*: UNDP (2008: 27).
- *Figure 82.3*: UNDP-GEF Adaptation portfolio. UNDP has leveraged over $800 million for climate change resilient development in 75 countries. *Source*: Data generated from UNDP 2010 <http://ccmap.undp.org>.
- *Figure 82.4*: Six dimensions for scaling up climate change. *Source*: Adapted from UNDP (2008: 17).
- *Figure 82.5*: Methodologies and processes for developing an ITCP. *Source*: Glemarec (UNDP 2009: 60).
- *Figure 82.6*: Key Steps in Assessing Adaptation Options. *Source*: Kurukulasuriya/Mendelsohn (2008). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 103).
- *Figure 82.7*: Key Data for Vulnerability Analysis. *Source*: Kurukulasuriya/Mendelsohn (2006). Kurukulasuriya/Glemarec/ Retiere (UNDP 2009: 106).
- *Figure 82.8*: Climate Analogues. *Source*: Kurukulasuriya/Mendelsohn (2006); Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 107).
- *Figure 82.9*: Adaptation Profiles. *Source*: Kurukulasuriya/Mendelsohn (2006); Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 108).
- *Figure 82.10*: Sequencing public finance and carbon finance. *Source*: Glemarec (UNDP 2009: 112).
- *Box 82.1*: UNDP. *Source*: <www.undp.org>.
- *Box 82.2*: Climate change threatens achieving the MDGs. *Source*: <www.undp.org/mdg>.
- *Box 82.3*: MDG Carbon Facility. *Source*: <www.mdgcarbonfacility.org>.
- *Box 82.4*: Montreal Protocol Programme. *Source*: <www.undp.org/montrealprotocol>.
- *Box 82.5*: Capacity Development for the Clean Development Mechanism. *Source*: <www.undp.org/climate-change/carbon-finance/CDM/>.
- *Box 82.6*: Methodologies and resources on adaptation. *Source*: <www.adaptationlearning.net> and <www.undp. org/climatechange/pillar_adaptation.shtml>.
- *Box 82.7*: The Territorial Approach to Climate Change (TACC). *Source*: <www.undp.org/climatechange>.
- *Box 82.8*: An approach to mixing policies and financing for wind energy. *Source*: <www.undp.org/energy/>.

Christian Egenhofer, Arno Behrens and *Anton Georgiev* documented chapter 83 with three tables and boxes based on sources that are in the public domain or summarize the results of a scientific study (box 83.1):

- *Table 83.1*: National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020 and member state greenhouse gas emissions limits in non-ETS sectors for the period 2013 to 2020. *Source*: European Parliament, Council of the European Union 2009b: 147; European Parliament, Council of the European Union 2009c: 46.
- *Table 83.2*: Stabilization Scenarios. *Source*: IPPC (2007b: 15).
- *Table 83.3*: Key Statistics of Annex I parties. *Source*: European Commission (2009d: 23).

- Box *83.1*: The meaning of the 2°C target. *Source*: Based on Neufeldt, van Vuuren, Isaac, Knopf, Edenhofer, Schade, Jochem and Berkhout (2009).
- *Box 83.2*: Criteria to define sectors 'exposed to carbon leakage' (based on Article 10a of the revised EU ETS Directive). *Source*: European Parliament/Council of the European Union 2009a: 72-75.
- *Box 83.3*: The scope of finance. *Source*: Behrens (2008b, 2009).

In chapter 85, Ricardo Zapata-Martí used five figures, two tables and three boxes that are either in the public domain or for which permission was granted:

- *Figure 85.1*: Impacts of disasters in Latin America and the Caribbean (1972-2008). *Source*: EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at : <www.emdat.be>.
- *Figure 85.2*: Evolution of climatic/meteorological events in Latin America and the Caribbean (1972-2008). *Source*: EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.
- *Figure 85.3*: Global trend of disaster impact for fatalities and economic damage. Number of people reported killed by natural disasters (1975-2008). *Source*: EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.
- *Figure 85.4*: Estimated economic damage (US$ billion) caused by reported natural disasters (1975-2008). *Source*: EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.
- Figure *85.5*: Climate change impacts in Latin America and the Caribbean. Source: IPCC (2007x: page).
- *Table 85.1*: ECLAC assessments of natural hazards in Latin America and the Caribbean (1970-2008). *Source*: Zapata Martí (2005).
- *Table 85.2*: Mexico: Emissions of CO2 (MtCO2) based on IPCC categories (1990-2002). *Source*: National Ecology Institute (2006)
- *Box 85.1*: The destruction of the Amazon: a glaring example of the region's dilemma: concern on principle, little actions on the ground. *Source*: WWW (2007).

In chapter 88, Hiroshi Ohta compiled one table based on sources that are in the public domain:

- Table *88.1*: Six options for Japan's mid-term target. Source: Naikaku kanbo (Cabinet Secretariat, 17 April 2009).

In chapter 89, *Norichika Kanie, Hiromi Nishimoto, Yasuaki Hijioka* and *Yasuko Kameyama* acknowledge that an earlier version of this chapter is published in *International Environmental Agreements: Politics, Law and Economics* (Springer). They based table 89.2 on a specific model:

- *Table 89.2*: GHG emission reductions by countries and regions by 2020. *Source*: The result of the analysis was made based on the AIM/Enduse [Global] Model; at: <http://www.kantei.go.jp/jp/singi/tikyuu/kaisai/dai07tyuuki/07gijisidai.html> (14 April 2009).

Juan M. Quiñonero-Rubio, Francisco López-Bermúdez, Francisco Alonso-Sarría and *Francisco J. Gomariz-Castillo* documented chapter 90 with 14 figures and 1 table most of them are based on their own research and photos or on sources that are in the public domain.

- *Figure 90.1*: Rambla of La Azohía. Example of the geomorphology of streams. *Source:* photo by Juan M. Quiñonero-Rubio.
- *Figure 90.2*: Rambla de las Moreras. Water outlet and land-use changes between 1956 and 2003. *Source*: Regional Ministry of Spatial Planning.

- *Figure 90.3*: Historical floods of the Segura Basin. *Source*: Regional Atlas of Murcia (2008).
- *Figure 90.4*: Floods of the Segura River in the XX Century. *Source*: Regional Atlas of Murcia (2008).
- *Figure 90.5*: Flood annual destruction in the basin of the Segura River. *Source*: Regional Atlas of Murcia (2008).
- *Figure 90.6*: The centre of Cartagena city during the flood of 29 September 1919. *Source*: <http://www.cartagenaantigua.es>. The photo is in the public domain.
- *Figure 90.7*: Study area in Murcia. *Source*: This map was designed by the authors.
- *Figure 90.8*: Typical vegetation environment of the area. *Source*: Photo by Juan M. Quiñonero-Rubio.
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- *Figure 90.11*: Rambla de las Moreras Flood in September 1989. *Source*: High School of Mazarrón "Felipe II".
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- *Figure 90.13*: Land-use changes in a water outlet area of the coast of Mazarrón and 1956. *Source*: Regional Ministry of Spatial Planning.
- *Figure 90.14*: Hydrology and Hydraulic processes for simulation. *Source*: Created by the authors.
- *Table 90.1*: Evolution of hydrologic results. *Source*: Compiled by the authors.

Juan Carlos Villagrán de León illustrated chapter 93 with three figures and four tables based on sources that are in the public domain:

- *Figure 93.1*: Coastal regions of Sri Lanka affected by the 26 December 2004 tsunami. *Source*: Sri Lanka, Department of Census and Statistics.
- *Figure 93.2*: Risk as the integration of Hazard, Vulnerability, and Deficiencies in Preparedness; and the Elements of Risk Management: Prevention, Mitigation, and Preparedness. *Source*: The author
- *Table 93.1*: Summarized Table of Natural Disasters in Sri Lanka from 1957 to 2007, *Source*: EM-DAT: The OFDA/CRED International Disaster Database (Brussels: Université Catholique de Louvain); at: <www.em-dat.net>.
- Table *93.2*: Top 10 national disasters in Sri Lanka with regard to people killed, affected and economic damage. *Source*: EM-DAT: *The OFDA/CRED International Disaster Database* (Brussels: Université Catholique de Louvain); at: <www.em-dat.net>.
- *Table 93.3*: Statistics on the total number of dead or missing corresponding to nine districts in Sri Lanka. *Source*: Census of Buildings and Persons Affected by the Tsunami (2004); Department of Census and Statistics, Sri Lanka (2005).
- *Table 93.4*: High risk areas within the city of Galle. *Source*: The author.

Permission was obtained for:

- *Figure 93.3*: Satellite image of the central part of the City of Galle, Sri Lanka and of the coastal area indicating places where vulnerable groups may congregate. *Source*: Satellite image by GeoEye through European Space Imaging. Copyright: GeoEye, all rights reserved.

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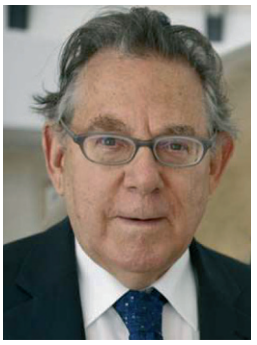


The Anthropocene: Geology by Mankind

Paul Crutzen, Nobel Laureate for Chemistry
Max Planck Institute for Chemistry
Department Atmospheric Chemistry

During 4,5 billion years of Earth history, after a long string of biological processes, only a million years ago, a single species 'homo sapiens' evolved, which grew increasingly capable of influencing the geology of our planet. That species is unique in the solar system and maybe beyond. A species, us, was created with a brain size of only some 1,300 g, which is capable of using and manipulating the Earth's environment in major ways from generation to generation in a catalytic fashion. Especially over the past hundred years, the human impact has become increasingly clear. Supported by great technological and medical advances and access to plentiful natural resources, the expansion of humankind, both in numbers and exploitation of the Earth's resources is astounding. Let us give a few examples.

- During the past 3 centuries human population increased tenfold to more than 6,000 million.
- This expansion was accompanied by a growth in cattle population to 1,400 million (about one cow per average size family). They produce methane gas.
- Urbanization has increased more than tenfold in the past century. About half of the human population lives in cities and megacities.
- Similarly large or larger were the increases in several other factors, such as world economy, of industries (40 times) and of energy use (16 times).
- More than half of all accessible fresh water is used by mankind.
- Fish catch increased 40 times.
- In a few generations humankind is exhausting the fossil fuels that were generated over hundreds of million of years.
- The release of sulphur dioxide, about hundred million tonnes per year, at least two times larger than the sum of all natural emissions, has led to acidification of precipitation, causing forest damage and fish death in biologically sensitive regions, such as Scandinavia and the north-east of North America. The situation in these regions has improved. However, in the meanwhile, the problem has got worse in East Asia.
- 30–50 per cent of the world's land surface has been transformed by humans; land under cropping has doubled during the past century at the expense of forests.
- More nitrogen is applied as synthetic fertilizer in agriculture than fixed naturally. Oversupply of nitrogen fertilizers have led to eutrophication of surface waters.
- Human activity has already increased species extinction rates by orders of magnitude.
- As a result of increasing fossil fuel burning, agricultural activities, deforestation, and intensive animal husbandry, several climatically important 'greenhouse' gases have substantially increased in the atmosphere over the past two centuries: CO_2 by more than 30 per cent and CH_4 by more than 100 per cent, causing the observed global average temperature increase by about 0.6 °C that has been observed during the past century.
- According to IPCC's 'business as usual scenario', global average temperatures are projected to rise by 2.0–4.5 °C during the current century and sea level is expected to rise by 9–88 cm, up to 50–140 cm.
- Humankind also releases many detrimental substances in the environment and even some, the chlorofluorocarbon gases ($CFCl_3$ and CF_2Cl_2), which are not directly toxic, but which destroy stratospheric O_3 and have led to the Antarctic 'ozone hole'. A global catastrophe has been averted through the Montreal Protocol and suc-

cessive amendments. Nevertheless, it will take more than half a century before the ozone layer may have recovered.

- Considering these and many other major and still growing impacts of human activities on earth and atmosphere, and at all scales, it thus is more than appropriate to emphasize the central role of humankind in the environment by using the term 'Anthropocene' for the current geological epoch. The impact of current human activities is projected to last and even expand over long periods. According to M. Loutre and A. Berger (2000), because of past and future anthropogenic emissions of CO_2, climate will depart significantly from natural behaviour over the next 50,000 years (no ice ages).
- To assign a more specific date to the onset of the 'Anthropocene' we propose the latter part of the 18^{th} century, when the global effects of human activities became clearly noticeable, by data retrieved from ice cores, which show the beginning of a growth in the atmospheric concentrations of several 'greenhouse gases', in particular CO_2 and CH_4. Such a starting date also coincides with James Watt's invention of the steam engine in 1784.
- Humankind will remain a major geological force for many millennia, maybe millions of years. To develop a worldwide accepted strategy leading to sustainability of ecosystems against human-induced stresses is one of the great challenges of humankind, requiring intensive research efforts and wise application of the knowledge thus acquired.

Hopefully, in the future, the 'Anthropocene' will not only be characterized by continued human plundering of the Earth's resources and dumping of excessive amounts of waste products in the environment, but also by vastly improved technology and management, wise use of the Earth's resources, and control of human and domestic animal population. For example, building on the success of the Montreal Protocol, we need something similar for climate, starting with COP 15 at Copenhagen. But maybe we run out of elements, such as phosphorus, and will experience a short Anthropocene.

Connecting Inconvenient Truths: Urgency of Nuclear Disarmament in a World of Pressing Problems[1]

Amb. Jayantha Dhanapala,
Former UN Under-Secretary General for Disarmament,
President, Pugwash Conferences on Science and World Affairs[2]

The fall of the Berlin Wall symbolized the end of the Cold War, a toxic legacy of which is the nuclear weapon. In 1989, Francis Fukuyama proclaimed the "the end of history" arguing "What we may be witnessing is not just the end of the Cold War or the passing of a particular period of post-war history, but the end of history as such: that is, the end point of mankind's ideological evolution and the universalization of Western liberal democracy as the final form of human government."

This neo-conservative dogma has propelled the world into a succession of calamities. The invasion of Afghanistan and Iraq, the bombing of its civilians, escalating global military expenditure of which the US share in 2008 was 41.5 per cent, the gulag of Guantánamo and the practice of torture and rendition, casino capitalism on Wall Street causing the greatest financial meltdown since the Great Depression of 1929, and the general rejection of multilateral cooperation as a means of finding durable global solutions to global problems are some of them.

With President Obama's policies a unique opportunity exists to reaffirm multilateralism. The 58th Pugwash Council statement of April 2009 stated that:

> the new international climate makes it possible for multilateral co-operative solutions to be negotiated for the critical issues affecting the global community. On nuclear disarmament and non-proliferation, weapons of mass destruction, terrorism, the international economic crisis, the urgent problem of climate change, the achievement of the *Millennium Development Goals* (MDGs), the strengthening of the rule of law, human rights, and other issues, the moment has arrived and we must seize the opportunity.[3]

But the international community is missing this opportunity. In November 2009, a FAO food security summit held to face the challenge of one billion hungry people in our world today declined to commit to the $ 44 billion needed as agricultural aid and failed to set a target date for the eradication of hunger. Underinvestment in agriculture – the source of livelihood for 70 per cent of the poor – will mean that in 2050 when the world's population reaches an estimated 9.1 billion, we will be in a worse situation than today.

The UN Climate Change Conference in Copenhagen failed to reach a binding agreement on greenhouse gas emissions between developed and developing countries with pledges of financial aid. In April 2010, the Obama Administration convened a World Nuclear Security Summit to ensure the safeguarding of the nuclear materials in the world and counter efforts of terrorist groups and the black market to exploit existing loopholes and weaknesses in the systems in place. In May 2010 the parties to the *Treaty for the Non-proliferation of Nuclear Weapons* (NPT) met in New York for its Eighth Review Conference forty years after the global non-proliferation regime entered into force.

Global interdependence has long been established, as the findings of the *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b, 2007c) have shown. No state however powerful and wealthy can solve the problems facing its citizens without global cooperation that must be based in this cen-

1 This text is based on a speech at the Royal Society, London, 1 December 2009.

2 Pugwash Conferences and Joseph Rotblat were jointly awarded the Nobel Peace Prize in 1995 for their efforts to diminish the part played by nuclear arms in international politics and in the longer run to eliminate such arms.

3 See at: <http://www.pugwash.org/reports/pic/58/council-statement.htm>.

tury on the fundamental values of freedom, equality, solidarity, tolerance, and respect for nature and shared responsibility as lessons gleaned from the pages of history. The holistic approach to international peace and security that has now evolved compels us to recognize that there can be "no security without development; no development without security and no security or development without human rights" (Kofi Annan 2005). A convergence of national and human security (Ogata/Sen 2003) is also needed. We observe the interconnection among the problems facing our global community from nuclear weapon possession and proliferation, the risks of the peaceful uses of nuclear energy, the problems of climate change, the escalation of world military expenditure to levels exceeding those of the Cold War and the conflicts they fuel, the poverty of the 'bottom billion' (Collier 2007), international terrorism and the danger of non-state actors acquiring weapons of mass destruction, the widespread violation of human rights and other issues. The global chain connecting us all is as strong as its weakest link.

With the end of the Cold War we hope to end ideological or civilizational confrontation. New challenges facing the global community are terrorism, nationalism, and consumerism. Without global responses we are likely to endanger the future of our planet through nuclear annihilation or disastrous climate change or both.

The global reach of modern international terrorism with its complex network of funding, arms purchases and supplies, training and planning, is new, and 9/11 represents its epitome. It has resulted in a global consensus condemning terrorism in all its forms and manifestations, and a recognition that no cause justifies the use of terrorism. Thirteen international conventions were adopted to counter terrorism. Evidence of terrorist groups seeking weapons of mass destruction has emerged, and the network of clandestine nuclear proliferation activities of Dr. A. Q. Khan enhances the danger of nuclear terrorism. International cooperation is the key to combating terrorism.

That cooperation is undermined by nationalism. With supranational economic entities like the European Union and other regional and global international organizations, nation states were prematurely regarded as historical relics of the 1648 Treaty of Westphalia. Nationalist competition over territory and resources dominated international politics until World War II when the United Nations was established with the hope of eliminating "the scourge of war" and ushering in global cooperation for freedom, peace, development, and human rights. In the post-Cold War phase, nationalism is alive with multiple ethno-nationalist groups, all seeking to achieve statehood. It is also evident in the actions of large countries defending their national security interests. This trend cannot be underestimated. Dangers arise from the covert support for terrorism by some countries to groups elsewhere in support of irredentist claims or international rivalries. Encouragement of groups who have used or continue to use terrorist means by the grant of recognition or by arms supplies violates the global strategy against terrorism. It can also be self-destructive as terrorist groups created for one purpose mutate horribly to strike back even at their own creators.

Thus the Taliban, financed and run by the CIA against the Soviet invaders in Afghanistan, transformed themselves into the extremist force that harboured Bin Laden and incubated global terrorism against the USA and others. Within South Asia, Indira Gandhi's short-sighted policy of encouraging Bhindranwale as a counter to the Akali Dal's dominance in the Punjab led to Sikh terrorism and her own assassination. Examples abound but the lessons are not learned as surreptitious means are found to finance, arm, and otherwise support groups to destabilize neighbours or opponents in the perceived national interest. And so the unbridled nationalism of some countries is in conflict with the common interest of stamping out terrorism in terms of the UN strategy of 2006. We have to ensure that the legitimate pursuit of national security interests meshes with common and cooperative security and a norm-based structure that serves our interests.

Nationalism spurs nuclear weapon possession that is identified as an insurance policy for national security and as a symbol of global power status. But nuclear deterrence cannot be good for some and bad for others. Hence the clandestine WMD programmes of Saddam Hussein's Iraq which were discovered and destroyed by the UN and the IAEA acting under the authority of the Security Council; and North Korea's withdrawal from the NPT and subsequent nuclear tests. There was also popular jubilation when India and Pakistan conducted their nuclear tests in 1998 and became nuclear weapon states. Similarly, there were also strong nationalistic reactions of Iran over its enrichment of uranium at its Natanz and Fordo facilities belatedly reported to the IAEA.

Finally, consumerism has become an important driver of the global economy. With mass production,

consumerism is now a global phenomenon that lubricates markets and creates a demand for commodities and brands. The recent emergence of large economies in the South, particularly in China, India and Brazil, has led to a demand for energy and other commodities, entailing a rise in prices already distorted by agricultural subsidies in the USA, the European Union, and other developed countries. Economic nationalism drives protectionism, obstructing free and fair trade. Despite the stalemate over the Doha Round of the World Trade Organization, we need to move rapidly for equality in terms of trade, so allowing developing countries access to markets and to commodities that their people seek in an increasingly interdependent world. We cannot continue the use of fossil fuels to satisfy the consumer demands of the world. The reports of the IPCC (1990, 1995, 2001, 2007) argued that case. To ignore them would be a supreme, self-destructive folly.

The case against hydrocarbon has resulted in a 'nuclear renaissance'. Although Article IV of the NPT guarantees that non-nuclear weapon state parties will have an 'inalienable right' to the peaceful uses of nuclear energy, the world has suddenly woken up to the perils of this. It is less the threat of massive radiation leaks or accidents, like in Chernobyl (1986) and Three Mile Island (1979), to human lives and the environment but more the lack of credible firewalls between peaceful uses of nuclear energy and the development of nuclear weapons. The signing of the voluntary Additional Protocol of the *International Atomic Energy Agency* (IAEA) is no longer the confidence building measure. Many proposals for the multilateralization of the fuel cycle have been made. While some states will opt not to have their own enrichment facilities others will not want to be dependent on foreign supplies of nuclear fuel for their development needs. The dilemma could be resolved through innovative technology with proliferation-resistant reactors and the elimination of highly-enriched uranium. The discovery of other cheaper and safer sources of energy and greater investment in wind and solar power could also lower the demand for nuclear power.

The interconnectedness of these 'isms' is self evident. So also is their link with prevailing crises and the solutions. The first crisis is the possible use of the 8,392 nuclear weapons deployed by the nine nuclear weapon states (of their combined 23,300 warheads) either by accident or in accordance with their nuclear doctrines (SIPRI 2009: 16). President Obama (2009) said in Prague that

> one nuclear weapon exploded in one city – be it New York or Moscow, Islamabad or Mumbai, Tokyo or Tel Aviv, Paris or Prague – could kill hundreds of thousands of people. And no matter where it happens, there is no end to what the consequences might be – for our global safety, our security, our society, our economy, to our ultimate survival.[4]

Building on studies of a 'nuclear winter' (Crutzen/Birks 1982) caused by the use of nuclear weapons, more recent research has concluded[5] that even a minor nuclear war with 0.03 per cent of the current global arsenals will produce catastrophic climate change.

- Nuclear weapon proliferation arises largely from the strong demand for national security in a world of competing nationalisms where some nations are permitted to have these weapons and others are not. Neither the NPT nor the Nuclear Terrorism Convention together with UN Security Council Resolution 1540 which seeks to prevent terrorist groups acquiring weapons of mass destruction, can hold this demand in check as long as nuclear weapons are held by some states and vast amounts of enriched uranium and separated plutonium lie around.
- The second crisis confronting us is climate change caused by our global consumption patterns, the prevailing structure of international trade and our failure to invest in and cooperate in the search for new environmentally friendly sources of energy.

Both crises have the best chance of being resolved through a nuclear weapon free world – consistently espoused by Pugwash and more recently endorsed by George Schultz, Henry Kissinger, Sam Nunn, and Bill Perry.[6] This vision is being pursued by President

4 The White House, Remarks by President Barack Obama, Hradèany Square, Prague, Czech Republic, 5th April 2009; at: <http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/> (24 November 2009).

5 A. Robock, L. Oman, G. L. Stenchikov, O. B. Toon, C. Bardeen, and R. P. Turco: "Climatic consequences of regional nuclear conflicts"; at: <http://climate.envsci.rutgers.edu/pdf/acp-7-2003-2007.pdf>.

6 George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn: "A World Free of Nuclear Weapons", in: *The Wall Street Journal*, 4 January 2007, A15, and see also George P. Shultz, , William J. Perry, Henry A. Kissinger, and Sam Nunn: "Toward a Nuclear Free World", in: *The Wall Street Journal*, 15 January 2008, 13; at: <http://online.wsj.com/article/SB120036422673589947.html?mod=opinion _main_commentaries> (24 November 2009).

Obama. Any delay in implementing nuclear disarmament and nuclear non-proliferation policies can be dangerous even though Obama himself hedges on a timetable for achieving his vision. The Obama-Medvedev Joint Statement of 1 April 2009[7] and Obama's Prague speech of 5 April 2009 set the goals[8] that are being implemented through

- the resumption of bilateral US-Russian negotiations for a follow-up to the *Strategic Arms Reduction Treaty* (START) that expired on 5 December 2009 with significant nuclear weapon reductions in both countries that own 95 per cent of nuclear weapons;
- the lifting of US impediments to the negotiation of a *Fissile Material Cut-off Treaty* (FMCT) in the Conference on Disarmament permitting other countries to reciprocate;
- the message by Obama to the parties to the NPT at their Preparatory Committee meeting in New York in May 2009 stressing the US commitment to the NPT;
- the statement of Secretary of State Hillary Clinton at the Article XIV Conference of the *Comprehensive Nuclear Test Ban Treaty* (CTBT) in New York, 24 September 2009;
- President Obama's statement on 24 September 2009 and the unanimous adoption of Resolution 1887 (2009) stressing more non-proliferation than nuclear disarmament;
- and the return to diplomacy resulting in fresh negotiations with Iran on the basis of IAEA proposals and the prospect of direct US-North Korean talks.

But obstructionist tactics are evident in the nuclear disarmament area both within the USA and with some NATO allies. As a confidence building measure President Obama has reversed the US ballistic missile defence plans in the Czech Republic and Poland. But the unfulfilled agenda is huge as is the task of setting the right conditions for a successful NPT Review Conference in May 2010. A new US Nuclear Posture Review must reflect the Obama vision accurately by abandoning nuclear first use and launch-on-warning capabilities deemphasizing the role of nuclear weapons in US defence strategy. The US senate must 'advise and consent' to both treaties: the new START and the CTBT. A well-organized campaign is needed and compromises must be reached to maintain his domestic and international support. The Nobel Peace Prize Committee has referred to Obama's "vision of a world free from nuclear arms (which) has powerfully stimulated disarmament and arms control negotiations".

West European leaders, especially within NATO, and of countries enjoying the shelter of the US nuclear umbrella must help persuade US Senators of the global importance of ratifying the new START and the CTBT. There is an international responsibility to protect the vision of Obama. In autumn 2009, the new German government has called for the elimination of US nuclear weapons from its soil. In the UK, Douglas Hurd, Malcolm Rifkind, David Owen, and George Robertson[9] supported this goal on 30 June 2008, as did the June 2009 report of the House of Commons Foreign Affairs Committee on "Global Security: Non-proliferation"[10] and the launch of the Top Level Group of UK Parliamentarians for Multilateral Nuclear Disarmament and Non-proliferation on 29 October 2009 who share the vision of a nuclear weapon free world.

However, until the UK government and the governments of other nuclear weapon states take more practical steps towards realizing this vision, a credibility gap will remain between the nuclear weapon states and non-nuclear weapon states within the NPT. Over six decades after Hiroshima and Nagasaki incremental steps towards a nuclear weapon free world makes the goal seem a mirage. The Global Zero group has set a target of 2030 for the completion of its phased verified programme for the total elimination of nuclear weapons. Reports of the *International Commis-*

7 The White House, Joint Statement by Dmitry A. Medvedev, President of the Russian Federation, and Barack Obama, President of the United States of America, Regarding Negotiations on Further Reductions in Strategic Offensive Arms; at: <http://www.whitehouse.gov/the_press_office/Joint-Statement-by-Dmitriy-A-Medvedev-and-Barack-Obama/>.

8 The White House, Remarks By President Barack Obama, Hradèany Square, Prague, Czech Republic, 5th April 2009; at: <http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/> (24 November 2009).

9 Douglas Hurd, Malcolm Rifkind, David Owen and George Robertson: "Start worrying and learn to ditch the bomb. It won't be easy, but a world free of nuclear weapons is possible", in: *The Times*, 30 June 2008; at: <http://www.timesonline.co.uk/tol/comment/columnists/guest_contributors/article4237387.ece >.

10 UK, House of Commons Foreign Affairs Committee: "Global Security: Non-Proliferation – Foreign Affairs Committee"; at: <http://www.publications.parliament.uk/pa/cm200809/cmselect/cmfaff/222/22210.htm>.

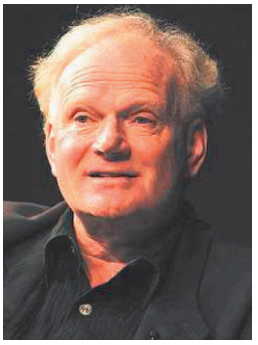
sion for Nuclear Non-proliferation and Disarmament (ICNND), co-chaired by the former Foreign Ministers of Australia and Japan, point to advocacy of a 'minimization' point of over 1,000 nuclear warheads by 2025, while President Obama says "perhaps not in my lifetime".

The simplest and most direct route would be to negotiate a verifiable Nuclear Weapon Convention to outlaw nuclear weapons as the world outlawed biological and chemical weapons. A draft Convention is before the UN, proposed by Malaysia and Costa Rica, and recommended by the Secretary-General in his 5-point plan of October 2008. It will contribute towards easing global tensions and resolving the burning issues of our times – nuclear weapons, climate change, terrorism, poverty, international finance, and human rights which intersect. With the elimination of nuclear weapons we have, in the words of UN Secretary-General Ban Ki-moon, "a global good of the highest public".

There is no greater task than achieving peace and security through disarmament. Einstein (1879–1955), the co-author of the Manifesto that continues to inspire Pugwash, once said,

> concern for man himself and his fate must always be the chief interest of all technical endeavours...in order that the creations of our minds shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations.

Scientists remain at the centre of weapon laboratories, the military industrial complexes, and energy consuming industries in all countries. National loyalties and protectionist pressures are strong in such situations and I can only quote the Russian playwright Anton Chekhov (1860–1904) who said, "Science cannot be national, in the same way that a multiplication table cannot be national. If a science becomes national it ceases to be a science." The common humanity of all scientists should act as a code of ethics to ensure nuclear disarmament and to arrest and reverse climate change. The Russell-Einstein Manifesto of 9 July 1955 said, "We appeal, as human beings, to human beings: Remember your humanity, and forget the rest." It is time to follow this advice before it is too late.



Living in and Coping with World Risk Society

Ulrich Beck

The narrative of global risk is a narrative of irony. This narrative deals with the involuntary satire, the optimistic futility, with which the highly developed institutions of modern society – science, state, business and military - attempt to anticipate what cannot be anticipated. Socrates has left us to make sense of the puzzling sentence: I know that I know nothing. The fatal irony, into which scientific-technical society plunges us, is, as a consequence of its perfection, much more radical: We don't know what it is we don't know - but from these dangers arise, which threaten mankind! The perfect example here is provided by the debate about the cooling agent CFC. About 45 years after the discovery of the CFC, the chemists Rowland and Molina (1974) put forward the hypothesis, that CFCs destroy the ozone layer of the stratosphere and as a result increased ultraviolet radiation would reach the earth. The chain of unforeseen secondary effects would lead to a significant increase of cancer all over the world. When coolants were invented no one could know or even suspect, that they would create such a danger.

The irony of risk is that rationality, that is, the experience of the past, encourages anticipation of the wrong kind of risk, the one we believe we can calculate and control, whereas the disaster arises from what we don't know and cannot calculate. The bitter varieties of this risk irony are virtually endless: climate change, mad cow decease, 9/11 terror attacks, global financial crises, swine flue virus and latest but not last, volcano ash clouds disrupting air traffic in Europe and elsewhere.

To the extent that risk is experienced as omnipresent, there are only three possible reactions: *Denial*, *apathy*, or *transformation*. The first is largely inscribed in modern culture, the second resembles postmodern nihilism, and the third is the 'cosmopolitan moment' of world risk society (Beck 1986, 1992, 2006, 2007, 2009). I would like to demonstrate that here in three steps (drawing on empirical research findings of the Munich Research Centre on 'Reflexive Modernization'):

1. Old dangers - new risks: What is new about world risk society?
2. Ruse of history: To what extent are global risks a global force in present and future world history, controllable by no one, but which also open up new opportunities of action for states, civil society actors etc.?
3. Consequences and perspectives: In order to understand the manufactured uncertainty, lack of safety and insecurity of world risk society is there a need for a paradigm shift in the social sciences?

Old Dangers - New Risks: What is New About World Risk Society?

Modern society has become a risk society in the sense that it is increasingly occupied with debating, preventing and managing risks that it itself has produced. That may well be, many will object, but it is indicative rather of a hysteria and politics of fear instigated and aggravated by the mass media. On the contrary, would not someone, looking at European societies from outside have to acknowledge that the risks which get us worked up, are luxury risks, more than anything else? After all, our world appears a lot safer than that, say, of the war-torn regions of Africa, Afghanistan or the Middle East. Are modern societies not distinguished precisely by the fact that to a large extent they have succeeded in bringing under control contingencies and uncertainties, for example with respect to accidents, violence and sickness?

As true as all such observations may be, they miss the most obvious point about risk: that is, the key distinction between risk and catastrophe. Risk does *not* mean catastrophe. Risk means the *anticipation* of catastrophe. Risks exist in a permanent state of virtuality, and only become 'topical' to the extent that they are anticipated. Without techniques of visualization, without symbolic forms, without mass media etc. risks are nothing at all. In other words, it is irrelevant, whether we live in a world which is in fact or in some sense 'objectively' safer than all other worlds; if destruction and disasters are anticipated, then that produces a compulsion to act.

The theory of 'world risk society' maintains that modern societies are shaped by new kinds of risks, that their foundations are shaken by the global anticipation of global catastrophes. Such perceptions of global risk are characterized by three features:

1. *De-localization*: Its causes and consequences are not limited to one geographical location or space, they are in principle omnipresent.
2. *Incalculableness*: Its consequences are in principle incalculable; at bottom it's a matter of 'hypothetical' risks, which, not least, are based on science-induced not-knowing and normative dissent.
3. *Non-compensatibility*: The security dream of first modernity was based on the scientific utopia of making the unsafe consequences and dangers of decisions ever more controllable; accidents could occur, as long and because they were considered compensatible. If the climate has changed irreversibly, if progress in human genetics makes irreversible interventions in human existence possible, if terrorist groups already have weapons of mass destruction available to them, then it's too late. Given this new quality of 'threats to humanity' – argues Francois Ewald (2002: 275) – the logic of compensation breaks down and is replaced by the principle of *precaution through prevention*. Not only is prevention taking precedence over compensation, we are also trying to anticipate and prevent risks whose existence has not been proven. Let me explain these points - de-localization, incalculableness, non-compensatibility – in greater detail.

The de-localization of incalculable interdependency risks takes place at three levels:

1. *spatial*: The new risks (e.g. climate change) do not respect nation state or any other borders;
2. *temporal*: The new risks have a long latency period (e.g. nuclear waste), so that their effect over time cannot be reliably determined and limited.
3. *Social*: Thanks to the complexity of the problems and the length of chains of effect, assignment of causes and consequences is no longer possible with any degree of reliability (e.g. financial crises).

The discovery of the incalculability of risk is closely connected to the discovery of the importance of not-knowing to risk calculation, and it's part of another kind of irony, that surprisingly this discovery of not-knowing occurred in a scholarly discipline, which today no longer wants to have anything to do with it: economics. It was Knight and Keynes, who early on insisted on a distinction between predictable and non-predictable or calculable and non-calculable forms of contingency. In a famous article in *The Quarterly Journal of Economics* Keynes (1937: 213–14) writes: "...by 'uncertain knowledge', let me explain, I do not mean merely to distinguish what is known from what is merely probable. The sense in which I am using the term is that in which the price of copper and the rate of interest twenty years hence, all the obsolescence of a new invention are uncertain. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know..." However, Keynes' admonition to open up the field of economic decision-making to the unknown unknowns was entirely neglected in the subsequent development of mainstream economics (including mainstream Keynesian economics); and this denial of non-knowing has become a causal condition for the emergence of the global financial crisis in 2009.

The crucial point, however, is not only the discovery of the importance of non-knowing, but that simultaneously the knowledge, control and security claim of state and society was, indeed had to be, renewed, deepened, and expanded. The irony lies in the institutionalized security claim, to have to control something, even if one does not know, whether it exists! It are precisely unknown unknowns which provoke far-reaching conflicts over the definition and construction of political rules and responsibilities with the aim of preventing the worst. For the time being the last and most striking example of that are the volcano ash clouds in spring 2010: flights are back – ash is too!

If catastrophes are anticipated whose potential for destruction ultimately threatens everyone, then a risk calculation based on experience and rationality breaks down. Now all possible, more or less improbable scenarios have to be taken into consideration; to knowledge, therefore, drawn from experience and science there now also has to be added imagination, suspicion, fiction, fear (Ewald 2002: 273–301). The boundary between rationality and hysteria becomes blurred.

Given the right invested in them to avert dangers politicians, in particular, may easily be forced to proclaim a security, which they cannot honour. Because the *political* costs of omission are much higher than the political costs of overreaction. In future, therefore, it is not going to be easy, in the context of state promises of security and a mass media hungry for catastrophes, to actively limit and prevent a diabolical power game with the hysteria of not-knowing. I don't even dare think about deliberate attempts to instrumentalize this situation.

The Ruse of Risk: Global Risk is an Unpredictable and Impersonal Force in the Contemporary World

There is no better way than to start with an example: in 2005 Hurricane Katrina destroyed New Orleans. This was a horrifying act of nature, but one which simultaneously, as a global media event, involuntarily and unexpectedly developed an enlightenment function which broke all resistance. What no social movement, no political party, and certainly no sociological analysis (no matter how well grounded and brilliantly written) would have been able to achieve, happened within a few days: America and the world were confronted by global media pictures of the repressed *other* America, the largely racialized face of poverty. How can this relationship between risk and the creation of a global public be understood? In his 1927 book *The Public and its Problems*, John Dewey explained that not actions but *consequences* lie at the heart of politics. Although Dewey was certainly not thinking of global warming, BSE or terrorist attacks, his idea is perfectly applicable to world risk society. A global public discourse does *not* grow out of a consensus on decisions, but out of *dissent* over the *consequences* of decisions. Modern risk crises are constituted by just such controversies over consequences. Where some may see an overreaction to risk, it is also possible to see grounds for hope. Because such risk conflicts do indeed have an enlightenment function. They destabilize the existing order, but the same events can also look like a vital step towards the building of new institutions. Global risk has the power to tear away the facades of organized irresponsibility.

Egoism, autonomy, autopoesis, self-isolation, improbability of translation – these are key terms which, in sociological theory, but also in public and political debates, distinguish modern society. The communicative logic of global risk can be understood as the exact opposite principle. Risk is *the* involuntary, unintended compulsory medium of communication in a world of irreconcilable differences, in which everyone revolves around themselves. Hence a publicly perceived risk compels communication between those, who do not want to have anything to do with one another. It assigns obligations and costs to those who refuse them - and who often even have current law on their side. In other words: Risks cut through the self-absorption of cultures, languages, religions and systems as well as the national and international agenda of politics, they overturn their priorities and create contexts for action between camps, parties and quarrelling nations, which ignore and oppose one another.

I propose that a clear distinction be made between the philosophical and normative ideas of cosmopolitanism on the one hand and the 'impure' actual cosmopolitanization in the sociological sense on the other. The crucial point about this distinction is that cosmopolitanism cannot, for example, only become real deductively in a translation of the sublime principles of philosophy, but also and above all through the back doors of global risks, unseen, unintended, enforced. Down through history cosmopolitanism bore the taint of being elitist, idealistic, imperialist, capitalist; today, however, we see, that reality itself has become cosmopolitan. Cosmopolitanism does not mean - as it did for Immanuel Kant – an asset, a task, that is to order the world. Cosmopolitanism in world risk society opens our eyes to the uncontrollable liabilities, to something that happens to us, befalls us, but at the same time stimulates us to make border-transcending new beginnings. The insight, that in the dynamic of world risk society we are dealing with a cosmopolitanization under duress, robs 'impure' cosmopolitanism of much of its ethical attractiveness. If the cosmopolitan moment of world risk society is both at once: deformed and inevitable, then seemingly it is not an appropriate object for sociological and political reflections. But precisely that would be a serious mistake.

As important as all these arguments are, the decisive question is a different one: To what extent does the threat and shock of world risk society open up the horizon to *historic alternatives of political action*? For an answer see *Power in the Global Age* (Beck 2005). Here I can only outline the basic idea.

Two premises: (1) World risk society brings a new, historic key logic to the fore: No nation can cope with its problems alone. (2) A realistic political alternative in the global age is possible, which counteracts the loss to globalized capital of the commanding power

of state politics. The condition is, that globalization must be decoded not as economic fate, but as a strategic game for world power. A new global domestic politics that is already at work here and now, beyond the national-international distinction, has become a meta-power game, whose outcome is completely open-ended. It is a game in which boundaries, basic rules and basic distinctions are renegotiated - not only those between the national and the international spheres, but also those between global business and the state, transnational civil society movements, supranational organizations and national governments and societies.

The strategies of action, which global risks open up, overthrow the order of power, which has formed in the neo-liberal capital-state coalition: global risks *empower* states and civil society movements, because they reveal new sources of legitimation and options for action for these groups of actors; they *disempower* globalized capital on the other hand, because the consequences of investment decisions and externalizing risks in financial markets contribute to creating global risks, destabilizing markets, globally operating banks, and activating the power of the state as well as of that sleeping giant the consumer. Conversely, the goal of global civil society and its actors is to achieve a connection between civil society and the state, that is, to bring about a *cosmopolitan form of statehood*. The forms of alliances entered into by the neo-liberal state instrumentalize the state (and state-theory) in order to optimize and legitimize the interests of capital world wide. Conversely the idea of a cosmopolitan state in civil society form aims at imagining and realizing a robust diversity and a post-national order. The neo-liberal agenda surrounds itself with an aura of self-regulation and self-legitimation. Civil society's agenda, on the other hand, surrounds itself with the aura of human rights, global justice and struggles for a new grand narrative of radical-democratic globalization.

Why is this not wishful thinking, why is it an expression of a *cosmopolitan realpolitik*? The cosmopolitan perspective suggests that there is a hidden link between global risk and Immanuel Kant. It is precisely the stark realism of the *cosmopolitan imperative: either Kant or catastrophe! either cooperate or fail!* which is also cause for hope.

Consequences and Perspectives

It is evident, that the taken-for-granted nation-state frame of reference – what I call 'methodological nationalism' – prevents the social and political science from understanding and analyzing the dynamics and conflicts, ambivalences and ironies of world risk society. This is also true - at least in part - of the two major theoretical approaches and empirical schools of research, which deal with risk, on the one hand in the tradition of Mary Douglas, on the other in that of Michel Foucault. These traditions of thought and research have undoubtedly raised key questions and produced extremely interesting detailed results as far as understanding definitions of risk and risk policies is concerned, work which no one can dispense with and which will always remain an essential component of social science risk research. Their achievement and their evidence are to open up risk as a battle for the redefinition of state and scientific power.

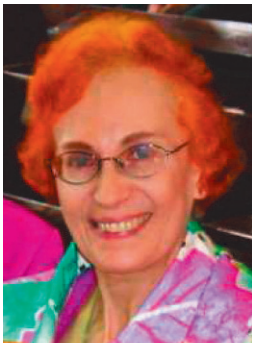
An initial defect lies in regarding risk more or less or even exclusively as an ally, but failing to perceive it as an *unreliable* ally and not at all as a potential antagonist, as a force hostile both to nation state power as well as to global capital. Surprisingly the research traditions of Douglas and Foucault define their problem in such a way, that the battle over risk always comes down to the reproduction of the social and state order of power. Because the nation state, which attempts to deal with global risks in isolation, resembles a drunk man, who on a dark night is trying to find his lost wallet in the cone of light of a street lamp. To the question: Did you actually lose your wallet here, he replies, no, but in the light of the street lamp I can at least look for it.

In other words, global risks are producing 'failed or bankrupt states' - even in the West (last example Greece, but maybe in the near future also Italy or Great Britain or even the USA). The state-structure evolving under the conditions of world risk society could be characterized in terms of both inefficiency *and* post-democratic authority. A clear distinction, therefore, has to be made between rule and inefficiency. It is quite possible, that the end result could be the gloomy perspective, that we have totally ineffective and authoritarian state regimes (even in the context of the Western democracies). The irony here is this: manufactured uncertainty (knowledge), insecurity (welfare state) and lack of safety (violence) undermine *and* reaffirm state power beyond democratic legitimacy. Given the maddening conditions of world risk society, the older critical theory of Foucault is in

danger of becoming simultaneously affirmative and antiquated, along with large areas of sociology, which have concentrated on class dynamics in the welfare state. It underestimates and castrates the communicative cosmopolitan logic and irony of global risks; consequently the historic question, where politics has lost its wallet, that is, the question of an alternative modernity, is analytically excluded by the vain searching in the cone of light of the nation state street light.

Cosmopolitan social sciences, which face up to the challenges of global risks, must also, however, shed its political quietism: Society and its institutions are incapable of adequately conceptualizing risks, because they are caught up in the concepts of first nation state modernity, believing in scientific certainty and linear progress, which by now have become inappropriate. And it has to face the question: How can non-Western risk societies be understood by a sociology, which so far has taken it for granted, that its object - Western modernity - is at once both historically unique and universally valid?[1] How is it possible to decipher the internal link between risk and race, risk and enemy image, risk and exclusion?

1 See special issue on "Varieties of Second Modernity: Extra-European and European Perspectives", of: *British Journal of Sociology* 61(3), ed. by U. Beck and E. Grande, September 2010 (in print).



Population Prospects and the Challenges of Sustainability

Hania Zlotnik[1]

As the world prepares to cope with the challenges posed by environmental change, the implications of the rapid population growth that started almost a century ago and of future population trends cannot be ignored. Between the late 1920's and today, the population of the world has more than tripled, passing from 2 billion to nearly 7 billion. Except for a short hiatus caused by the Second World War, the growth rate of the world population accelerated between the 1920's and the late 1960's, passing from 0.5 per cent per year to 2.0 per cent per year. Such acceleration was the result of reductions in mortality, particularly among children. Starting in the 1970's, declining fertility in developing countries began to counteract the reduction of mortality to produce a declining global rate of population growth. Yet, despite the major reductions in fertility that the majority of countries have recorded, population growth still averages 1.2 per cent per year globally and is a high 2.4 per cent per year in sub-Saharan Africa and 2.3 per cent in the least developed countries (about two thirds of which are in sub-Saharan Africa).

Because of population momentum, even if the fertility of each country were to reach replacement[2] level tomorrow, the world population would still increase to 9 billion by 2050 and, in a scenario without further change in fertility and mortality, it would attain 10.1 billion by mid-century and still have a large potential for continued growth.

These population outcomes need to be borne in mind when considering the medium variant projection (UN 2009) produced by the United Nations Population Division, whose results are the most often used to indicate the likely size of the world population by mid-century. In the medium variant, mortality is projected to decrease in all countries and fertility levels in developing countries are projected to fall below replacement level, whereas the fertility of developed countries is expected to recuperate somewhat from the very low levels reached over the past decade. The result is a population of 9.1 billion in 2050, whose annual rate of change would have dropped to 0.3 per cent by then and would therefore be well on the way to stabilization. Nevertheless, this low growth rate is not equally shared by all development groups. Developed countries as a whole are projected to have a declining population in 2050. In sharp contrast, the population of the least developed countries will still be growing at a rate of 1.1 per cent annually and the rest of the developing world will have a population that is nearing the end of population growth, rising annually at a low rate of just 0.2 per cent.

According to the medium variant, nearly all the increases in population expected from now to 2050 will occur in developing countries. Out of the additional 2.2 billion people expected to live on Earth by 2050, 48 per cent will be added to the population of Asia and 43 per cent to that of Africa. The least developed countries, which account for just 12 per cent of the world population today, are projected to account for 36 per cent of the population growth expected from now to 2050 under the medium variant.

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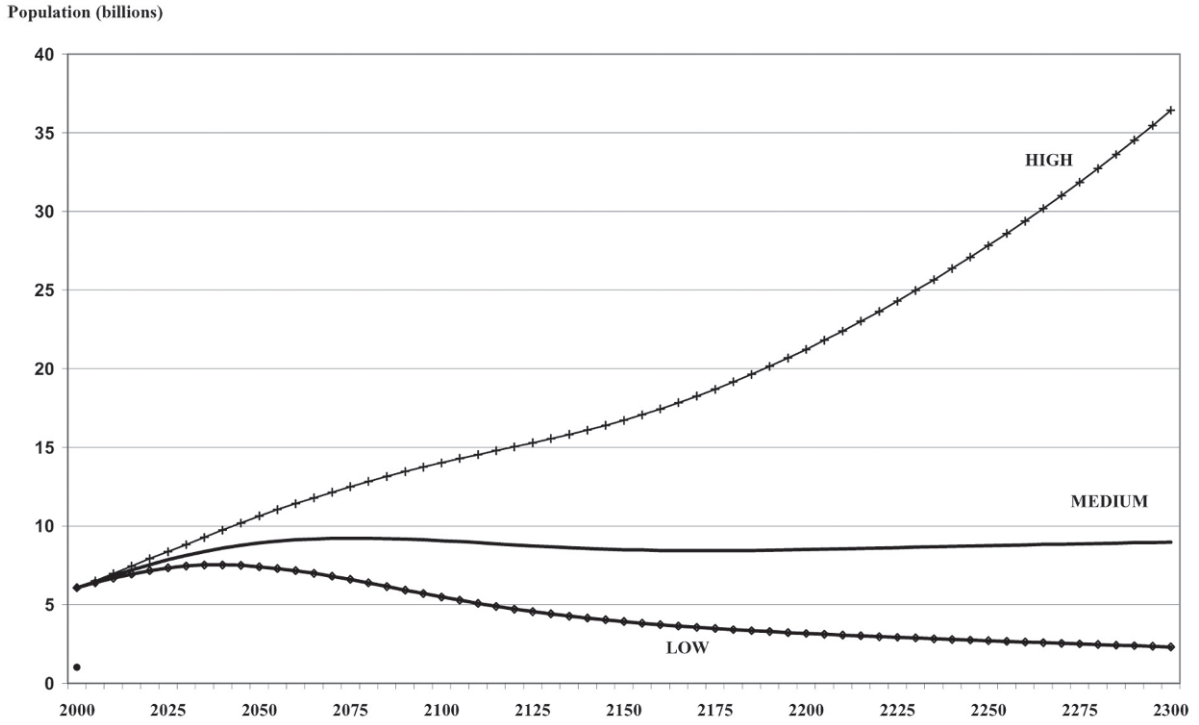
1 The views and opinions expressed in this essay are those of the author and do not necessarily represent those of the United Nations.

2 Replacement-level fertility is the number of children women should have on average to ensure that every woman is replaced by a daughter. Because some women die before they reach the age when they can reproduce and more boys are born than girls, replacement-level fertility is always above 2 children per woman and can be much higher in high-mortality countries. In the scenario whose results are cited here, replacement-level fertility is calculated exactly for each country according to its level of mortality.

Figure PE 4.1: World population according to different scenarios, 2000-2300. **Source:** UN (2004).



These trends present opportunities and challenges. The population reductions expected in developed countries as a whole can help moderate the impact that high standards of living have on the environment. Similarly, slowing population growth in the majority of developing countries can assist in counterbalancing the impact that accelerated economic growth will likely have on the forces leading to environmental change. Yet, even with slowing population growth, India alone will account for nearly 18 per cent of future population increases and, together with China, Indonesia and Brazil, in order of importance, will add 541 million inhabitants to Earth by 2050 or a quarter of the overall projected population increase.

In the least developed countries, the rapid population growth still expected to occur is likely to present more challenges than opportunities. Precisely the populations that are already most vulnerable to environmental change because of the limited capacity and resources they have to adapt are those most likely to see their numbers double over the next forty years. An Africa of 1 billion people today is very likely to become the home of 2 billion by 2050. The least developed countries, whose current population is 0.9 billion, are projected to have 1.7 billion inhabitants by mid-century.

The Sensitivity of Long-term Population Trends to Deviations from Zero Population Growth

In 2004, the United Nations Population Division produced long-range projections to 2300 to explore the impact that deviations from replacement-level fertility would have on the eventual size and distribution of populations (UN 2004). The medium scenario in that set of projections produced a world population of 8.9 billion in 2050 and a population that peaked at 9.2 billion in 2075, declined to 8.3 billion in 2175 and then increased slowly to reach again 9.0 billion in 2300. Underlying those changes in population size was a fertility path that kept every country at below replacement level for about 100 years and then returned fertility to replacement level[3] and maintained it there until 2300. The population did not quite stabilize over the projection period because mortality was projected to keep on declining, producing therefore a sustained but very slow population increase.

3 Replacement-level fertility for each country was calculated according to its level of mortality. If mortality is constant and net migration is nil, maintaining fertility at replacement level yields eventually an unchanging population with zero population growth.

Two different scenarios were produced to test the sensitivity of future population size to small but sustained deviations of fertility from replacement level. Thus, a low scenario, where fertility remained a quarter of a child below that in the medium scenario, yielded a 2300 population of just 2.3 billion, similar in size to the global population in 1950. In contrast, a high scenario where fertility remained a quarter of a child higher than in the medium scenario produced a 2300 population of 36.4 billion.

Even more telling was the scenario where fertility was maintained constant at the level it had in 1995–2000. Under that assumption, world population soared to 244 billion by 2150 and 134 trillion in 2300, indicating the unsustainable character of current fertility levels. Furthermore, all the projected population increase occurred in the developing world, whose population rose from 4.9 billion in 2000 to 134 trillion in 2300. Africa's population alone was projected to rise from 0.8 billion in 2000 to 115 trillion in 2300. In contrast, the population of developed countries as a whole was projected to be cut in half, from 1.2 billion in 2000 to 0.6 billion in 2300. This unlikely scenario served to highlight the stark regional differences that exist today in population trends and their implications for the future.

Although none of the scenarios produced as part of the long-term projections may actually come to pass, their implications are clear: positive deviations from zero population growth maintained over the long run are unlikely to be sustainable. So far, the major cause of the global deceleration of population growth has been the reduction of fertility, which dropped from nearly 5 children per woman in 1950–1955 to 2.6 in 2005–2010. The medium variant produced in 2008 projected that global fertility would be slightly below replacement level by 2045–2050, at 2.0 children per woman. To attain that level, fertility still needs to decline in many countries, including in the least developed countries, where fertility averages 4.4 children per woman, and in a number of other developing countries, especially those in South-central Asia, Western Asia and Northern Africa, where fertility still averages just under 3 children per woman, and in Central America, where it averages close to 2.5 children per woman. A number of measures can be taken to promote and facilitate the further reduction of fertility, including improving information and access to contraceptive methods (UN 2009a) and supporting the empowerment of women through education, equality of rights with men and women's increased participation in economic and social life.

The Increasing World Urbanization

With 50.5 per cent or 3.5 billion of the people on Earth living in cities in 2010 and urban populations growing, often at the expense of rural areas, the global population as a whole has become more urban than rural.[4] Yet, there are major disparities in the levels of urbanization among regions. Northern America, Latin America and the Caribbean, Europe and Oceania are highly urbanized, with proportions urban ranging from 70 per cent in Oceania to 82 per cent in Northern America. In sharp contrast, Africa and Asia remain mostly rural, with just 40 per cent and 42 per cent of their respective populations living in urban settlements in 2010.

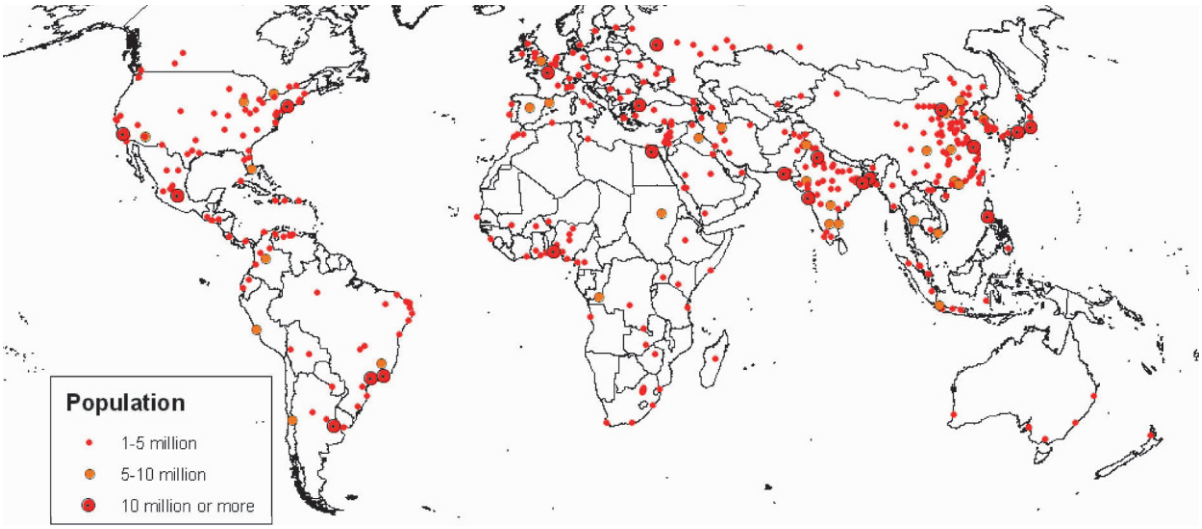
A third of all urban inhabitants (1.1 billion) live in small urban localities with populations below 100,000. Another 0.6 billion live in urban centres with populations ranging between 100,000 and 500,000 inhabitants. In all, 52 per cent of the urban population lives in urban centres with fewer than half a million inhabitants. The rest live in 958 cities having more than half a million inhabitants each in 2010, only 53 of which have populations surpassing 5 million. These larger cities include 21 megacities, that is, cities with at least 10 million inhabitants, which altogether account for 9 per cent of the world urban population (324 million).

According to current projections, the level of urbanization of the highly-urbanized regions is expected to increase slowly, but a relatively rapid urbanization is projected in both Africa and Asia. Nevertheless, by 2050 both Africa and Asia are expected to be significantly less urbanized than the other regions, with 60 per cent and 65 per cent of their respective populations living in urban areas. All other regions, except Oceania, are projected to be more than 84 per cent urban in 2050.

In 2009, 140 out of the 230 countries or areas constituting the world were already more than half urban. Over the next four decades, 66 countries or areas are expected to reach that threshold for the first time. In 2050, only 24 countries or areas are expected to fall

4 This section draws heavily on the following United Nations publications: UN (2009b, 2010); and on "World Urbanization Prospects: The 2009 Revision", Press Release, New York, 25 March 2010; at: <http://esa.un.org/unpd/wup/Documents/WUP2009_Press-Release_Final_Rev1.pdf>. All UNPD documents are accessible at: <http://www.un.org/esa/population/>.

Figure PE 4.2: The world's cities above 1 million inhabitants. **Source:** UN, "World Urbanization Prospects: The 2009 Revision", Press Release, New York, 25 March 2010; at: <http://esa.un.org/unpd/wup/Documents/WUP2009_Press-Release_Final_Rev1.pdf>.



short from being half urban, including eight countries in Africa, another eight in Oceania and five in Asia.

Globally, the rural population is projected to start decreasing around 2020 and 0.56 billion fewer rural inhabitants are expected in 2050 than today, with the rural population projected to decline from 3.4 billion in 2010 to 2.9 billion in 2050. Asia, having the largest number of rural inhabitants, is expected to experience the most sizable reduction: from 2.4 billion in 2010 to 1.8 billion in 2050. In contrast, the rural population of Africa is expected to gain 147 million and to keep on rising until 2040. By 2050, Africa is expected to have 0.8 billion rural inhabitants.

The slowing pace of growth and outright decline of the rural population and the rising levels of urbanization are two sides of the same coin. Urbanization results from the restructuring of economies to become more productive and is an intrinsic part of the development process. Agriculture, the major economic activity in rural areas, is subject to diminishing returns if, over long periods, the number of agricultural workers grows more rapidly than the land available for production. When the urban productive sector can absorb the excess labour force in rural areas, both sectors benefit. Successful economies have all experienced an acceleration of urbanization. Today, countries having large proportions of the population living in rural areas are more likely to be among the least developed countries and to have lower levels of national income per capita. Conversely, higher levels of urbanization are associated with higher income levels.

Because the rural population is projected to decrease, the urban areas of the world are expected to absorb all the population growth expected over the next four decades while at the same time drawing in some of the rural population. Between 2010 and 2050, the world population is expected to increase by 2.2 billion, passing from 6.9 billion to 9.1 billion. At the same time, the population living in urban areas is projected to gain 2.8 billion, passing from 3.5 billion in 2010 to 6.3 billion 2050. Asia, which is home to the largest number of urban dwellers in the world (1.8 billion in 2010) is expected to see its urban population increase by 1.6 billion, to reach 3.4 billion. Africa, whose urban population is the fourth largest in the world in 2010, following those of Europe and Latin America and the Caribbean, is expected to see it rise by 0.8 billion, to reach 1.2 billion in 2050, when it will be the second largest after that of Asia.

The expected redistribution of the world's population between urban and rural settlements has important implications for both economic growth and environmental change. It is estimated that the 3.5 billion people living in cities today occupy 3 per cent of the Earth's land area, while the livelihoods of today's 3.4 billion rural dwellers depend mainly on cropland, which accounts for 12 per cent of the world's land area (UN 2009c). Burdening agricultural areas with the additional 2.2 billion people expected to live on Earth by 2050 would be unsustainable. Cities, where wealth, infrastructure and know-how are already concentrated, are in a better position to adapt to growing populations but to do so authorities at both the local

and the national levels must address the ills that often affect urban settlements, especially environmental contamination stemming from traffic congestion, the concentration of industry and inadequate waste disposal systems, as well as inequities arising from the persistent disparities among city dwellers, which mean that poor people bear the brunt of the negative aspects of urbanization. The expected rapid urbanization of low-income countries, particularly those in Africa and Asia, pose special challenges. Providing urban populations with access to services, including water and sanitation, transport and adequate housing, is necessary if their vulnerability to the extreme weather events associated with climate change is to be reduced. The concentration of population in cities generates the economies of scale that can justify improving planning for the provision of services in ways that are consistent with better protection of the environment.

As the world becomes increasingly urban, decisions taken today in cities across the world will shape the economic, social and environmental future of humankind. Properly managed, urbanization can help in combating poverty, inequality and environmental degradation, but action to capitalize on the opportunities it presents and to address the challenges it raises must be prompt and sustained (UN 2009c: 46–47).

Towards a Great Land-Use Transformation?

Christoph Müller, Hermann Lotze-Campen, Veronika Huber, Alexander Popp, Anastasia Svirejeva-Hopkins, Michael Krause and Hans Joachim Schellnhuber

The Climate Change Challenge and Land-use Mitigation Options

Climate change poses great threats to many compartments of the Earth System and, as a consequence, to human societies. There is growing scientific evidence that a rise of the global mean temperature by more than 2 °C (as compared to pre-industrial levels) would irreversibly harm many ecosystems and most likely exceed the adaptive capacities of many societies. In order to confine global warming to maximally 2 °C, major efforts to reduce emissions of greenhouse gases are required. These may even include 'negative emissions' of carbon dioxide to be achieved by the second half of this century: carbon dioxide may have to be actively removed from the atmosphere and deposited on land for many decades, centuries, or even millennia.

The transformation of the energy system, steering away from fossil fuels, will have to contribute the lion's share of emission reductions. However, land-use changes are currently responsible for one third of total greenhouse gas emissions, so improved land management and productivity increases on land under cultivation could significantly contribute to climate change mitigation since soils and forests store large amounts of carbon.

Several techniques that would allow for negative emissions are currently discussed: afforestation and the restoration of peat and wetlands would be the most easily accessible options. Other options such as technologies for *carbon capture and storage* (CCS) in the energy sector involve sequestration of carbon dioxide in geological formations underground. Carbon dioxide could be directly extracted from the atmosphere making use of chemical reactions turning the greenhouse gas into solid carbonates. The large-scale application of these technologies is however still in its infancy. The most promising mechanism to achieve negative emissions is to fuel power plants with biomass, extract carbon dioxide from the exhaust and sequester it underground. However, in order to draw down a really significant amount of carbon dioxide, enormous quantities of biomass would have to be processed this way.

Increasing Demands on Land and the Need for Adaptation

In many regions, most of the available resources of fresh water and fertile land are already being used excessively, either directly for the production of food, fibre, and timber, or indirectly as carbon sinks, for water and air purification, nature conservation, and many other ecosystem services. This scarcity of basic resources is amplified by a non-sustainable use, causing degradation of ecosystems and production potentials. Fifteen per cent of the global land surface (about 2 billion hectares) are currently considered as being degraded – due to overgrazing, deforestation, over-exploitation and non-sustainable agricultural practices.

Since the year 2000, global agricultural supply has not kept pace with an increasing demand for food and bioenergy. The food price spike in 2007–2008 and related food riots in more than 60 countries had many underlying causes, but increasing demand in large emerging economies and dwindling stocks were certainly part of them. High oil prices and subsidies for biofuels in rich countries urged farmers around the world to allocate land and other factor inputs to energy crops, thus reducing the production of staple food crops. Continuous droughts, e.g. in Australia, added more pressure on food markets. Finally, an underlying cause of stagnating productivity increase in

agriculture is a lack of funds for research and development.

In most countries, land prices insufficiently reflect the growing imbalance between demand and supply of fertile land. However, first conspicuous signs of land shortages have emerged. Large companies and even countries are already trying to stake their claims globally, a process known as 'land-grabbing'. In addition to buying food on the world market, several governments and large companies lease or buy land abroad, and ship the products back home. Advocates of these deals emphasize that poor countries may gain from access to new seeds and advanced farming practices. However, leasing land to financially powerful investors has also sparked conflict in the recent past. In Madagascar, public hostility to a deal that would have leased 1.3 million hectares to a South Korean company – half of the country's arable land – contributed to the overthrowing of the government. While foreign investors mostly secure land to improve food security in their home countries, an increasing number of projects involve growing biomass for fuel production. China has recently succeeded in leasing 2.8 million hectares in the Congo to construct the world's largest palm oil plantation.

Climate change is expected to increase these pressures and further reduce land productivity in many regions (chap. 1 by Brauch/Oswald Spring). The need for climate change adaptation is evident – already today. Most developing countries are located in the lower latitudes, they are dependent on agriculture, they will be strongly affected by climate impacts, and they have lower adaptive capacity (chap. 49 by Adeel; chap. 50 by Galil Hussein; chap. 51 by Arredondo/Huber-Sannwald; chap. 63 by Bikienga). People migrate from degraded to more fertile areas, from the countryside to cities, from regions that cannot provide sufficient resources to sustain people's livelihoods to more fortunate places. The war in Sudan, for example, has partly been blamed on the competition for water supplies and grazing lands. About 155 million people worldwide are known to be currently displaced by environmental conflicts and natural disasters (chap. 40 Guha-Sapir/Vos). This number could significantly grow under climate change as more people are expected to be affected by water shortages, sea level rise, deteriorating pasture land, and crop shortage.

Negative climate impacts on agriculture may be reduced through a range of adaptation measures. Adjustments in production technology and soil management, crop insurance schemes, modified agricultural policies, and diversified international trade flows can improve regional food availability and security of farm incomes. Creating more options for climate change adaptation and improving the adaptive capacity in the agricultural sector will be crucial for improving food security and rural development, and for preventing an increase in global inequality in living standards in the future (chap. 48 by Safriel; chap. 54 by García Lorca). However, at present, these improvements are often blocked by the lack of information, financial resources and good governance in the developing world.

The Earth's Carrying Capacity Conundrum

Mismatches between the demand and supply of land and its services already exist today. They could increase in the future not only due to climate change but also due to human population growth. Until the year 2100, human population is projected by the UN to grow up to 9–12 billion people, while already today about 1 billion people are undernourished. Changing lifestyles will further accelerate demand growth as people start to consume more goods that are produced with large amounts of energy, land, and water (such as meat) as soon as they can afford it.

The increasing competition for land and water resources between production sectors, ecosystem services, and regions raises the question of the Earth's carrying capacity for humans.[1] The first known attempt to answer the question of how many people the Earth can support was undertaken in the late 17th century. By extrapolating the population density of the Netherlands at that time to the global scale, Antonie van Leeuwenhoek in 1679 calculated a maximum human population of 13.4 billion people, which is astonishingly close to current UN projections of maximum world population.

Estimates of the human carrying capacities since then have varied substantially in a range of below 1 billion to more than 1 trillion people. Magnitudes reflect surprisingly well optimistic or pessimistic contemporary beliefs on the pace of technological progress and future development of energy supply. The broad range of possible lifestyles and accompanying usage

1 Ecologists define 'carrying capacity' as the population of a given species that can be supported indefinitely in a defined habitat without permanently damaging the ecosystem upon which it is dependent.

patterns of energy, land, and water complicate a direct assessment of the human carrying capacity. Estimating the human carrying capacity in any serious manner therefore requires first of all answers to a set of crucial sub-questions:

- Solar energy is theoretically infinitely abundant and could be harvested to fulfil all global energy needs. However, is it feasible given the current state of technology?
- It has been shown during the past 'Green Revolution' that agricultural productivity can be increased by 2 per cent per year for some time, but can this be sustained for another half a century into the future?
- How much land will be available for food production, while other land-use types for forestry, energy, infrastructure and settlements, and nature conservation also have to be taken into account?
- Agriculture accounts for 70 per cent of global freshwater use. How can agricultural water use be reduced in the future, in order to meet increasing demands from households and industry?

Defining a realistic set of assumptions on limits to technological change, energy generation, and the availability of land and water is a most difficult task. Consequently, it is more promising to undertake the *inverse* exercise and, instead of aiming at an estimate of the human carrying capacity, to ask the question: How much land, water, agricultural productivity increase, and financial resources are required to feed 9–12 billion people in a sustainable manner, i.e. without exhausting the planetary regeneration capacities?

With the given competition for the scarce resources of fertile land and water, higher production on currently used areas is a necessity. Assessments show, however, that average productivity of current cropland needs to be increased by 70 per cent by 2050 if only population growth and changing diets with rising income are considered. If further climate change impacts and increasing demand for bioenergy are taken into account, agricultural productivity may need to be increased by 150 per cent by 2050. This would be equivalent to an average annual growth rate of 2.3 per cent in land productivity over the next 40 years.

The historic development of agricultural productivity puts this challenge into perspective: The overall increase over the period 1961–2005 was approximately 1.4 per cent per year. These growth rates could be achieved because of large-scale application of artificially synthesized nitrogen (Haber-Bosch process) and chemical pest control, but also improvements in cropping methods, mechanization, and breeding. These technological advances allowed for agricultural production to keep pace with past population growth and diet changes, including rising consumption of animal products, which require higher inputs of nitrogen, water, and land per calorie produced than vegetal products. It is, however, questionable whether technological innovation and further intensification of agriculture will bring about the productivity rise needed to feed 9–12 billion people on a planet suffering from climate change and land degradation.

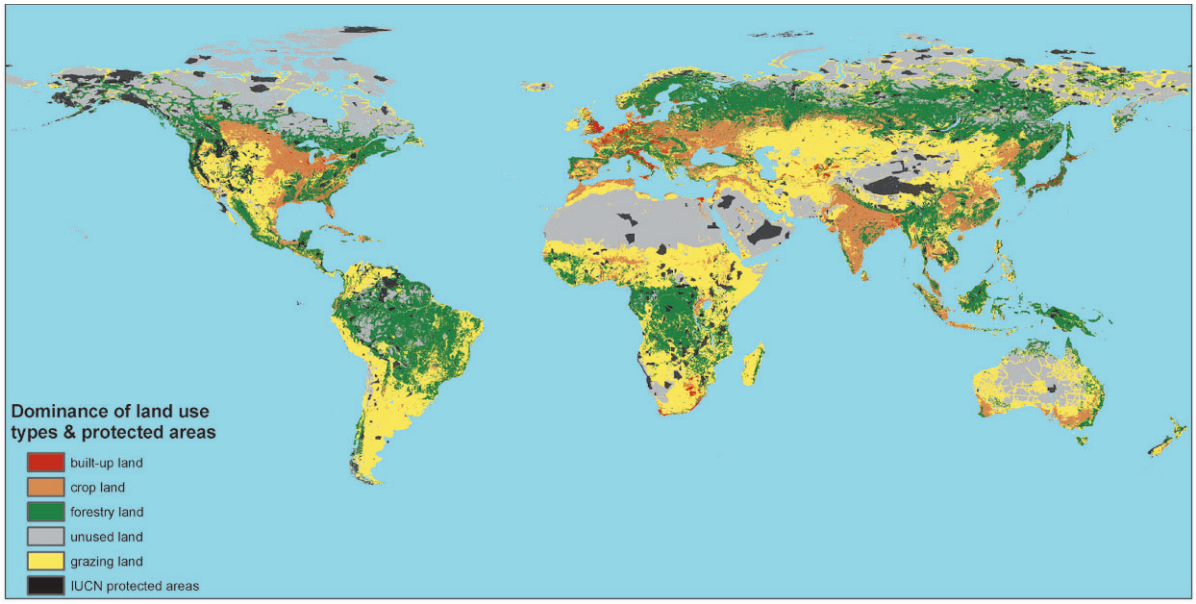
Water scarcity may be technically overcome by improved desalination. However, this depends on the availability of clean energy as well as on future cost reductions for desalination technologies. Aquaculture has the potential to provide an increasing share of world food supplies, but it is not without its own sustainability challenges regarding feed and nutrient management. In other words: It seems unlikely that improved management and technological change alone will suffice to counterbalance the increasing pressure on land and water resources.

The Great Land-use Transformation

Climate change and the scarcity of land and water resources are global-scale challenges to humankind and therefore require global-scale transformations in the energy and food systems. However, initiating and managing major socio-economic transitions is often impeded by path dependencies – or so-called "QWERTY phenomena": Q-W-E-R-T-Y are the first six letters on the upper left part of an English typing keyboard. As a matter of fact, this arrangement of symbols has become an iconic constituent of our technical culture. Interestingly, the arrangement of letters on modern computer keyboards is by no means optimized with respect to the frequencies of use defined by the language. Instead, the key configuration probably originates from some mechanical requirements for the first typewriters built in the 19th century. Similarly, societal processes are often locked, through historic pathways, into certain patterns, which are defined by past knowledge and technologies and which can only be changed through major investments and/or behavioural changes. New and potentially radical ideas and actions are needed to overcome these lock-in phenomena.

Current land-use patterns have developed over hundreds of years, largely reflecting heterogeneous

Figure PE 5.1: Global map showing current dominant land-use types: agriculture (including cropland, managed pasture land and rangeland), forestry, infrastructure and settlement, unused land, and nature conservation (protected areas as listed by the International Union for the Conservation of Nature, IUCN). Areas that are used for renewable energy generation are either included in the cropland category (in the case of bioenergy) or are not represented in the map (in the case of e.g. solar thermal power in the deserts and onshore/offshore wind energy production). **Source:** Data sets on global land-use types, i.e. built-up land, cropland, forestry land, unused land, and grazing land were provided by Erb, Gaube, Krausmann, Plutzar, Bondeau and Haberl (2007).[a]

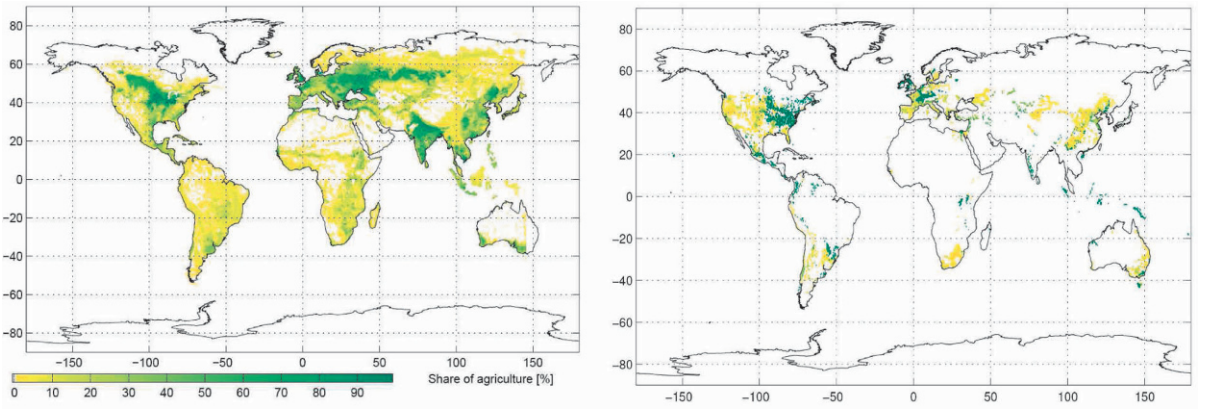


a. Currently protected areas and restricted management areas were captured by overlaying data sets on IUCN protected areas category I to VI, i.e. nature reserves and wilderness areas, national parks, natural monuments, habitat/species management areas, protected landscapes, and protected areas sustainable use of natural resources (UNEP-WCMC 2007). Data sets were integrated at a spatial resolution of 5 arc minutes, i.e. 8.3 km times 8.3 km at the equator. By rule, the land-use type bearing the maximum fraction per grid cell was defined as dominant. Built-up land which covers 10 per cent of the grid cell at a minimum was intuitively added in order to emphasize the presence of rural and urban built-up areas, industrial and transport facilities, as well as other urban areas. The IUCN protected area cover entered as a separate layer independent of the underlying land-use types. The map was produced by means of ArcGIS v. 9.2 and R v. 2.8.1.

distribution and growth of population density and productivity of the land. From a local perspective, land-use patterns have been well adapted and optimized given local resource and market conditions and constraints. However, the globalization of trade has made some parts of these local multi-purpose land-use mosaics obsolete. About 10 per cent of the total raw production of food, fibre, and forest products is traded around the world, and a much higher percentage could be allocated reasonably by the global market. Still, land-use patterns determined by history are largely persistent. This lock-in situation can be partly explained by transportation costs and the inertia of land-use patterns due to large investments required for land conversion. However, another factor is societies' and countries' desire to remain largely autonomous with respect to their most fundamental resources: food and water.

If humankind wants to manage the climate change challenge through a cooperative global strategy, such heterogeneous land-use patterns for agriculture, forestry, energy, infrastructure, and nature conservation (figure 1) may have to be questioned. If productivity cannot be increased to similar levels across the globe, due to a variety of bio-physical, social, institutional, and economic reasons, a larger share of production may have to be concentrated in the most productive areas instead. Studies show that optimal spatial allocation and specialization can, in theory, strongly reduce the area needed for agricultural production, literally leaving room for other purposes such as bioenergy production, afforestation for carbon storage, or nature conservation (figure 2).

Figure PE 5.2: Observed global agricultural land-use pattern of 1995 (left panel) versus globally optimized pattern that would allow feeding 12 billion people with 1995 dietary habits (right panel). Agricultural areas shown in right panel correspond to roughly one third of the area currently used for crop growing. **Source:** Figures were taken without modifications from Müller, Bondeau, Lotze-Campen, Cramer and Lucht (2006).[a]



a. Details on data used, underlying assumptions and optimization algorithm can be found in the publication.

The world's regions have heterogeneous potentials and different land-use categories also have very heterogeneous demands. Climate change will certainly require reallocating some of the land-use types on the planetary map simply for ensuring their functionality. There is an ongoing debate about advantages and disadvantages of segregating versus integrating nature conservation and agricultural production at the local scale. But the climate change challenge requires lifting this discussion also to the global scale. In the future, specific migration corridors may be needed which allow species to move with changing climate patterns. Agricultural areas will be abandoned if they are degraded or fall dry. Settlements may also have to be moved if droughts, heat waves, hurricanes, and floods occur more frequently, or if sea level rise threatens to inundate them.

As global land-use patterns will have to adapt to climate change, the potential for optimizing these patterns by matching the different land-use categories to the needs of heterogeneous potentials have to be considered. There are and will be regions that are especially appropriate for certain land-use types, e.g. because of their favourable climatic conditions or fertile soils. Urban areas, for example, often spread on fertile land even though they do not require them, outcompeting agricultural or forestry systems that do depend on fertile soils. The Sahara region, on the other hand, is of little use for agriculture, but is suitable for solar power harvesting, potentially combined with desalination of water along the coastlines. This, however, requires large investments to install the infrastructure for power generation and for electricity transport to the regions with high energy demand – such as Europe. Joint international efforts, like the recently launched DESERTEC project, could lead the way to the benefit of all. In the interest of climate mitigation, adaptation, and development, international efforts are needed to harmonize the spatial patterns of land use with the spatial patterns of potentials, beyond national boundaries and interests.

Global Agricultural Commons: A Proposal

'Global Agricultural Commons' may provide a way to overcome the inefficient use of land resources. Under such a scheme the most fertile areas of the planet would be declared a global public good (albeit still part of the national territories) and reserved for agricultural production. Wealthier regions increasingly expect countries like Brazil, Indonesia, and the Congo to refrain from large-scale deforestation or timber harvest and protect the global public goods and services that tropical rainforests provide to humankind. Could these countries in return expect other countries to put their productive agricultural systems to the most valuable and yet sustainable use to feed the world? Declaring the fertile soils of the Earth a common agricultural good would help to frame the supranational obligation to use them efficiently and sustainably.

The idea of conserving areas of international interest is not new: the UNESCO's 'Convention concerning the Protection of the World Cultural and Natural Heritage' and its *International Union for Nature*

Conservation (IUCN) already provide frameworks for the protection of areas of universal value. Intensive but sustainable exploitation of the agricultural production potential is, however, not yet considered a value that deserves internationally coordinated protection.

There are of course several restrictions to the idea of globally optimized land-use patterns and agricultural commons. First of all, the ecological side effects will have to be carefully evaluated. Land conversion often triggers undesired secondary effects, such as carbon emissions, degradation, or increased vulnerability to climate variability. Intensive agricultural management often comprises non-sustainable treatment of soils and water as well as spillover of nutrients and pesticides to neighbouring ecosystems and also causes emissions of nitrous oxide and methane, both being very potent greenhouse gases. These systems have high energy requirements for providing production inputs, like fertilizers, pesticides, and machinery. An optimized global land-use pattern will require more trade and transportation between the producing and the consuming regions.

There are, certainly, also many political obstacles, the most important being the lack of international trust. The supply of fundamental resources to sustain human livelihoods, like water, food, and energy, is usually considered a question of national autonomy. Not surprisingly, the most protectionist policies are prevalent in the agricultural and energy sectors. Relying on international trade for providing a larger share of domestic food supplies would require the development of strong and competitive non-agricultural sectors, which is an obstacle for many food-insecure countries.

Yet, in a world that faces the risk of dangerous climate change and the enormous challenge to guarantee a decent life for 9–12 billion people these political obstacles may have to be overcome. Planet Earth, a number of degrees Celsius warmer than today, is unlikely – if not by all means incapable – of carrying such a big human population. Rising up to the double challenge of climate change and population growth seems impossible without calling into question the current land-use pattern, which has emerged from a history that was more or less blind to considerations of global sustainability.

Part I Introduction: Concepts of Security Threats, Challenges, Vulnerabilities and Risks

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Hans Günter Brauch and Úrsula Oswald Spring

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1 Introduction: Coping with Global Environmental Change in the Anthropocene

Hans Günter Brauch and Úrsula Oswald Spring

1.1 Introduction and Objectives of the Book

This third volume of the *Global Environmental and Human Security Handbook for the Anthropocene* (GEHSHA) focuses on issues of *Coping with Global Environmental Change* that are contributing to a *reconceptualization of security* in the 21st century that has evolved since the end of the Cold War and has significantly been influenced by the globalization process.

1.1.1 Contextual Change from the Holocene to the Anthropocene

While the end of the Cold War marked the first peaceful global transition of the structure, strategies and policies of international politics since the French Revolution (1789) and the Congress of Vienna (1815) and of the Westphalian sovereignty-based system of nation states, the transition from the Holocene period of Earth history to the 'Anthropocene' is more profound (preface essay by Crutzen). The Holocene started with the end of the glacial period about 12,000 years ago what marked the onset of major human progress and the development of high civilizations in the Mediterranean, in China, India and in Mesoamerica. In earth and human history a fundamental change has occurred since the Industrial Revolution (1750) from the '*Holocene*' to the '*Anthropocene*' due to increasing human interventions, especially through the burning of fossil energy that has resulted in an anthropogenic period of climate change. The 'Anthropocene' concept was introduced by Crutzen (2002) as "a new geologic epoch in which [hu]mankind has emerged as a globally significant – and potentially intelligent – force capable of reshaping the face of the planet" (Clark/Crutzen/Schellnhuber 2004: 1; Ehlers/Krafft 2006; Ehlers 2008).

The 'Holocene' is a period of geological transition with a dramatic environmental change with a major sea-level rise due to the melting of the huge ice sheets that covered large areas in the northern hemisphere. Bond, Kromer, Beer, Nuscheler, Evans, Showers, Hoffmann, Lotti-Bond, Hajdas and Bonani (2001) postulated a 1,500 year cycle throughout the Holocene with an important contrast in hydrological circulation patterns. These changes in climate had a major influence on the development and collapse of high civilizations (Fagan 2004; Diamond 2005; Bluemel 2009: 104). The Roman Empire coincided with the 'Roman optimum' while its collapse occurred during a cooler period when massive people's migration occurred from Central Asia to Europe and from Northern Europe to the Mediterranean (Issar/Zohar 2004: 14, 2007: 12; 2009: 125). The second climatic downturn led to the "little ice age" (Fagan 2000, 2002) that coincided with bad harvests, famines, pandemics (pest), and the Thirty Years War (1618–1648).

The role of climate for the decline and fall of civilizations has been disputed between climate determinists and climate sceptics (Brown 2001). Since the 1930's the anthropogenic model placed all blame on human malpractice (Issar/Zohar 2003, 2007). The neo-deterministic paradigm "emphasizes the dynamic interaction between the natural environment ... and the human society" (Issar/Zohar 2009: 110–120). Many neo-determinists have argued that during the Holocene cold periods, precipitation changes and long periods of drought triggered massive people's movements.[1] Due to natural climate variability, longer periods of drought and famine resulted in the sudden collapse of several high civilizations (Diamond 2005).[2]

1 For an overview on the old people's migration see: Curta (2001), Heather (1998), Kulikowski (2007), Todd (1996), Noble and Goffart (2006), Fouracre (2005) and Halsall (2007).

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Since the late 19th century several authors have referred to the human intervention into nature (Marsh 1864, 1965; Stoppani 1873; Vernadsky 1926, 1998) and the earth system that were facilitated by major population growth (Malthus 1798; preface essay by Zlotnik) due to technological and medical advances and the availability of cheap fossil energy sources (Mc Neill 2000, 2009). Crutzen (2006: 13–17) pointed to the chemical impacts of human activities during the Anthropocene resulting in increasing air pollution, acidification of precipitation, major changes in land-use.[3] Crutzen (2006: 16) concluded that the "still growing impacts of human activities on earth and atmosphere" make it "appropriate to emphasize the central role of [hu]mankind in geology and ecology by using the term 'Anthropocene' for the current ecological epoch".

In response to the gradual understanding of the anthropogenic contribution to *global environmental change* (GEC) and climate change in the Anthropocene the 'sustainable development' (Brundtland 1987) concept was adopted in Rio de Janeiro (1992) at the *United Nations Conference on the Environment and Development* (UNCED) and became a key policy goal of UN Secretary-General Kofi Annan's *Millennium Report* (2000), and at the *World Summit on Sustainable Development* (WSSD) in Johannesburg (2002) where "the need for harnessing science and technology in support of efforts to achieve the goal of environmentally sustainable human development in the Anthropocene was generally recognized" (Clark/Crutzen/Schellnhuber 2004: 3).

Crutzen (2006: 17) argues that as humankind "will remain a major geological force for many millennia" it is necessary "to develop a world-wide accepted strategy leading to sustainability of ecosystems against human induced stresses" what will be "one of the greatest tasks of [hu]mankind, requiring intensive research efforts and wise application of the knowledge".

This fundamental change in earth and human history provides the third causal chain for a reconceptualization of the security. The societal and political impacts of this far more severe global change than the end of the Cold War is gradually being understood by policy-makers and international relations and security specialists who have launched a process of the securitization of the causes, effects, impacts and societal outcomes of global environmental change (Brauch 2009_4; Brauch/Oswald Spring 2009; Oswald Spring/Brauch 2009, 2009a).

During the 21st century, the causal relationship between the causes and severe societal outcomes of GEC and climate change may result in environmentally-induced massive and forced people's movements, hunger- and famine-induced protests and small-scale societal violence, and possibly also in violent conflicts within and between countries that may pose multiple security dangers that have increasingly been addressed by governments and international organizations. The causal linkages and possible extreme and sometimes fatal societal outcomes have been discussed from four perspectives:

1. *Determinists* have claimed that climate change will lead to wars during the twenty-first century. This argument has been made by scientists (e.g. Welzer 2008; Leggewie/Welzer 2009; Lee 2009), humanitarian organizations, and NGOs and a few governments.
2. *Empiricists* have stressed (Dalby/Brauch/Oswald 2009; Oswald/Brauch/Dalby, 2009) that environmental stress and climate change have contributed to forced migration and small scale violence (Kahl 2003, 2006). They analysed the securitization of climate change impacts (Brauch 2009; Scheffran 2010, chap. 42; Scheffran/Brozska/Brauch/Link/Schilling forthcoming) and reviewed conflict constellations triggered by climate change (WBGU 2008).
3. *Sceptics* have pointed to a lack of evidence in the peer-reviewed, quantitative literature on the linkage between climate change and wars (Gleditsch/Nordas 2009; Breitmeir 2009).
4 *Deniers* have challenged both the anthropogenic climate change (Lomborg [2]2009, 2004) and the linkages between climate change and possible conflicts posing security threats. For different reasons many governments expressed this view within the UN context.

2 The urban Late Uruk society in Mesopotamia that suddenly collapsed at about 5200–5000 BP due to a short but severe drought (Weiss/Bradley 2001). The collapse of the Mycenaean Kingdom, the Hittite Empire in Anatolia and of the Egyptian Empire (3206–3150 BP) were due to a persisting drought (Drew 1977; Weiss 1982). Between 810 and 910 AD, several mega-droughts occurred in the Yucatán Peninsula and in the Petén Basin that resulted in land degradation (Coe 1999: 26–27; Braswell 1990) and the collapse of the Mayan civilization (Demarest 2004; Sabloff 1990; Gill 2000). In China, the decline of the Tang (850–940), the Yuan (1340–1360); and late Ming period (1580–1640) were all related to a reduction of the monsoon and to severe droughts.

3 Vitousek/Dantonio/Loope/Westbrooks 1996; preface essay by Müller/Lotze-Campen/Huber/Popp/Svirejeva-Hopkins/Krause/Schellnhuber

While future climatic scenarios can be simulated and socio-economic trends can be projected, specific events (Gaddis 1992–1993), such as climate conflicts and wars as the outcome of decisions of future policy-makers cannot be predicted, rather several 'conflict constellations' can be foreseen (WBGU 2007, 2008; Bauer 2009, chap. 41) that may possibly escalate into violence.

1.1.2 Structure of the Environmental Security Handbook

A key goal of this multidisciplinary and international '*Global Environmental and Human Security Handbook for the Anthropocene*' (GEHSHA) is to conceptually map the manifold reconceptualizations of security that have been observed, analysed, assessed and interpreted by scientists from different disciplines primarily since 1990.

While many dangers that were influenced or triggered by the human-nature interface have affected humankind for millennia, only during the past two decades have they been socially constructed as posing severe security dangers and concerns for the livelihoods and survival of billions of people and, if business as usual trends continue unabated, in the very worst case even for the human species. Since 2007 they have increasingly emerged in the social discourse as new security concerns that may pose multiple soft security issues during the 21st century.

While the impacts of a large nuclear war or the result of a possible 'nuclear winter' (Crutzen/Birks 1982; Turco/Toon/Ackerman/Pollack/Sagan 1983; Robock/Oman/Stenchikov 2007) have been discussed by natural scientists and strategic security analysts during the Cold War as major threats to the lives of millions of people, the new security threats posed by GEC are fundamentally different. These threats are not posed by 'them', the other social system, the competing military alliance or political and economic bloc, nor is it posed by an 'axis of evil' and by 'rogue states', but by us, by our lifestyle, especially by the adored and imitated 'American way of life' of consumerism – that has since World War II been pursued as a goal by the middle and upper classes around the globe – without taking the environmental externalities into account. If 'we' are the threat causing the multiple global environmental changes, then the military strategies, policies and means based on the mindsets of the Cold War have become totally obsolete for coping with this new threat in the Anthropocene.

Of the two previous volumes of the GEHSHA the first on *Globalization and Environmental Challenges* analysed the conceptual response primarily to the first two causes of the end of the Cold War and of globalization, while the second on *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* reviewed the third cause and several of the new sectoral security concepts that have been used by international organizations to legitimate their activities in terms of different referents, i.e. of human, national and international security. This third volume on *Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks* moves a step further by addressing strategies, policies and measures, as well as goals and means for dealing with these manifold new security 'threats, challenges, vulnerabilities and risks' (chap. 2 by Brauch) in a proactive manner what requires forward-looking and policy-relevant research, anticipatory learning and policy-makers with a vision, a sense of responsibility and courage to implement many of the unpopular measures that challenge fundamental features of our lifestyles and ways of life.

These three volumes of the GEHSHA aim to achieve these three scientific goals: a) to map the *North-South scientific debate* on *reconceptualizing security*; b) to document a *multidisciplinary debate* and learning; and c) to offer a *dialogue between academia and policy-makers* in international organizations, national governments and *between academia and* non-governmental actors in civil society and in social movements on security concepts. These three volumes focus on the conceptual thinking on a wide notion of security in all parts of the world that has often been used to legitimate the allocation of public and private resources and to justify the use of force both to 'protect' and to 'kill' people in the realization of a major value.

1.1.3 Three Stages of Addressing Global Environmental Change

Three stages of addressing *Global Environmental Change* (GEC) can be distinguished:

1. The emergence as a new interdisciplinary scientific field of study since the 1970's and 1980's that has focused on climate change, desertification, water and biodiversity. Since the 1990's global change scientific networks, programmes (IGBP, IHDP, DIVERSITAS, WCRP), and projects as well as policy-focused scientific "epistemic communi-

ties" (Haas 1989, 1990, 1992, 1993) as the IPCC (Bolin 2007) have evolved that assess and interpret scientific research results, and explain them to the global policy community and via the media to a global attentive public (*scientific agenda setting* or *scientization*).

2. The development of a new major policy field of international (environment) policy since the Earth Summit in Rio de Janeiro in 1992 has resulted in new forms of international governance (climate change, biodiversity, desertification, water regimes) that have moved to the centre of political concerns (*politicization)*[4] through major global governmental conferences in the framework of the annual *conference of parties* (COPs) of UNFCCC,[5] CBD,[6] UNCCD,[7] and the triennial World Water Fora.[8]

3 Since the early 21st century this process of *politicization* has been complemented by a process of declaring selected global challenges (especially climate change) as political issues of 'utmost importance' that 'require extraordinary means' (Wæver 1995, 2008), and by addressing these global dangers and concerns as key security issues (*securitization*).

The year 2007 has been a turning point in this process of *securitization* of questions of global environmental change, and especially of climate change (Brauch 2009a) when the highest national policy-makers (G-8, European Council) and high-level fora (UN Security Council) and officials of international organizations (UN Secretary-General 2009) addressed global warming (in relationship with desertification and water scarcity) as key political and security issues that may lead to internal displacements, forced distress migration, as well as crises and conflicts. This emerging *securitization* of GEC focuses on the environmental dimension of security and on the complex interaction between human beings and humankind as causes, triggers, and victims of the societal consequences of this process.

On 11 June 2009, the UN General Assembly adopted the first resolution on "Climate change and its possible security implications" (A63/281) that invited the organs of the UN "to intensify their efforts in considering and addressing climate change, including its possible security implications" requesting "the Secretary-General to submit a comprehensive report ... on the possible security implications of climate change". In his report (A/64/350 of 11 September 2009) Secretary-General Ban-Ki Moon identified five channels through which climate change could affect security:

a) *Vulnerability*: Climate change threatens food security and human health, and increases human exposure to extreme events.
b) *Development*: If climate change results in slowing down or reversing the development process, this will exacerbate vulnerability and could undermine the capacity of states to maintain stability.
c) *Coping and security*: Migration, competition over natural resources and other coping responses of households and communities faced with climate-related threats could increase the risk of domestic conflict as well as have international repercussions.
d) *Statelessness*: There are implications for rights, security, and sovereignty of the loss of statehood because of the disappearance of territory.
e.) *International conflict*: There may be implications for international cooperation from climate change's impact on shared or undemarcated international resources (A/64/350: 1).[9]

4 An extensive scientific and political literature is available on these issues that have contributed to the process of politicization especially of climate change issues (Dessler/Parson 2006, 2008).

5 The *UN Framework Convention on Climate Change* (UNFCCC) was signed in 1992 at the Earth Summit and entered into force on 21 March 1994; its Kyoto Protocol (1997) entered into force on 16 February 2005 with the ratification by Russia and it will expire in 2012. Until April 2008 the USA and Turkey did not ratify the Kyoto Protocol. See the documentation at: <http://unfccc.int/essential_background/items/2877.php>.

6 The *Convention on Biological Diversity* (CBD) was signed in 1992 at the Earth Summit and until April 2008 it was ratified by 187 countries. Its Cartagena Protocol on Biosafety was adopted in 2000 and entered into force in 2003, and by April 2008 147 countries had deposited their ratification. The USA did so far neither sign nor ratify this protocol. See the documentation at: <http://www.cbd.int/>.

7 The UNCCD was signed in 1994 and entered into force on 26 December 1996. As of March 2002 over 179 countries were parties. See the documentation at: <http://www.unccd.int/>.

8 The first five world water fora occurred in Marrakesh (I: 1997), The Hague (II: 2000), Kyoto (III: 2003), Mexico City (IV: 2006) and Istanbul (V: 2009); the sixth is scheduled for 2012 in Marseilles.

9 See at: <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N09/509/46/PDF/N0950946.pdf?OpenElement>.

The report points to views interpreting climate change as a 'threat multiplier' and identifies several 'threat minimizers', such as "conditions or actions that are desirable in their own right but also help lower the risk of climate-related insecurity", which "include climate mitigation and adaptation, economic development, democratic governance and strong local and national institutions, international cooperation, preventive diplomacy and mediation, timely availability of information and increased support for research and analysis to improve the understanding of linkages between climate change and security". With the goal "to bolster these threat minimizers", the report also "identifies a set of emerging climate change related threats ... that appear highly likely, are large in magnitude, may unfold relatively swiftly, and are unprecedented in nature, including: loss of territory, statelessness and increased numbers of displaced persons; stress on shared international water resources, e.g. with the melting of glaciers; and disputes surrounding the opening of the Arctic region to resource exploitation and trade".

The report which focuses on "the mutual interdependence between the security of individuals and communities and the security of nation states" is based on the response of governments and regional organizations[10] and a literature review that distinguishes among five groups of threats to a) human well-being, b) to economic development, c) from uncoordinated coping, d) of loss of territory and statelessness, and e) to international cooperation in managing shared resources. A UNEP study (2007)[11] emphasized "that the potential consequences of climate change for water availability, food security, prevalence of disease, coastal boundaries, and population distribution may aggravate existing tensions and generate new conflicts" (cited in UN-SG, A/64/350: 20).

With regard to responding and preventing climate change-induced emerging security threats the report referred to the following policy responses: a) mitigation, b) adaptation, c) economic growth and sustainable development, d) effective governance mechanisms and institutions, e) information for decision-making and risk management, and f) reinforcing international cooperation. The report pointed also to the need for the international capacity "to anticipate and prepare itself to address a number of largely unprecedented challenges posed by climate change for which existing mechanisms may be inadequate", by pointing specifically to climate-induced displaced persons and migrants, to the "statelessness of citizens of submerged island nations", water-scarcity and the increased competition "over newly accessible Arctic natural resources and trade routes". Among the states' responses only those of the present two major contributors, of the United States and the People's Republic of China, as well as the primary victims, the small islands developing countries, will be briefly referred to.

While the previous US administration of George W. Bush (2001–2009) doubted the existence of an anthropogenic climate change, this position changed prior to the Obama Administration when the U.S. National Intelligence Estimate on Security and Climate Change (2008)[12] claimed "that no country will be immune to the effects of climate change" and that most "developing states that will potentially suffer from adverse impacts to economic security are in Sub-Saharan Africa, the Middle East, and Central and Southeast Asia", and that the possible "spillover – from potentially increased migration and water-related disputes – could have a harmful global impact".[13] In 2008, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council of the United States, summarized the key findings of the secret report

> We judge global climate change will have wide-ranging implications for US national security interests over the next 20 years. Although the United States will be less affected and is better equipped than most nations to deal with climate change, and may even see a benefit owing to increases in agriculture productivity, infrastructure repair and replacement will be costly. We judge that the most significant impact for the United States will be indirect and result from climate-driven effects on many other countries and their potential to seriously affect US national security interests. We assess that climate change alone is unlikely to trigger state failure in any state out to 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions. Climate change could threaten domestic stability in some states, potentially contributing to intra- or, less likely, interstate conflict, particularly over access to increasingly scarce water resources. We judge that economic migrants will perceive additional reasons to

10 See the statements by Argentina, Bahamas, Bangladesh, Brazil, China, Finland, Guatemala, Iceland, Indonesia, Italy, Kiribati, Maldives, Marshall Islands, Mexico, Micronesia, Monaco, Nauru, New Zealand, Oman, Pakistan, Palau, Panama, Seychelles, Solomon Islands, Tuvalu, USA, European Union and the Pacific Small Island Developing States; at: <http://www.un.org/esa/dsd/resources/res_docugaecos_64.shtml>.

11 UNEP, 2007: Sudan: *Post-Conflict Environmental Assessment* (Geneva: UNEP).

> migrate because of harsh climates, both within nations and from disadvantaged to richer countries.

The US submission to the above report of the UNSG (A/64/350) pointed to many security dangers due to i) agricultural production at risk, and ii) international migration that will also have severe implications for the US due to an increase of humanitarian emergencies. The US report specifically pointed to a lack of resolution to analyse the security implications at the country level and it pointed to a need for "better information on physical, agricultural, economic, social, and political impacts from climate change at country and regional levels", what may "also facilitate adaptation efforts". It argued that

> the security elements of climate change are best understood and addressed in the context of pre-existing social, political, and environmental conditions. ... Additional analysis is required to determine the world-wide potential vulnerability to storm tracks and severe weather. ... In addition, detailed agriculture vulnerability should be studied; this would include anticipated changes in temperature, precipitation levels and patterns (US-CCIS 2009: 8–9).[14]

The most recent issue of the CIA's: *Global Trends 2025: A Transformed World* (20 November 2008) argued that "Climate Change is expected to exacerbate resource scarcity" (NIC 2008: viii) and in one of its four scenarios on *October Surprise* it illustrated the potential impact of inattention to climate change (NIC 2008: 57–59). This report concluded on climate change:

> *Climate change* is unlikely to trigger interstate war, but it could lead to increasingly heated interstate recriminations and possibly to low-level armed conflicts. With water becoming scarcer in several regions, cooperation over changing water resources is likely to be increasingly difficult within and between states, straining regional relations. Such regions include the Himalayan region, which feeds the major rivers of China, Pakistan, India, and Bangladesh; Israel-Palestinian Territories; along the Jordan River (Israel-Jordan) and the Fergana Valley of Central Asia. Such dire scenarios are not inevitable even with worse-than-anticipated climate change impacts, however. Economic development, the spread of new technologies, and robust new mechanisms for multilateral cooperation to deal with climate change may foster greater global collaboration (NIC 2008: 66, 68).

In contrast, the *People's Republic of China* (PRC) referred to the fundamental differences between climate change and security, treating climate change as an issue of sustainable development where developed countries should take the primary responsibility while developing countries "should improve their capacity to address climate change", and address it in the "framework of sustainable development".[15] However, this claim ignores that the PRC has in 2007/2008

12 United States House Permanent Select Committee Intelligence, House Select Committee on Energy Independence and Global Warming, 25 June 2008; National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030 Statement for the Record of Dr. Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council of the United States; see at: <http://www.dni.gov/testimonies/20080625_testimony.pdf>. While this report is 'secret', Mr. Fingar described the process as follows: "We began our effort following a National Intelligence Priorities Framework review in 2006. ... Following draft Congressional language in the spring of 2007, we elevated the level of our effort to a *National Intelligence Assessment* (NIA), developed terms of reference, and initiated the study (emphasis added, the authors)." He noted the "fundamentally different kind of analytical methodology" and that the NIC "depended upon open sources and greatly leveraged outside expertise. Since the Intelligence Community does not conduct climate research, we began our effort by looking for other US government entities that were experts in this area". Its primary sources was the IPCC's (2007, 2007a, 2007b, 2007c) Fourth Assessment Report and "other peer-reviewed analyses and contracted research". Its referent object was a broad definition of US national security, especially its impacts on "US homeland, a US economic partner, or a US ally. We also focused on the potential for humanitarian disaster, such that the response would consume US resources. We then considered if the result would degrade or enhance one of the elements of national power (Geopolitical, Military, Economic, or Social Cohesion), and if the degradation or enhancement, even if temporary, would be significant. In the end, we reported on key effects that we judged would meet this threshold."

13 After the publication in 2008 of the National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030 the US *National Intelligence Council* (NIC) explored in greater detail the national security implications of climate change in six countries or regions of the world: India, China, Russia, North Africa, Mexico and the Caribbean, and Southeast Asia and the Pacific Island States. On each of these six countries or regions detailed research and conference reports have been published. All these reports may be accessed at: <http://www.dni.gov/nic/special_climate 2030.html>.

14 US Department of State, 2009: "Submission of the United States of America on the Security Implications of Climate Change"; at: <http://www.un.org/esa/dsd/resources/res_docugaecos_64.shtml>.

overtaken the USA as the major producer of CO_2, even though its per capita contribution to global warning is still less than ¼ of each American consumer.

In contrast, in their submission the *Pacific Small Island Developing States* (PSIDS) pointed to the biophysical factors (rising sea levels, changing weather patterns and natural disasters, soil erosion, loss of coral reefs) that could have security implications for food (fisheries, agriculture) and water security, public health, physical and social infrastructure, the loss of lives and livelihoods, migration (internal, external), loss of islands, territorial integrity, sovereignty, legal rights, conflict and unrest, as well as for socio-cultural impacts. The PSDIS concluded that the above factors

> either already have security implications or are likely to become threats to national security as well as to international peace and security. ... While the[se] factors ... can cause conflict directly, the combination of the threats stemming from climate change impacts ... will create risks to national and regional security as well as to international peace and security. ... Climate change ... has the potential to cause multiple problems simultaneously and erode already fragile conditions. ... The combination of increased disease ... and migration will continue to escalate into humanitarian crises that will strain government resources around the globe and especially within the Pacific. In the Solomon Islands, the combination of various adverse impacts of climate change led to armed conflict. ... These elements all lead to increased humanitarian crises.[16]

The PSIDS see the effects of climate change as a direct threat to their national security and survival. In their assessment "the security threats posed by climate changes are ... no longer a *possibility* but a reality". They call on the UN "to keep track of the growing security implications of climate change", and to consider urgently the "immediate actions which can reduce security implications of climate change, including long-term security issues" (PSIDS 2009: 14).

A study of the European Commission and the Council on "Climate Change and International Security" (14 March 2008) suggested detailed policy recommendations especially for the US, China and India and on the implications of its long-term relations with Russia. The paper recommended regarding an improvement of the analytical capabilities of the EU:

> A first step to address the impact of climate change on international security should be to *build up knowledge and assess the EU's own capacities*, followed by an improvement in the *prevention of, and preparedness for early responses to, disasters and conflicts*. Financial implications for such responses should be identified and also be considered in the EU's budget review.

On the international level the EU plans to take over a multilateral leadership role with regard to furthering climate security.[17] The Report on the "Implementation of the European Security Strategy - Providing Security in a Changing World" of 11 December 2008 noted that the *EU's European Security Strategy - A Secure Europe in a Better World* approved in December 2003: already identified the security implications of climate change.

> Five years on, this has taken on a new urgency. ... Natural disasters, environmental degradation and competition for resources exacerbate conflict, especially in situations of poverty and population growth, with humanitarian, health, political and security consequences, including greater migration. Climate change can also lead to disputes over trade routes, maritime zones and resources previously inaccessible. We have enhanced our conflict prevention and crisis management, but need to improve analysis and early warning capabilities. The EU cannot do this alone. We must step up our work with countries most at risk by strengthening their capacity to cope. International co-operation, with the UN and regional organisations, will be essential.

For the EU Presidency, the Swedish Foreign Ministry submitted many specific proposals for dealing with climate change as a security issue at the UN.[18] At the request of the DG External Relations of the European Commission, as part of the EU Roadmap process on climate change and international security, a survey of studies on the regional security implications of climate change was prepared which summarizes the recommendations on awareness raising, further research, stakeholder dialogue, capacity building, policy priorities, priority regions and international system

15 PR of China, 2009; at: <http://www.un.org/esa/dsd/resources/res_pdfs/ga-64/cc-inputs/China_CCIS.pdf>.

16 PSDIS, 2009: "Fiji, Marshall Islands, Micronesia (Federated States of), Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu: Views on the Possible Security Implications of Climate Change to be included in the report of the Secretary-General to the 64th Session of the United Nations General Assembly": 12; at: <http://www.un.org/esa/dsd/resources/res_pdfs/ga-64/cc-inputs/PSIDS_CCIS.pdf>.

17 For a summary of key proposals see Brauch (2009a: 91–93).

18 On behalf of the EU Presidency, Sweden summarized the EU position and activities; at: <http://www.un.org/esa/dsd/resources/res_pdfs/ga-64/cc-inputs/EU_CCIS.pdf>.

development (Maas/Tänzler 2009). Several regional scenarios focusing on sub-regions in Central America, in Southwest and Southeast Asia as well as in the Indian-Pacific region were completed by December 2009. On 8 December 2009 the Council of the European Union adopted conclusions on "climate change and security" (box 1.1).

Box 1.1: Excerpts from the Council conclusions on climate change and security adopted at its 2985th Foreign Affairs Council meeting, Brussels, 8 December 2009. **Source**: Council of the European Union; Press Release 17218/09 (Presse 371; at: <http://www.consilium. europa.eu/uedocs/cms_data/docs/pressdata/EN/foraff/111833.pdf>.

1. The Council endorsed the *Joint Progress Report and Follow-up Recommendations on Climate Change and International Security* (CCIS) as a follow-up to the Joint Paper in March 2008 ..., the report of the implementation of the *European Security Strategy* (ESS) ..., and the report on the implementation of the Joint Paper presented to the Council in December 2008.
2. The Council stated that climate change and its international security implications are part of EU's wider agenda for climate, energy and the Common Foreign and Security Policy ... This adds an incentive to strengthen EU's comprehensive efforts to reduce emissions and to increase its energy security.
3. The Council underlined the possible international security implications of climate change, and the potential risk for increased natural disasters and conflicts over scarcer resources, its effect on migration and state and regional instability, which will add additional stress on the increasingly interdependent global system and structures. ...
4. The Council concluded that more vulnerable parts of human society in developing countries and emerging economies will be adversely affected, and will need our support, but developed countries will also suffer. Adaptation to climate change, sound policies on displacement, migration and conflict prevention are the most effective ways of dealing with the international security implications of climate change. We will address these issues in a spirit of partnership between developed and developing countries and confirm our commitment to take bold action on climate change mitigation in order to limit temperature increases to below a threshold of 2°C ... An ambitious and comprehensive international agreement (UNFCCC) will be an important factor in preventing and reducing the security implications of climate change.
5. The Council welcomed that the UN has taken a leading role on CCIS demonstrated by the UN General Assembly resolution A/63/281 of June 2009, ... followed by the Secretary-General's report A/64/350 on Climate Change and its possible Security Implications of September which was discussed in the UN General Assembly in November this year. The Council ... looked forward to further debates in the UN Security Council ... The EU stands ready to support this global endeavour. ...
6. The Council noted ... that considerable progress has been made to enhance EU capacities for early warning, analysis and response to climate-induced international security implications and to foster international cooperation with the aim to create dialogue, common awareness, share analysis and cooperatively address the challenges in all relevant existing fora, including the UN.
7. The Council supported the recommendations in the Progress Report; to promote EU multilateral leadership in cooperation with the UN and third parties, reinforce the EU's institutional capacity to deal with CCIS in the implementation of the Lisbon Treaty, include security aspects in climate change in EU development assistance, build knowledge, hone and sharpen the EU's crisis management capabilities relevant to dealing with CCIS and to follow-up the implementation through a report to the Council during the latter part of 2010.

But also other regions, besides the most severely affected *small developing island states* (SIDS) have addressed the security relevance and impacts of climate Change. On 21 February 2010, the Government of Mexico and the Member States of the Caribbean (CARICOM), in a summit at Riviera Maya, Quintana Roo also addressed the danger of climate change in their "Climate Change Declaration" (box 1.2).

Since 2007, this emerging UN debate and the considerations of the European Union as well as many other regional bodies, such as the PSIDS and of CARICOM, offer a political context for the securitization of climate change, even though the latter did not refer specifically to the 'security' threat posed by climate change.

1.2 Three Debates on GEC, Security and Disasters

This book goes a step further by analysing the synergies and linkages between three scientific 'epistemic communities' focusing on global environmental change (1.2.1), security (1.2.2), natural hazards and

Box 1.2: Excerpts from the *Climate Change Declaration* adapted by the Heads of State and Government of Mexico and the Member States of the Caribbean (CARICOM), Riviera Maya, Quintana Roo on 21 February 2010. **Source:** at: <http://www.presidencia.gob.mx/en/ press/?contenido=53294>.

1. We, the Heads of State and Government of Mexico and the Member States of the Caribbean (CARICOM)... confirm our commitment to reinforcing cooperation to deal with the threat of climate change through joint efforts by our nations.
2. We express our concern over the scientific evidence showing that climate change induced by humans is worse than predicted and that the impacts of climate change we are already experiencing in our region will intensify.
3. Since the Caribbean is a highly vulnerable region to the harmful effects of climate change, we are determined to strengthen our mitigation and adaptation policies with the support of the international community to cope with this serious threat. We call for an increase in cooperation in our region to achieve understanding and adapt to the adverse impacts of climate change and in this respect, we will ask for the establishment of collaboration links between the Caribbean Community's Center for Climate Change (CCCCC) and the Government of Mexico.
4. Our region widely acknowledges the fact that the development of mitigation actions will reduce the long-term costs and effects of the climate phenomenon. In this respect, we have been concerned to note that ever year, the continuous increase in global emissions reduces the possibilities of stabilizing the average global temperature and at the same time, increases the costs associated with this stabilization.
5. We stress the need to continue negotiations within the United Nations Framework Agreement on Climate Change and the Bali Action Plan and we urge all the states to become constructively involved in the negotiations and to build on the results achieved in Copenhagen.
6. We regard the Copenhagen Agreement as a significant step towards the implementation of the Bali Action Plan and express our interest in ensuring that the understanding reached over certain crucial elements will facilitate the negotiations underway at the Convention.
7. We also welcome the fact that our region will host the 16th Conference of the Parties to the Convention (COP 16) and the 6th Meeting of the Parties to the Kyoto Protocol (CMP 6) and we pledge to collaborate and support the Mexican Government to ensure the adoption of a broad, ambitious, effective agreement that will meet the challenges and needs of mankind, particularly the most vulnerable sectors. CARICOM and Mexico agree over the importance of ensuring that the COP 16 results are legally binding.

societal disasters (1.2.3) that are pursued by different scientific disciplines, as well as by different national and international institutions.

1.2.1 Focus on GEC: Approaches from the Natural Sciences

In the introduction to the previous volume the evolution of GEC research has been reviewed in detail (Brauch 2009a) that encompass "a full range of globally significant issues relating to both natural and human-induced changes in the Earth's environment, as well as their socio-economic drivers". According to Munn (2002: xi) "changes greater than humankind has experienced in its history are in progress and are likely to accelerate". Dealing with future environmental trajectories requires more than a prediction of a single future path. It requires to "map a broad range of future environmental trajectories" that may confirm "that the changes of the 21st century could be far greater than experienced in the last several millennia" (Munn 2002: xii). Scientists, but also decision-makers and administrators are challenged to think the unthinkable; to minimize 'surprise' should nature manifest itself.

Since the 1990's this evolving research field has been advanced and coordinated by the *International Geosphere-Biosphere Programme* (IGBP, chap. 77 by Noone/Nobre/Seitzinger), the *International Human Dimensions Programme* (IHDP, chap. 75 by von Falkenhayn/Rechkemmer/Young), the *World Climate Research Programme* (WCRP, chap. 78 by Church/Asrar/Busalacchi/Arndt), *DIVERSITAS* (chap. 76 by Walther/Larigauderie/Loreau) and by the *Earth Systems Science Partnership* (ESSP, chap. 74 by Leemans/Rice/Henderson-Sellers/Noone) that will be addressed in this book.[19] However, in the rapidly growing multidisciplinary research programmes on *Earth System Science* (ESA) the security dimension that has been addressed by the UN Security Council, the General Assembly, the Secretary-General and on a regional level by the European Commission and the European Council as well as by many countries, has

19 The early activities of these four programmes until 2001 are covered in the *Encyclopedia of Global Environmental Change* (Munn 2002); Diversitas (Prance 2002: 268–271); IGBP (McCarthy 2002: 350–351; Steffen 2002: 351–357); IHDP (IV: Shaw 2002: 245); Perry (2002: 753–754).

so far only been addressed by the *Global Environmental Change and Human Security* (GECHS) project within IHDP (Barnett/Matthew/O'Brien 2008) that has come to an end with the synthesis conference in June 2009.[20]

1.2.2 Focus on Security: Approaches of the Social Sciences

The narrow classical security approach inspired by a Hobbesian obsession is bound to fail in addressing these new security dangers, as are the security strategies, policies and measures that are guided by the power-centred worldviews of policy analysts and advisers and the mindsets of policy-makers that have been influenced by the Cold War experience. The multiple new security dangers posed by the implications of GEC, especially by incremental or linear climate change projections and possible nonlinear tipping points (Lenton/Held/Kriegler/Hall/Lucht/Ramstorf/Schellnhuber 2008) in the climate system, have increasingly been perceived and socially constructed as security concerns since the turn of the millennium.

While the debate on the reconceptualization of security was initially focused backward by addressing the security consequences of the Cold War and the impacts of globalization adding new non-state actors (terrorists and organized crime), the new security agenda of the Anthropocene (Dalby 2009; Brauch/Oswald Spring 2009a) addresses fundamentally different objective security dangers that threaten first the lives, livelihoods and survival of human beings in small islands states, in coastal regions and river deltas, but also those that are seriously affected by the increasing intensity of climate-induced natural hazards (heatwaves, droughts, forest fires as well as by storms, floods and landslides).

Thus, the focus of the new environmental security studies will have to shift from environmental scarcity, degradation and stress during the first three research stages both to the complex causes and the manifold natural implications and the societal outcomes posed by GEC during the Anthropocene era of earth and human history. Wæver's theory (1995, 2008a) of securitization as well as Beck's (2007, 2008, preface essay) theory of international risk society offer two different perspectives for dealing with the security impacts of GEC.

While Wæver's theory offers an approach for analysing policy declarations by policy-makers and representatives of international organizations that have declared climate change as well as water, soil, food and health as issues of 'utmost importance', Beck's (1986, 1992, 1999, 2007, 2007a) international risk society points to a new quality of risk against which traditional insurance efforts do not apply any longer.

1.2.3 Focus on Natural Hazards and Societal Disasters

Natural hazards and human-induced societal disasters existed throughout earth and human history due to the natural variability in climate and extreme weather events, causing in the past mass migrations, multiple conflicts and even the declines of civilizations due to the natural variations of the climate during the Holocene age of earth history (see 1.1.1). The new challenges in the Anthropocene have been an increase in the number and especially in the intensity of natural hazards (chap. 40 by Guha-Sapir/Vos) that have affected more people due to the rapid increase in populations often living in urban conglomerates. Many of these natural hazards and societal disasters have further increased the social vulnerability of the affected people and thus posed dangers for human, national and international security.

The hazard impact depends on the degree of social vulnerability of the affected people and on the coping capacities of the states. Therefore the societal impacts are the most severe in the poorest countries with limited financial and administrative capabilities and resilience. Some developing countries (e.g. Cuba) have often been more effective in coping with the societal impacts of hurricanes, as the case of Hurricane Katrina has illustrated for the United States.

1.3 Coping with GEC and Hazards with Adaptation, Mitigation and Resilience Building

Three different modes for 'coping' with the causes of GEC, including global climate change and desertification and land degradation, and with the societal impacts of hazards, e.g. of droughts and subsequent storms and flooding, have been distinguished in the GEC and hazard communities to adapt to, to mitigate against, and to build resilience. The 'coping' con-

20 On GECHS, see at: <http://www.gechs.org/>; on its synthesis conference in 2009, at: <http://www.gechs.org/synthesis-conference/>.

cept[21] has been widely used in psychology.[22] It has later been taken up by the global change community (including climate change)[23] and hazards (Mitchell 1995; Ammann/Dannenmann/Vulliet 2006) and also applied by the security community.[24] In this book the concept of 'coping' embraces the three concepts of adaptation[25], mitigation[26] and resilience building.[27]

> Mitigation strategies can reduce ecosystem vulnerability, and adaptation strategies can increase ecological resilience to climate and landscape change. Mitigation strategies are actions to prevent, reduce, or slow climate and/or landscape change. Adaptation strategies are actions to counteract the adverse consequences of climate and landscape change. Natural resource managers can use both strategies to reduce adverse ecosystem effects of climate and landscape change.[28]

An early IPCC (1995) glossary did not offer any definition for coping, adaptation, mitigation and resilience.[29] But later IPCC assessment reports, and especially the fourth of 2007, gave detailed definitions of adaptation and mitigation that differed among the working groups. The term 'coping' was not defined by the IPCC (2007, 2007a, 2007b).

The IPCC's second working group (2007a: 869) used adaptation as: "adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation". It referred to *anticipatory adaptation* as "adaptation that takes place before impacts of *climate change* are observed" that is also "referred to as proactive adaptation". In contrast, *autonomous adaptation* "does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*, also referred to as spontaneous adaptation". Finally, *planned adaptation* "is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state".

The IPCC's third working group (2007b: 809) defined adaptation: as "Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects." This working group also distinguished among "anticipatory and reactive, private and public, and autonomous and planned" adaptation by referring to "raising river or coastal dikes, the substitution of more temperature shock resistant plants for sensitive ones, etc". According to the IPCC adaptive capacity refers to

21 According to the *Oxford Dictionary and Thesaurus* (2001: 160) the verb cope (coping) refers to: manage, deal effectively or contend, get by, survive, win through, endure. The *Chambers Dictionary* (2001) refers i.a. to these meanings: to contend, deal with successfully, to encounter, meet, to match.

22 In psychology, according to Ray, Lindop and Gibson 1982): "Coping is action directed at the resolution or mitigation of a problematic situation. There are a number of ways in which this may be attempted, and a number of ways of classifying coping strategies. This paper presents a simple schema of six coping themes, ordered in terms of their defensiveness and the degree of attempted personal control which they imply. They comprise rejection, control, resignation, dependency, avoidance and minimization, and characterize the meaning or qualitative 'style' of the individual's response, rather than the formal characteristics of the strategies employed." Alan, Lazarus and Reevy (2007) in five chapters introduce the coping concept as used in psychology and offer four more chapters with examples of coping with stress and disease.

23 Easterling, William E.; Hurd, Brian H.; Smith, Joel B., 2004: "Coping with global climate change: the role of adaptation in the United States", in: *Pew Center on Global Climate Change* (June); at: <http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Global_warming/pew_climate_0704.pdf >.

24 In May 2009 the 8th Security Forum held in Geneva addressed as the conference theme: "Coping with global change"; see at: <http://www.8isf.ethz.ch/index.cfm>.

25 According to the *Oxford Dictionary and Thesaurus* (2001: 9) the verb 'adapt' refers to: "fit, adjust, alter, make suitable, modify, adjust to new conditions". The *Chambers Dictionary* (2001: 17) refers to 'adaptation' as: "the fact, act, process, or result of adapting".

26 According to the *Oxford Dictionary and Thesaurus* (2001: 479) the verb 'mitigate' means: "make less intense or severe". The *Chambers Dictionary* (2001: 1032) refers to 'mitigate' as: "to mollify, appease; to make more easily borne, to lessen the severity, violence or evil of; temper".

27 According to the *Oxford Dictionary and Thesaurus* (2001: 645) the adjective 'resilient' means: "resuming original form after compression etc., readily recovering from setback". The *Chambers Dictionary* (2001) refers i.a. to 'resilient' as: "recoiling, rebounding, able to recover form and position elastically, able to withstand shock, suffering, disappointment, etc."

28 Tony Prato and Dan Fagre: "Coping with Climate Change – An ActionBioscience.org original article"; at: <http://www.actionbioscience.org/environment/prato_fagre.html>.

29 IPCC, 1995; at: <http://www1.ipcc.ch/pdf/glossary/ipcc-glossary.pdf>.

"the whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures".

The IPCC's first working group (2007: 949) referred to mitigation as "a human intervention to reduce the *sources* or enhance the *sinks* of *greenhouse gases*". Its second working group (IPCC 2007a: 878) defined mitigation as: "an *anthropogenic* intervention to reduce the anthropogenic forcing of the *climate system*; it includes strategies to reduce *greenhouse gas sources* and emissions and enhancing *greenhouse gas sinks*". Its third working group (IPCC 2007b: 818) understood mitigation as: "technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks". In the IPCC's understanding, mitigative capacity "is a country's ability to reduce anthropogenic GHG emissions or to enhance natural sinks, where ability refers to skills, competencies, fitness and proficiencies that a country has attained and depends on technology, institutions, wealth, equity, infrastructure and information. Mitigative capacity is rooted in a country's sustainable development path".

But only the IPCC's second working group (2007a: 880) defined resilience as: "The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change."

1.3.1 Phases of Scientization, Politicization and Securitization

Three phases of dealing with environmental and GEC issues may be distinguished of scientization, politicization and securitization.

1.3.1.1 Scientization

During the *first phase* the scientific issues related to GEC are gradually being addressed, framed, explained, and understood and communicated to the public at large via the media and perceived as issues of public importance that require a policy response. Although environmental (Thoreau 1854; Vernadsky 1926; Carson 1962), ecological (Haeckel 1866, 1870) and climate issues (Baron Jean-Baptiste Fourier in 1823; John Tyndall in 1860; Svante Arrhenius 1896; Roger Revelle and Hans Suess in the 1950's and 1960's)[30] have been addressed by a few natural scientists already in the late 18th century (Malthus 1798), a wider scientization of environmental problems and the emergence of environmental science (Chauhan 2008), of university departments and research institutes primarily in the natural sciences evolved since the 1960's and in the social sciences one or two decades later. Issues of global environmental change and climate change were increasingly addressed since the early 1970's.

Major scientific centres on climate change research have emerged since the late 1980's (besides many university centres, e.g. the Tyndall Centre, UK; Potsdam Institute on Climate Change Impact Research (PIK), Germany; Cicero Institute, Norway) and international scientific programmes on GEC evolved since the 1980's that were coordinated by the *World Climate Research Programme* (WCRP) and the establishment of the IPCC (1988). During this first stage of this *scientization* of global environmental and climate issues scientists put new scientific questions and political issues on the national and international scientific and political agendas humankind has been facing in the Anthropocene, especially since the late 1950's.

1.3.1.2 Politicization

While nature conservation organizations emerged since the 19th century focusing on wildlife management, water, soil conservation and sustainable forestry, major environmental NGOs were founded since the 1960's (e.g. WWF, 1961; Greenpeace, 1969), the first national environmental agencies (US-EPA, 1970) and ministries were established since the 1970's. The first global environmental conference of states took place in 1972 in Stockholm that established UNEP as the key agency within the UN system. In 1987 the World Commission on Environment and Development introduced the sustainability concept as a guiding scientific and political goal. The Rio Summit (1992) of the *United Nations Conference on Environment and Development* (UNCED) adopted the *biodiversity* (CBD) and *climate change* (UNFCCC) conventions and a mandate for the negotiation of a *convention to combat desertification* (UNCCD) that was adopted in 1994.

The Berlin Mandate (1995) that was approved at the first *conference of parties* (COP 1) launched a negotiation process that resulted in 1997 at COP 3 in

30 These historical references were brought to our attention by Sarina Keller, in a term paper at the Free University of Berlin (2010) based on Alfsen/Skodvin (1989), Bolin (2007); Luhmann (2009).

the adoption of the Kyoto Protocol that will expire in 2012. As COP 15 in Copenhagen (2009) failed to accept a new legally binding accord, in January 2010 the future of the climate change regime has become uncertain and it is uncertain whether and when a new legally binding regime will be adopted. During this second phase of the gradual *politicization* of GEC and global climate change issues many political initiatives were launched for 'responding' to and 'coping' with the causes and societal impacts of GEC and natural hazards.

Within this global climate change regime multiple declaratory and legally binding initiatives were approved by international organizations and partly implemented by nation states for coping with the anthropogenic causes, physical effects and societal impacts and outcomes by adapting to and mitigating against climate change. The third working group of the IPCC (1990, 1995, 2001, 2007) has assessed the state of the knowledge and of government plans and implementing activities. However, since UNFCC (1995) and the Kyoto Protocol (16 February 2005) entered into force only few governments have so far fully complied with their declaratory aims and their legally binding commitments under the Kyoto Protocol.[31]

1.3.1.3 Securitization

During the third stage – referred to above – some scientists, governments and international organizations have declared climate change as an existential political issue of utmost importance that require extraordinary political measures. The *securitization* of GEC by policy-makers and the relationship of climate change, desertification and water scarcity and degradation for human, national and international security are addressed in this book.

1.3.2 Coping with GEC

In the global environmental and climate change community three mayor schools or approaches prevail:

1. The *climate change community* focuses on physical outcomes and characteristics of vulnerability. Their vision of vulnerability "is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC 2007a: 883).
2. The *disaster risk reduction* (DRR) and hazard-related research approach deals with human responses. The DRR distinguishes different physical, social, cultural and psychological vulnerability features. Cutter (1996) identified three distinct sources of vulnerability: (a) as risk of exposure to hazards (e.g. for settlements in flood plains and river basins), (b) as a capability for social response (e.g. exit road systems or insurance), and (c) as an attribute of places (e.g. vulnerability of coastlines or river basins to floods). Vulnerability is related to one or several hazards, while climate change results in multiple hazards that may trigger societal outcomes.
3. The *sustainable development research community* centres on societal characteristics that make people vulnerable. These scholars examine poverty and capacity-building and for them vulnerability is a lack of capabilities or 'capitals' (Sen 2000) preventing them to cope with, to mitigate against or to adapt to climate change processes. Kofi Annan (2005) included in this approach elements of governance, institution-building and a legal framework. This community points to a vicious circle of vulnerability, where poverty creates the inability of people to cope with or to recover from hazards or situations that disrupt their life (e.g. through illness). Any of these processes represent an immediate threat for their livelihood and survival that are beyond their control. Besides by rapid onset hazards and the increase of food prices or the alteration of market structures, the most vulnerable

31 For an overview of the compliance with the Kyoto Protocol see at: <http://unfccc.int/kyoto_protocol/compliance/items/2875.php>. See also: UNFCC, 2009: "National greenhouse gas inventory data for the period 1990–2007", FCCC/SBI/2009/12 (12 October 2009); at: <http://unfccc.int/resource/docs/2009/sbi/eng/12.pdf>. Among the 41 annex I countries with reduction obligations under the UNFCCC between 1990 and 2007 without land-use changes and forestry 23 countries should have decreases in emission reductions by more than 1 per cent, while 18 countries showed increases above 1 per cent. Russia reduced its emissions by 35.9 per cent, the 27 EU countries by 4.3 percent (among them Germany by 21.3 per cent, the UK by 17.3 per cent, France by 5.3 per cent) while Japan increased its GHG emissions by 8.2 per cent; the USA by 16.8 per cent, Canada by 26.2 per cent and Australia by 30.0 per cent and Spain by 53.5 per cent and Turkey by 119.1 per cent (UNFCCC 2009: 16). These data slightly differ if land-use changes and forestry are included (UNFCCC 2009: 17).

people are further affected by middle-range processes such as land degradation, desertification, lower precipitation and sea-level rise. Indirect processes of climate change are related to lower ecosystem services, economic crises and unemployment in developed countries. This often leads to rural-urban migration where these people find some social protection (subsidies, food support) or to international migration to OECD countries. Strahm and Oswald Spring (1990) and Richards (2000, 2001) and others have argued that vulnerability is caused by industrialization and its polluting activities along with the present consumption model that have harmed poor countries.

1.3.3 Mitigation Against GEC

These three approaches create different concepts of mitigation:

1. In the climate change and natural hazard communities mitigation involves the reduction of the concentration of greenhouse gases, either by reducing their sources (by geo-engineering, solar radiation management, seeding oceans with iron, etc.) or by increasing their sinks (by carbon capture and storage, bio-sequestration, elimination of waste methane). These processes are technologically specific (e.g. fluorescent light bulbs, geothermal and pollution reduction), industry-related (e.g. public private partnerships in the oil or petrochemical industry, bus and public transportation) and system-wide (such as the reduction of GHG in urban areas, recycling of waste, public transport systems, district heating systems, etc.).
2. The hazard and DRR community emphasizes three simultaneous mitigation processes: a) infrastructure for protective measures (sea walls, levees, dams for water regulation and irrigation, restoration of damaged ecosystems such as mangroves, coral reefs, seagrass and forests). City planners are modelling the risks in cooperation with citizens from megacities and urban agencies to develop a coordinated approach for protecting vulnerable people, roads, tunnels, water supplies, energy and transportation systems, sewage and water treatment plants and industries with hazardous materials.
   a) insurance and micro-insurance and the establishment of escape routes to reduce human harm and permit a fast recovery after an extreme event;
   b) early warning, preventive evacuation, urban and landscape planning, civil protection laws, disaster funds, etc.;
   c) education and training on DRR and disaster management.
3. The sustainable development research community integrates the socio-economic processes with network building, reinforcement of capacities and the combined use of different capitals (natural, economic, societal and cultural), to create circles of virtuous development processes. This community has proposed carbon emissions trading, sustainable land and forest management, carbon taxes, financial and technological transfer from industrialized to affected poor countries. They have combined the preventive disaster management with proactive development processes to enhance the capability of the people for resisting extreme events and dealing with multiple socio-natural hazards. They have promoted population control, healthcare for children and mothers, preventive health services (by vaccination and campaigns against HIV-AIDS) and food supply for the hungry. Their interest has focused on sustainable consumption patterns, small-scale and self-sufficient agriculture and micro-credits for livelihood improvements in the framework of an economy of solidarity (Cadena 2009) or informal economic activities. This community has supported education from the kindergarten onward (Van Dijk 2009), survival strategies adapted to scarce resources, and fair trade to reduce the negative impacts of a collapse or a sudden increase of prices.

1.3.4 Adaptation to GEC

On adaptation these three schools propose different ways to deal with GEC:

1. For many researchers in the climate change community the adaptation concept had a traitorous connotation. They initially believed that this concept would undermine the urgency to mitigate against the threat of global warming by significantly reducing GHG emissions. Therefore, adaptation was for quitters. Based on systematic measurements of GHG and their significant increase during the past decade, this school argued that mitigation alone would not resolve climate related threats. Therefore, the climate change and natural hazard communities have suggested different processes of adaptation to climate change with regard to data collection and scenario development.

Despite improved meteorological data and mid-term weather forecasts it is still impossible to predict for farmers, the people, and insurance companies which regions will become wetter or drier. So far there is little agreement how these trends will affect the annual or seasonal rainfall patterns and the growing season to determine yield productivity. Furthermore, glaciers are retreating what will lead to increased temporal floods but throughout the year to a decline in water resources for rain-fed agriculture and urban development. This will affect large populations in China, in South and East Asia but also in the Andes in South America and the land around Kilimanjaro in Africa. Thus, scientists must develop and share knowledge on land-use, forestry and agriculture (by developing drought- and saline-resistant crops) and develop scenarios for dealing not only with linear, but also with chaotic impacts of climate change. Adaptation should also address negative societal outcomes. More intensive floods from storm surges require complex and expensive solutions for protecting home, people, sanitation, communication and transportation infrastructures.[32]

2. According to the DRR and hazard community adaptation requires: a) assessing risk and reducing vulnerability of the affected people; b) adaptation planning at the national and regional level to reduce the impacts of climate change; c) a more resilient infrastructure; d) broader disaster relief and preparedness measures; e) new agricultural technologies and practices of land management and productive processes to counter the increased climate risks; f) conservation and restoration processes to maintain the environmental services. Adaptation planning at the local, state, and national levels may reduce the damage caused by climate change, as well as the long-term costs of responding to climate-related impacts. It is estimated that by 2030 about 60 per cent of the world's population will live in flood-prone coastal areas. This requires conserving and restoring mangroves to counter the flooding of agricultural land and human settlements. This will also protect deltas from washing away. Bangladesh and other highly affected countries are also reforesting in the upland to prevent downstream erosion. Low lying islands are creating natural buffer zones for human settlements to adapt to rising seas.
3. The sustainable development community argues that strategies for coping with the impacts of a warmer world will be complex and expensive. Adaptation strategies must:
   a) Deal simultaneously with poverty alleviation, high population growth and job creation for young people. This is further reinforced by natural events in countries with low human development, few trained people and the lowest capacity to cope with the high impact of climate-related disasters.
   b) The expected increase of diseases due to climate change, above all in the sensitive regions due to flooding and sea-level rise, may also contaminate water supplies and intensify the vicious circle of poverty, diseases, ignorance and disasters.
   c) Biodiversity and recovery of affected ecosystems is a local adaptation strategy that creates for most marginal people a potential to charge for environmental services, thus reducing the negative impacts of extreme events.
   d) Early adjustment to increasing climate threats permits a better adaptation, making people resilient to possible changes and new threats, taking cultural, economic, and political differences into account.
   e) Traditional societies with a greater integration with nature adapt more easily to a warmer environment (e.g. Myanmar) than cultures driven by the extraction of oil and minerals (e.g. Peru), thus adaptation strategies must be carbon neutral.
   f) Oxfam (2009) pointed to "three major challenges that climate change brings to bear on rural communities: undermined sustainability of current livelihood strategies; increased pressure on already depleted natural resource bases; and increased disaster risk from climate hazards. Effective adaptation must therefore bring together sustainable livelihoods, natural resource management, and disaster risk reduction approaches to secure and enhance assets within the analysis of climate change", including the reduction of social vulnerability and DRR.
   g) Sustainable energy and energy efficiency are crucial for the adaptation process to climate change including incentives for the private sec-

32 New York City, Mumbai, Calcutta, Lagos, Buenos Aires, Bangkok and other megacities are only a few metres above sea level and they must develop adaptation plans for sea-level rises and for increased tidal and storm surges.

tor, the elimination of counterproductive subsidies (e.g. in water-intensive crops), and the protection of land-use, ownership and guarantee of the social security for the most vulnerable people.

1.3.5 Protection, Empowerment and Resilience Building

The concept of resilience has been used differently by authors and scientific communities. It was critiqued for emphasizing systems stability over change and thus reducing DRR with preventive measures. Wisner, Blaikie, Cannon and Davis (2004) use resilience as a continuous learning process to improve the capacity for handling hazards and to reduce risk by empowering communities to make better decisions on dealing with hazards. Resilience may also be linked to vulnerability (Manyena 2006) and adaptation capacity. Resilience is understood to have inherent functions in normal times and to be adaptive during extreme events and disasters. This is related to infrastructure, institutions and social, cultural or economic systems.

1. Climate experts defined resilience as the "ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change" (IPCC 2007a: 880).
2. "Determining whether resilience is an outcome or a process is an important step toward its application to disaster reduction. When compared to the global change perspective, hazards researchers often embed adaptive capacity or mitigation within resilience" (Cutter/Barnes/Berry/Burton 2008: 600). According to researchers working on hazards, resilience focuses on technical and social systems, where preventive DRR helps to cope with and minimize the potential disaster impacts through early warning, evacuation and post-event processes (Bruneau 2006; Tierney/Bruneau 2007). The Hyogo Framework for Action stressed the need to build resilient communities through integrated disaster prevention, mitigation, preparedness and vulnerability reduction, where the local capacity is increased for dealing better with hazards. In this framework DRR is integrated into early warning, the response, recovery, and reconstruction process in case of a disaster.
3 The research community dealing with resilience and sustainable development goals includes human rights and basic human needs. The human security approach (UNDP 1994) was the starting point for combining human capitals (social, economic, political and cultural) with protection and empowerment (Ogata/Sen 2003) and resilience-building in regions threatened by climate impacts (UNEP, FAO, Oxfam, Greenpeace, etc.). This community defined the resilience process as the ability to "tolerate – and overcome – damage, diminished productivity, and reduced quality of life from an extreme event without significant outside assistance" (Mileti/Mileti 1999: 4). Within the context of natural disasters, this community redefined the sustainability approach as the necessity of a systems' change, including risk factors not only from natural extreme events, but also from the complex interrelationship with human factors, such as chaotic urbanization, livelihood loss, economic crises, environmentally forced migration, unstable governments and the linkage among several factors. Particularly a high exposure is related to the distribution and access to land, water and productive means that are crucial to reinforce the livelihood at the local level or to expel people when their survival is at risk.
Social safety networks are crucial to prevent, support, and recover from extreme hydro-meteorological events. In facing climate change the sustainable research and action community emphasizes to conserve and restore the natural capital, while the cultural, economic and political capitals are oriented at resilience-building, sustainable agriculture and dignified livelihood. Social movements have analysed the inefficiency of agribusiness, pollution and agricultural subsidies that have increased hunger worldwide due to speculation with food prices and the use of basic grains for biofuel. Their adaptation strategies start at the local level with the recovery of environmentally damaged ecosystems and the improvement of environmental services. FAO (2009) adopted the food sovereignty concept of Vía Campesina as a holistic approach for increasingly insecure situations. In this approach hazard-prone countries in the South that are exposed to risk are concentrating their technical, economic and human capitals on efficient DRR and CCA processes, where bottom-up initiatives, disaster organizations and international bodies collaborate. The reduction of social vulnerability requires democratic structures, norms and laws, disaster funds, but also bottom-up resilience-building.

The three research communities agree that the greater the level of risk of a country or community and the

greater the resilience is, the better the DRR and the lower the negative impact of an extreme event will be. This permits a more rapid recovery, but also a better preparedness and rebuilding processes. As global environmental change is an increasing risk and not only a hazard but also a vulnerable and exposure component, the combined economic, energy and food crises may threaten sustainability in a larger and in the extreme case at global scale (see the present financial crisis).

Thus, significant financial resources are required, and until new sources are available, most of them must be diverted from existing development programmes what again affects the highly vulnerable regions and social groups. Oxfam (2009) estimates that sustainable climate change programmes with resilience-building require about 40 billion/year, while the World Bank estimates that financial needs would be four times higher if adaptation and mitigation processes are included.

This also requires institutional arrangements, above all in the water, agriculture and productive structure, with an increasing coordination among different sectors and levels for DRM with participatory community involvement in decision-making and educational programmes. Safety nets for disaster-stricken households and strengthened disaster preparedness may substantially reduce the disaster costs with early warning, improved hydro-meteorological services, and weather prediction. These safety nets also develop self-sustaining bodies of expertise in remote and marginalized regions. Women are not only the world's poorest and most vulnerable persons, but their social representations are also able to consolidate and support countries and communities prior, during, and after a disaster (Oswald 2006). Building on existing and past experiences of a proactive and constructive dynamics among top-down and bottom-up efforts may open a potential to reduce human and economic costs in a world increasingly threatened by GEC.

1.4 Dialogue Among Three Scientific Epistemic Communities on Global Change, Security and Disaster

The 95 chapters in this book bring together authors from these three research communities (1.3.2–1.3.4) and from three distinct scientific research areas and many different scientific disciplines in the natural and social sciences, including teams of authors reflecting multi- and interdisciplinary approaches (table 1.1).

1.4.1 Security Community

Of these three scientific communities the security research community has evolved since the end of the Second World War as two competing research programmes: on the one hand as war, national, international and global security or strategic studies, and on the other as peace science, studies or research. Since the late 19th century, issues of external and internal security, and the activities of the military, diplomacy and of the police have been reviewed by historians and lawyers, the state sciences and especially since the late 1940's by international relations scholars, and as a response to the Cold War, since the late 1950's by peace researchers.

In 1958, the *International Institute for Strategic Studies* (IISS) was set up in London, and in 1959 the *International Peace Research Institute in Oslo* (PRIO), and in 1966 the *Stockholm International Peace Research Institute* (SIPRI) were established. Since then numerous security policy think tanks and scientific research institutes as well as peace research institutes and programmes and scientific journals have emerged and several controversial methodological and policy-focused controversies have taken place between the traditional and the critical wings of the security community (Albrecht/Brauch 2008, 2009). This wide-ranging security community pursued different tasks to analyse, assess, critique or legitimize specific security policies and decisions.

With the reconceptualization of security since 1990 the scope of analysis has widened from the classic policy and military dimensions to include the economic, societal and environmental dimensions and the range of referent objects or actors have deepened from state-centred perspectives of national, international and global security to human- or people-centred approaches of human and gender security. This widening and deepening of the security concept since 1990 has been conceptually mapped in the previous two volumes of this GEHSHA. Furthermore, many international organizations have sectorialized the security concept by linking it to their key mission of energy (IEA), food (FAO, WFP), health (WHO), water (UNEP, UNU) and more recently to climate (UNSC, UNGA, UNSG, EU, PSIDS)

The security repercussions of GEC, especially of climate change and of natural hazards as well as of societal disasters are gradually being addressed since

Table 1.1: Three epistemic communities focusing on global environmental change, natural hazards and security. **Source:** Developed by the authors.

Epistemic community (research area)	Security	Natural hazards	Global environmental and climate change
Primary discipline (policy, politics, polity)	• Political science • international relations • policy studies	• Geography and geo-sciences • hydrology • soil sciences • geophysics (earthquakes, volcanism, tsunamis)	• Meteorology • climatology • soil sciences • hydrology • biology • ecology
Secondary disciplines	• History, law, economics, ecology • natural sciences, engineering, IT • communication science (C_3I problems)	• Sociology • human geography • political science (international humanitarian policy) • psychology	• Physics • chemistry • oceanography • agriculture • medicine • anthropology
Research programmes	• War, security or strategic studies • peace studies, science or research	• Natural hazard research (drought, (tropical) storms, floods)	• Global environmental change • ESS or ESA • geoecology
Scientific Institutes (no university departments, institutes)	• RAND, IISS • PRIO, SIPRI, ISFH, PRIF	• Natural Hazards Centre (UC, Boulder) • UCL Hazard Research Centre • Centre for Natural Hazard Research	• Tyndall Centre • MPI for Climatology • PIK • Cicero • Pew Centre on Global Climate Change
International scientific networks	• IISS (members) • ISA (members) • IPRA, CLAIP etc.	• Provention Consor-tium	• WCRP, IGBP, IHDP, DIVERSITAS, ESSP
Science Assessment	• none	• none	• IPCC
Scientific transfer (political regimes & organizations)	• UNSC, OAS, OSCE, AU, Arab League	• UNOCHA, ECHO	• UNFCC • UNCBD • UNCCD
Theory	• Securitization	• Object of analysis	• Object of analysis
Spatial component	• National sovereignty • National territory • Beyond: globalization	• Transnational impact	• Geography & geosciences
Analysis of spatial components	• geopolitics • geo-strategy • geo-economics		• Ecopolitics • Ecological geopolitics
Integrative concept		← Political geoecology →	

the early 21st century (chap. 42 by Scheffran; chap. 41 by Bauer) by security specialists from both security studies (Schwartz/Randall 2003; Campbell/Lennon/Smith 2007) and peace research (Gleditsch/Nordas 2009; Brauch 2009a). Besides, the social sciences, policy think tanks[33], NGOs (Brown/Crawford 2008) and the US intelligence and military community have addressed the climate change and security linkage.[34]

Climate change impacts on international, national and human security have also increasingly been addressed by think tanks, NGOs and scholars in Asia[35] (chap. 87 by Yu/Smith; chap. 88 by Ohta; chap. 89 by Kanie), Africa[36], Latin America[37] and in the Middle East[38].

1.4.2 Natural Hazard and Disaster Community

The natural hazard community is much older and goes back to the early high civilizations when various water saving technologies were developed to cope with the effects of drought and to reduce the impacts of floods and inundation. Since the 1930's, hazards were not any longer perceived as pure engineering problems but increasingly analysed as societal issues that were influenced by societal preferences and resource allocations. The practical applications of this community comprises three main activities of emergency management: a) of civil defence,[39] b) disaster relief,[40] and c) disaster risk reduction (DRR).[41]

Within the UN System, the *International Strategy for Disaster Reduction* (UN/ISDR)[42] has been a major coordinator of the many stakeholders involved in DRR, besides the ProVention Consortium[43] that is coordinated by the Red Cross and Red Crescent Society in Geneva. In the European Union, the DG Environment has been responsible for the coordination within the EU[44], while within the DG Development its *European Humanitarian Aid Office* (ECHO)[45] has become a key actor and source of financial support for UNOCHA. Besides, the World Bank, UNDP and UNEP, the International Red Cross as well as humanitarian organizations have become major actors in

33 Since mid 2008, US security think tanks published reports on climate change and security; e.g. Congressional Budget Office (2009); U.S. Global Change Research Program (2009); Carnegie Endowment for International Peace (2009); Strategic Studies Institute (Parsons 2009); Pew Center on Global Climate Change (2009); and the American Security Project (2009); for web links see at: <http://www.hsdl.org/hslog/?q=node/5093>.

34 In September 2009, the CIA set up a "Climate Change and National Security Center"; at: <https://www.cia.gov/news-information/press-releases-statements/center-on-climate-change-and-national-security.html>.

35 There are many reports on the impact of climate change on national, food and energy security in India, see: IDSA Working Group on Security Implications of Climate Change (2009); Nitin Desai, an adviser to the Prime Minister of India: "When Things Hot Up", in: *Times of India*, 29 September 2009, at: <http://timesofindia.Indiatimes.com/opinion/edit-page/Top-Article-When-Things-Hot-Up/articleshow/5065540.cms>; see: The RSIS Centre for NTS Studies Conference on Climate Insecurities, Human Security and Social Resilience, 27–28 August 2009, Four Seasons Hotel, Singapore; at: <http://www.rsis.edu.sg/nts/Events/Climate_change_conf. html>; Zhang, Zhang, Lee and He (2007); Zhan, Brecke, Lee, He and Zhan (2007).

36 See: Oli and Crawford (March 2009); Leonie Joubert: "Africa: Climate Change 'Is a Security Issue'", in: *allAfrica.com* (28 August 2009); at: <http://allafrica.com/stories/200908310376.html>; IRIN: "AFRICA: Climate change and conflicts" (23 February 2009); at: <http://www.irinnews.org/Report.aspx? Report Id=83096>; Brown, Crawford (24 March 2008); Brown, Hammil and McLeman (2008); Brown, Hammil and Crawford (2007); Hendrix, Glaser (2007): Swatuk (2007).

37 There are a few reports on the impact of climate change on food, energy and national security in Latin America: e.g. by the Centro Mario Molina; Fetzek (October 2009), at: <http://www.rusi.org/downloads/assets/Mexico_CC_Text_-_English.pdf>; "Investigadores británicos hablan sobre cambio climático y seguridad", in: *Excélsior* (13 July 2009), at: <http://ukinmexico.fco.gov.uk/es/newsroom/?view=News&id=20563860>; Emilio Sempris: "Climate Change and Freshwater in Latin America and the Caribbean", in: *UN Chronicle*, at: <http://www.un.org/wcm/content/site/chronicle/cache/bypass/lang/en/home/archive/Issues2009/pid/5075?ctnscroll_articleContainerList=1_0&ctnlistpagination_articleContainerList=true>; DFID: *Climate Change in Latin America*, at: <http://www.dfid.gov.uk/Documents/publications/climatechange/12LatinAmerica.pdf>.

38 Freimuth, Bromberg, Mehyar and al Khateeb (2007); Brauch (2007); Brown and Crawford (2009).

39 In most countries the ministries for interior are responsible for civil defence functions. In the USA, the civil defence function was developed in the 1950's to cope with the threat of a nuclear war; in the 1980's the new *Federal Emergency Management Agency* (FEMA) focused "almost exclusively on nuclear attack and continuity of government planning"; in the 1990's "FEMA adopted an all-hazards approach to disaster man-agement ... for natural hazards preparedness and mitigation programs". During the administration of G.W. Bush "at the federal level, funding for traditional natural and technological hazard programs at FEMA have been cut significantly, and funding for hazard mitigation programs such as Project Impact have been cut completely", (see: George Haddow: "The Challenges of Emergency Management Planning in 2005"; at: <http://www.disaster-resource.com/articles/05p_056.shtml>.

40 Primarily international organizations and humanitarian NGOs are responsible for the implementation of the disaster relief programmes.

political efforts of disaster relief and disaster risk reduction.

The impacts of hazards have been intensively discussed and analysed in many scientific contributions and UN reports in the context of food, water, health and human security (Seck 2007).[46] While in the USA hazards were addressed in the context of homeland security, since the mid 2000's climate change impacts were discussed in a security context (BMU 2002; WBGU 2008). The security impacts of natural hazards within the EU context have been interpreted as "functional security" (Ekengren 2009). From the perspective of many analysts and third world countries hazards pose major threats to their national security and for the human security of their citizens.

1.4.3 Global Change Community

The origins of the scientific global change community can be traced back to the 1970's in the aftermath of the Stockholm Conference (1972) on the *Environment and Development* that put the environment on the international institutional agenda with the establishment of UNEP, but it took another two decades until the four international global change programmes gradually evolved after the Rio Earth Summit. Increasingly climate change institutes with a primary focus on the natural sciences address security implications of climate change (Tyndall Centre[47]; Hamburg ClimateCampus[48]).

1.4.4 Towards a New Interdisciplinary Epistemic Community

These three distinct scientific communities have for many decades coexisted in parallel with a limited intellectual contact, debate and exchange. The disciplinary boundaries of these three scientific communities are gradually eroding but the emergence of an inter-, multi- and transdisciplinary epistemic community (Oswald Spring/Brauch 2008) has so far remained an ambitious scientific goal as – besides the initiatives referred to above – both the GEC and the hazard community have so far resisted to consider their issue areas in terms of theoretical approaches of security and peace studies.

In chap. 94 Brauch, Dalby and Oswald Spring suggest a new multi- and interdisciplinary scientific approach of a 'political geoecology' that fundamentally

41 The DDR term refers to techniques for preventing or minimizing the effects of disasters and has been adopted by the United Nations <http://www.unisdr.org/>. In the political realm, within the framework of UN/ISDR a Global Platform for DRR was set up that held so far two sessions. For the proceedings of the second session see at: <http://www.prevention-web.net/files/section/193_GPProceedingsFINAL. pdf>. Its list of participants offers a good overview of the many stakeholders involved in DRR activities.

42 On UN/ISDR's mission, see at: <http://www.unisdr.org/eng/un-isdr/secre-functions-responsibilities-eng.htm>. It is a system of partnerships with the overall objective to generate and support a global disaster risk reduction movement to implement HFA. Its Inter-Agency Group is to enhance "joint work programming among ... FAO, IFRC, ILO, OCHA, UNDP, UNEP, UNESCO, UNICEF, WFP, WHO, WMO and the World Bank ... and to improve coherence."

43 For details at: <http://www.proventionconsortium.org>.

44 Within the DG Environment, in the Directorate A: Legal Affairs & Civil Protection, two units deal with natural hazards: A3. Civil Protection - disaster response and A4. Civil Protection - prevention and preparedness¸ see at: <http://ec.europa.eu/dgs/environment/directory. htm>.

45 ECHO is made up of two directorates. The first is operations-oriented, organized geographically and thematically, and the second is dedicated to operational support; at: <http://ec.europa.eu/echo/index_en.htm> and on disaster response at: <http://ec.europa.eu/echo/aid/dipecho_en.htm>. From 2005 to 2008 the total funding of ECHO has increased from €631 to €884 million. In 2009, €571 million were spent for humanitarian aid, €280 million for food aid, €34 million for disaster preparedness and €9 million for support expenditure.

46 Papa Seck: "Links between Natural Disasters, Humanitarian Assistance and Disaster Risk Reduction: A Critical Perspective", in: UNDP, Human Development Report Office, Occasional paper on: *Human Development Report 2007/2008 - Fighting climate change: Human solidarity in a divided world* (New York: UNDP); at: <http://www.sarpn.org.za/documents/d0002903/Natural_disasters_HDR_UNDP_2007.pdf>.

47 In January 2010, the Tyndall Centre for Climate Change Research has focused on 'securities' as one of four research areas besides resilience, transitions and CIAS (A Community Integrated Assessment System). Within the context of securities these research topics are being analysed: "a) Food, water and human security, b) Biofuels: food security, energy, and equity implications, c) Food security, agriculture, fisheries and nutrition, d) Human security in the face of climate change and other stresses: health, migration and conflict, e) Implications of climate change extreme events for individual resilience and behavioural responses, f) Water security: Adaptation strategies for river basins and water infrastructure." See the overview and details at: <http://www.tyndall.ac.uk/research/transition-period/securities>.

48 See for details at: <http://clisec.zmaw.de/Contact.850.0.html>.

differs from 'old geopolitics' and that suggests to introduce the political and especially the security dimension into this new research agenda building on the 'theory or securitization' (Wæver 1995, 2008; Buzan/Wæver/de Wilde 1998, 2004) that focuses on issues of 'utmost importance' that require 'extraordinary means'. This new research approach suggests introducing both the environmental dimension and especially global environmental change issues into spatial policy and strategic considerations and a political dimension and a security perspective into earth system analysis and science in the natural sciences.

1.5 Horizontal Cooperation Among Ministries and International Organizations on GEC, Security and Disasters

While multi-, inter- and transdisciplinary cooperation among scientists has not been easy, the cooperation has often been difficult between organized civil society and the state, as well as the vertical cooperation between local, state and federal governments and the horizontal cooperation among different units within a ministry, and even more difficult is the collaboration among ministries and on the international level among international organizations.

Issues of GEC, security and disasters are not only an object of intensive scientific analysis by and among the three communities reviewed above by many government agencies and international organizations, but they have also become key issues of debate and controversy between organized civil society, including business organizations and the states on the national level as well as among transnational state-centred and non-governmental organizations. In the realm of international environment policy, several regimes – most prominently the climate regime – have evolved where these three key actors, the representatives of international society, and of the business community are continuously focusing their activities to influence the positions of their respective governments and to support or oppose the outcome of international negotiation processes, most recently at COP 15 of the UNFCCC in Copenhagen in December 2009. Thus, the activities of the state negotiators always focus simultaneously on the international but also on the national level to reflect the competing and often opposite interests of the business community, of social movements and social organizations, as well as of the specific interests of powerful lobby groups and international NGOs.

Global environmental change and especially climate change issues have not only been the exclusive interest of the nation state at the national level, but also of the state, municipal and local governments. They have played a crucial role in the process of agenda setting and policy formulation and implementation. The specific role and influence of the states and municipalities depends on the governmental system and whether a centralized or a federal system of government exists where certain competences are shared between the federal government and the states. But any impact of extreme weather events and natural hazards must first be addressed at the local and municipal level.

Horizontal cooperation among national or state ministries among the DGs of the European Union with shared competences with national ministries and implementation agencies as well as international organizations and agencies have often been suboptimal due to competing and conflicting competencies and 'turf conflicts'. Nevertheless, reactive and proactive policies as well as decisions on issues of global environmental change and in particular on climate change require multi-sectoral approaches that always involve many ministries, DGs, or international organizations (table 1.2).

1.6 Key Questions and Structure of the Book

In the five preface essays above the Nobel Laureate in atmospheric chemistry, *Paul C. Crutzen* (the Netherlands), introduces the 'Anthropocene' as the new era in the geology of humankind that is influenced by the direct and increasing human interventions into the processes of the Earth system. *Jayantha Dhanapala* (President, Pugwash Conferences on Science and World Affairs, former UN Under Secretary General for Disarmament) in the second essay suggests: "Connecting Inconvenient Truths: Urgency of Nuclear Disarmament in a World of Pressing Problems". In the next essay *Ulrich Beck* (Professor em. University of Munich and LSE) reflects on "Living in and coping with the world risk society". *Hania Zlotnik* (Director, UN Populations Division, UN, New York from Mexico) gives an overview on global "trends of population growth, urbanization and migration until 2050". In a co-authored essay eight authors from the *Potsdam Institute of Climate Change Research* (PIK), *Christoph*

Table 1.2: Different competencies and responsibilities of state and international bodies on security, natural hazards and global environmental change issues. **Source:** Developed by the authors.

	Security	Natural hazards	Global environmental change
Policy field (issue areas)	• Internal (police) • External (diplomacy and the military)	• Civil defence, protection and infrastructure • Humanitarian search and rescue, reconstruction, disaster relief • disaster risk reduction	• Climate change • Soil • Water • Biodiversity
Local community and municipality	• Police • Municipal guards, • Militia	• Local and municipal government • NGOs: firefighters, catastrophe protection, Red Cross and other humanitarian NGOs • Social movements	• Local government units and officials • Units of municipalities: implementation level of state and federal laws NGOs • Social movements • Professionals checking the implementation of legal norms
Nation state (federal or central government)	• Ministry of Interior (national, federal police, intelligence)	• -Subsidiary units of ministries of interior responsible for civil protection	
	• Ministry of Justice • Ministry of Foreign Affairs • Ministry of Defence	• Ministry of Interior or • Ministry of Defence	• Ministries of environment, development, agriculture, energy, economics, foreign affairs,
Supranational and intergovernmental (European Union)	• EU Council • DG External affairs	• DG Environment • DG Development (ECHO) • DG External Relations	• DG Development • DG Environment • DG External Relations • DG for Climate Policy
International/ regional	• OSCE, AU, OAS,AL • NATO and other military alliances	• UN-OCHA, UNDP, UNEP, World Bank • UN/ISDR • International Federation of Red Cross and Red Crescent • Humanitarian NGOs	• OSCE, basket II • OAS, • NAFTA (CEC, BECC)[a)] • AL (Council of Arab Environmental Affairs Ministers) • AU (African Ministerial Conference on the Environment)
International/ global	• UN (SC, MSC), GA • UN SG • NATO	• UN/ISDR, UN-OCHA	• UN (SC, GA, GS, ECOSOC) • UNFCCC Secretariat in Bonn, Germany • UNCCD Secretariat in Bonn, Germany • CBD Secretariat in Montreal, Canada
International, national and state polity (legal norms)	• UN-SC decisions • NATO decisions • EU decisions and recommendations • National implementation laws	• Hyogo Framework of Action (recommen-dations) • EU (directives, regulations, decisions and recommendations on civil protection) • UN/ISDR guidelines and recommendations	• International environmental law: treaties & conventions (UNCBD, UNFCCC, with legally binding Kyoto Protocol and successor regime)

a) CEC = Commission for Environmental Cooperation; BECC = Border Environment Cooperation Commission of NAFTA

Müller, Hermann Lotze-Campen, Veronika Huber, Alexander Popp (all from Germany), *Anastasia Svirejeva-Hopkins* (from Canada and Russia), *Michael Krause and Hans Joachim Schellnhuber* (Professor and Director of PIK, both from Germany), raise the issue of steps "Towards a great land-use transformation?"

The book is structured in ten parts, of which the first develops the key concepts of security threats, challenges, vulnerabilities and risks (1.6.1), while the second reviews the more narrow military and political hard and soft security dangers and concerns (1.6.2). The third assesses economic, social, environmental security and human threats, challenges, vulnerabilities and risks in the Mediterranean, in Central Asia and China (1.6.3) and the fourth focuses on the threats, challenges, vulnerabilities and risks for urban centres in hazards and disasters (1.6.4). The fifth part addresses different approaches to coping with global environmental change: climate change, soil and desertification as well as with water management, food and health issues (1.6.5). The sixth part shifts the analytical focus to coping with hazards and strategies for addressing social vulnerability and resilience building (1.6.6), while the seventh reviews different modes for coping with GEC as well as scientific and international and regional political strategies, policies and measures (1.6.7). The remaining three parts focus on vulnerability mapping and indicators of environmental security issues (1.6.8.), discuss moves towards an improved early warning of conflicts and hazards (1.6.9) and offer both conceptual and policy oriented conclusions for moving from knowledge to action (1.6.10).

1.6.1 Concepts of Security Threats, Challenges, Vulnerabilities and Risks

Of the next four chapters three offer a conceptualization of the four key concepts of threats, challenges, vulnerabilities and risks. From a political science perspective in chapter 2 *Hans Günter Brauch* (Adj. Professor (PD), Free University of Berlin, Germany) reviews the conceptual evolution and use by different scientific communities and in the areas of security, global environmental change and natural hazards of the four key "Concepts of Security Threats, Challenges, Vulnerabilities and Risks." In chapter 3, *Omar Darío Cardona A.* (Professor, Centre of Studies on Disasters and Risks, University of Los Andes, Colombia) analyses "Disaster Risk and Vulnerability: Concepts and Measurement of Human and Environmental Insecurity" from the vantage point of a civil engineer, while *Czeslaw Mesjasz* (Assoc. Professor, Economic University Cracow, Poland) develops the linkages between "Economic Vulnerability and Economic Security" in chapter 4. Finally, in chapter 5: *Lidia Mesjasz* (Assistant Professor, Economic University Cracow, Poland) discusses in an economic case study problems of "Debt Relief, Economic Growth and Poverty Reduction in Low-Income Countries".

1.6.2 Military and Political Security Threats, Challenges, Vulnerabilities and Risks

In the second part, fifteen chapters offer a conceptual mapping of the four key terms used in this book for the military and political security realm. The first six chapters address security conceptualizations in Europe or specific European security issues and of NATO, this is followed by four chapters focusing on Russia, the United States and China, two on the Middle East and two on Africa.

Chapter 6 starts with an analysis by Ambassador *Alyson J.K. Bailes* (Visiting professor, University of Iceland, Reykjavik from the United Kingdom) and the former director, of the *Stockholm International Peace Research Institute* (SIPRI) on "Security threats, challenges, vulnerabilities and risks in the evolution and implementation of the European Security Strategy" from 2003 up to the adoption of the implementation paper in December 2008. In chapter 7, *Pál Dunay* (Faculty member, Geneva Centre for Security Policy, Geneva from Hungary) reviews the "NATO's traditional security problems". In chapter 8, *Eduard Soler i Lecha* (Coordinador del Programa Mediterráneo, Fundación CIDOB, Barcelona, Spain) focuses on "European Responses to Security Threats in the Mediterranean in the Early 21st Century". In chapter 9, *Mustafa Aydin* (Rector, Kadir Has University, Istanbul, Turkey) and *Asli Toksabay Esen* (research associate, *Economic Policy Research Institute of Turkey* (TEPAV), Ankara, Turkey) discuss "Inside/outside: Turkey's security dilemmas and priorities in the early 21st century". In chapter 10, *Omar Serrano* (Ph.D. candidate, Graduate Institute of International and Development Studies, Geneva from Mexico and Switzerland) provides a quantitative analysis of "Promoting democracy as a security goal. The inward/outward paradox of the EU's foreign policy"; and in chapter 11, *Vilho Harle* (Professor, University of Tampere, Finland) and *Sami Moisi* (Docent at the Academy of Finland; senior research fellow, University of Turku, Fin-

land) offer a critical assessment of the "Rhetoric of military and other security challenges in Finland".

In chapter 12 *Alexander Sergunin* (Professor, St. Petersburg State University, Russia) assesses the "Changes in the Perception of Military Threats, Challenges, Vulnerabilities and Risks in Russia (1991–2008)", while *Pál Dunay* reviews in chapter 13 from the outside "Russian security policy in the 21st century based on the experiences of its first decade". This is followed in chapter 14 by a critical review by *Hans Günter Brauch* of the: "Security Threats, Challenges, Vulnerabilities and Risks in US National Security Documents (1990–2010)" that covers the two decades since the end of the Cold War of the US administrations of George Bush (1989–1993), William J. Clinton (1993–2001), George W. Bush (2001–2009) and Barack Obama (since 2009). This section concludes in chapter 15 with an essay by *Zhongqin Zhao* (Brig. General, Associate Professor, Military Academy, Shijiazhuang, China) on the "Non-traditional security and the new concept of security of China".

The third section shifts the focus on the Middle East and on West Africa. In chapter 16, *Gamal Selim* (PhD candidate, University of Calgary, Canada from Egypt) assesses the "Perceptions of hard security issues in the Arab world", while in chapter 17, *Mohamed El-Sayed Selim* (Professor, Kuwait University from Egypt) analyses the: "Arab perceptions of soft security issues".

In the last two chapters on West Africa, *Kwesi Aning* (Head, Conflict Prevention Department, Kofi Annan Center, Accra, Ghana) and *Andrews Atta-Asamoah* (Researcher, *Institute for Security Studies* (ISS), Nairobi, Kenya from Ghana) analyse in chapter 18: "Military challenges and threats in West Africa", while *John Emeka Akude* (Lecturer, Research Fellow, University of Cologne, Germany from Nigeria) gives in chapter 19 a theoretically-based empirical analysis on "Weak sates and security threats in West Africa".

1.6.3 Environmental and Human Security Dangers in the Near East and Three Regional Prospects until 2020 and 2050

This third part consists of nine chapters that are organized in two sections, whereof in the first part authors from Tunisia, Palestine and Israel address environmental and human security dangers in the Middle East and North Africa, and in the second section three chapters deal with regional environmental security prospects until 2020 and 2050 and potential impacts that may create instability and conflicts.

In chapter 20, *Bechir Chourou* (Director, University of Tunis-Carthage, and Professor of International Relations from Tunisia who taught in the United States, Europe and Tunisia) discusses multiple "Environmental challenges and risks in North Africa"; in chapter 21: *Bassam Ossama Hayek* (Director, Ecotech Park, *Royal Scientific Society* (RSS)., *Royal Scientific Society*, Amman, Jordan) and *Nisreen Daifallah Al Hmoud* (Researcher, Environmental Research Centre (RSS), Jordan) analyse: "Water degradation as a human security challenge in Jordan"; and in chapter 22: *Marwan Haddad* (Professor, Nablus University, Palestine) assesses: "Water scarcity and degradation in Palestine as challenges, vulnerabilities and risks for environmental security".

The next two chapters provide two distinct analyses on climate change impacts from a Palestinian and Israeli perspective. In chapter 23, *Hilmi S. Salem* (Research Professor and Director General, Applied Sciences and Engineering Research Centers, Palestine Technical University Kadoorie, Palestine) discusses "Social, environmental, and security impacts of climate change on the Eastern Mediterranean"; while in chapter 24 *Arie Issar* (Professor em., Ben Gurion University, Beer Sheva, Israel) develops his own concept of "Progressive development of the water resources of Israel and Palestine to mitigate the negative impact of global warming". This section concludes with chapter 25 by *Mohamed Dajani Daoudi* (Professor and director of America Institute, Al Quds University, Jerusalem) and *Ashraf M. Dajani* (Ph. D. Candidate, European University Institute, Florence, Italy from Palestine) on: "Jerusalem: Where To? In search for hidden opportunities", in which both authors discuss proposals by Christians, Jews and Muslims and develop their own concept of a sustainable conflict resolution for solving the highly disputed Jerusalem question.

In chapter 26, *Hans Günter Brauch*, discusses "Human and Environmental Security Challenges Posed by Global Environmental and Climate Change for the Mediterranean", while *Ernst Giese* (Professor emeritus, University of Giessen, Germany) and *Jennifer Sehring* (Assistant professor, University of Würzburg, Germany) assess in chapter 27 the impacts of "Global environmental change and conflict potential in Central Asia" and in chapter 28: *Thomas Heberer* (Professor, University Duisburg-Essen, Germany) and *Anja Senz* (Lecturer, University of Duisburg-Essen) analyse the "Impact of environmental change on stability and conflict potentials in China".

1.6.4 Threats, Challenges, Vulnerabilities and Risks for Urban Centres in Hazards and Disasters

In part IV the introductory chapter 29 by *Mark Pelling* (Reader, King's College, London, UK) offers a conceptual introduction on "The vulnerability of cities to disasters and climate change: A conceptual framework". In chapter 30 *Fabien Nathan* (Project Manager at Sogreah Consultants in Echirolles, France), discusses "Vulnerability to natural hazards: case study on landslide risks in La Paz". In chapter 31: *Mabel-Cristina Marulanda* (*Technical University of Catalonia* (UPC), Barcelona, Spain from Colombia), Omar Darío Cardona A. (Colombia) and *Alex H. Barbat* (Professor, UPC, Barcelona, Spain) in a case study on Latin America are "Revealing the impact of small disasters to the economic and social development"; while in chapter 32: *Carmen Lacambra* (PhD candidate, University of Cambridge, UK from Colombia) and *Kaveh Zahedi* (Climate Change Coordinator at UNEP from the UK) analyse: "Climate change, natural hazards and coastal ecosystems in Latin America: A framework for analysis".

In chapter 33 *Monalisa Chatterjee*, (PhD candidate, Rutgers University, USA from India) addresses the: "Flood loss redistribution in a Third World megacity: The case of Mumbai"; while in chapter 34: *Reena Singh* (Research associate, University of Cologne, Germany from India) focuses on: "Coping with water- and wastewater-related risks in the megacity Delhi"; and in chapter 35: *Nanda Kishor* (Doctoral Fellow, University of Hyderabad, India) offers a critical discussion on: "Politics of displacement and vulnerability".

In chapter 36 by *Xiaomeng Shen* (Associate academic officer, United Nations University Institute for Environment and Human Security (UNU-EHS) Bonn, Germany from China) focuses on "Linking Oriental and Western thinking to mitigate flood risk comparing risk perceptions of floods: The cases of Beijing and Bonn". In the next two chapters on hazards in Istanbul, *Sidika Tekeli-Yesil* (Research assistant, Institute of Social and Preventive Medicine, Swiss Tropical Institute in Basel, Switzerland from Turkey) analyses in chapter 37 the "Preparation for an Earthquake in the megacity Istanbul"; while in chapter 38 *Ebru Gencer* (Consultant at ARC and a member of the ISOCARP Urban Planning Advisory Team for Haiti and Chile) reviews: "Risk management strategies for the predicted earthquake hazard in Istanbul". Finally, in chapter 39: Adeniyi Sulaiman Gbadegesin (Professor, University of Ibadan, Nigeria); *Felix Olorunfemi* (Research Fellow, *Nigerian Institute of Social and Economic Research* (NISER), Ibadan, Nigeria) and *Usman Adebimpe Raheem* (Lecturer, University of Ilorin, Nigeria) assess the "Urban vulnerability to climate change and natural hazards in Nigeria".

1.6.5 Coping with Global Environmental Change: Climate Change, Desertification, Water Management, Food and Health

This part is organized in five sections and includes 28 chapters. First, in chapter 40 *Debarati Guha-Sapir* (Director, WHO *Collaborating Centre for Research on the Epidemiology of Disasters* (CRED) and Professor, University of Louvain, Brussels, Belgium) and *Femke Vos* (Researcher, CRED, University of Louvain, Brussels from the Netherlands and Belgium) offer a statistical overview on "Quantifying global environmental change impacts: methods, criteria and definitions for compiling data on hydro-meteorological disasters". The following five sections deal with the coping activities and efforts with regard to climate change (section A with chapters 41 to 46), to soil and desertification (section B with chapters 47 to 55), water management (section C with chapters 56–60), food (section D with chapters 61 to 65) and health (section E with chapters 66 to 67).

In section A on climate change, *Stefan Bauer* (Senior researcher, German Development Institute, Bonn; research assistant, German Advisory Council on Global Change (WBGU), Berlin, Germany) in chapter 41 addresses "Stormy weather: International security in the shadow of climate change". In chapter 42 *Jürgen Scheffran* (Professor, Hamburg University, Germany) offers a theoretical analysis on: "Security risks of climate change: vulnerabilities, threats, conflicts and strategies", while *Anders Jägersköp* (Programme Director, Stockholm International Water Institute (SIWI), Stockholm, Sweden) in chapter 43 discusses: "New threats? Risk and securitization theory on climate change and water".

The next two chapters focus on the Nile River and the Nile Basin. In chapter 44 a team of nine authors consisting of *Carlo Buontempo* (Senior scientist, Met Office Hadley Centre, UK from Italy), *Jens Kristian Lørup* (DHI, Denmark), *Mamdouh A. Antar* (Manager, Nile Forecast Centre, Ministry of Water Resources and Irrigation, Planning Sector, Cairo, Egypt), *Michael Sanderso* (Senior climate consultant, Met Office Hadley Centre, UK), *Michael Butts* (Head, Inno-

vation for Water Resources and Environmental Management, DHI, Denmark from New Zealand), *Erika Palin* (Climate change consultant, Met Office Hadley Centre, UK), *Rachel McCarthy* (Climate change consultant, Met Office Hadley Centre, UK), *Richard Jones* (Manager, regional climate predictions, Met Office Hadley Centre, UK) and *Richard Betts* (Head, climate impacts, Met Office Hadley Centre, UK) are "Dealing with uncertainties in climate change impacts assessments: A case study on the Nile Basin", *Mohammed El Raey* (Professor em., University of Alexandria, Egypt) in chapter 45 gives an empirical analysis of: "Mapping areas affected by sea-level rise due to climate change in the Nile Delta until 2100". Finally, in chapter 46 *Hans Jürgen Boehmer* (Senior research scientist and managing director, *Interdisciplinary Latin America Center* (ILZ), University of Bonn, Germany) analyses the "Vulnerability of tropical montane rain forest ecosystems due to climate change".

In section B on issues of soil degradation, drought and desertification in drylands nine chapters address a wide area of themes that are related to environmental security issues. In chapter 47, *Hans Guenter Brauch* and *Úrsula Oswald Spring* introduce into the theme of "Securitizing land degradation and desertification: A proactive soil security concept". In chapter 48 *Uri Safriel* (Professor, Hebrew Universty, Jerusalem, Israel) analyses: "Alternative livelihoods for attaining sustainability and security in drylands", while in chapter 49 *Adeel Zafer* (Director, UNU's Institute on Water, Environment and Health, Hamilton, Canada from Pakistan): addresses "Societal vulnerability to desertification and policy response options". In chapter 50, *Ismail Abd El Galil Hussein* (Chairman, Desert Research Centre, Cairo, Egypt): provides an overview of the "Desertification process in Egypt". In chapter 51, *Tulio Arredondo Moreno* (Researcher, Division Ciencias Ambientales (IPICYT), San Luís Potosí, Mexico) and *Elisabeth Huber-Sannwald* (Researcher, IPICYT, San Luís Potosí, Mexico from Austria) discuss the "Impacts of drought on agriculture in Northern Mexico". In chapter 52 *Pietro Laureano* (President, *Research Centre on Local and Traditional Knowledge* (IPOGEA), Florence, Italy) reviews the "Traditional knowledge in coping with desertification".

The next three chapters address problems of desertification in drylands in the Sahara, of agriculture in drylands in Almería and of impacts of climate change on desertification in Murcia in Spain. Chapter 53 that is co-authored by *Monique Mainguet* (Professor em., University of Reims Champagne Ardenne, France), *Frederic Dumay* (Research engineer, University of Reims Champagne Ardenne, France), *Lahcen Kabiri* (Professor, Moulay Ismaïl University, Meknes, Morocco) and *Boualem Rémini* (Professor, Blida University, Algeria) offer an analysis of "Prodromes of desertification in the Oasis of Tafilalet (Morocco) and specific local solutions". In chapter 54 *Andrés Miguel García Lorca* (Professor, University of Almería, Spain) reviews the "Agriculture in drylands: Experience in Almería"; while in chapter 55 *Francisco López-Bermúdez* (Professor, University of Murcia, Spain), *Jorge García Gómez* (Agronomic engineer, Eurovertice Consultants S.L., Murcia, Spain), *Juan Manuel Quiñonero Rubio* (Ph.D. candidate, University of Murcia, Spain) analyse "Land-use changes, desertification, and climate change impacts in Southeastern Spain".

In section C in five chapters authors from Sweden, China, India, Bangladesh, Niger, Mauritania and Tunisia analyse issues of water management with a specific focus on drylands. In chapter 56 *Jacob Granit* (Project Director, Stockholm International Water Institute (SIWI), Sweden) introduces into the topic by "Reconsidering integrated water resources management: Promoting economic growth and tackling environmental stress". In chapter 57: *Zhanyi Gao* (Director, Department of Irrigation and Drainage, *Institute of Water Resources and Hydropower Research* (IWHR), and Director, National Centre for Efficient Irrigation Technology Research, Beijing, PR China) and *Yaqiong Hu* (Senior Engineer, IWHR and National Centre for Efficient Irrigation Technology Research, Beijing, PR China) focus on "Coping with population growth, climate change, water scarcity and growing food demand in China in the 21st century".

In chapter 58 *Mohammed Rahman Zillur* (PhD candidate, The Australian National University (ANU) from Bangladesh) and *Kuntala Lahiri-Dutt* (Fellow, Australian National University, College of Asia and the Pacific from India) offer an analysis on "Ensuring water security in rural areas of Bangladesh under climate change and non-climatic drivers of change", while in chapter 59 *Kanupria Harish* (Project Director, Jal Bhagirathi Foundation, Jodhpur, India) and *Mathews Mullackal* (Head, Programme Development Group, JBF, Jodhpur, India): discuss "Applying bottom-up participatory strategies and traditional methods of water harvesting in the Desert Thar, Rajasthan". Finally, in chapter 60: Abdelkader Dodo (Hydrogeologist and manager, Iullemeden Aquifer System (IAS) project, Sahara and Sahel Observatory (OSS) Tunis from Niger), *Mohamedou Ould Bab Sy*

(Hydrogeologist, OSS, Tunis from Mauritania) and *Jihad Channem* (Special assistant to Executive Secretary and communications officer, OSS, Tunis from Tunisia) offer an overview on "Coping with water scarcity in the Sahel: Assessing ground water resources in the Western Sahel".

Section D on coping with food security issues combines five chapters. In chapter 61 *John Grin* (Professor, University of Amsterdam and until December 2009 scientific director, Amsterdam School for Social Science Research, the Netherlands) and *Esther Marijnen* (BSC student, University of Amsterdam) discuss "Global threats, Global changes and connected communities in the global agrofood system" and in chapter 62 *Úrsula Oswald Spring* deals with "Genetically modified organisms: A threat for food security and a risk for food sovereignty and survival".

In chapter 63 *Issa Martin Bikienga* (Deputy Executive Secretary, *Comité Permanent inter Etats de Lutte Contre Secheresse dans le Sahel* (CILSS) from Burkina Faso) gives an overview on "Natural disasters and major challenges towards achieving food security in the Sahel: The experience of CILSS", while in chapter 64 *Sreeja Nair* (Research associate, Center for Global Environment Research, TERI, New Delhi, India) focuses on "Responding to climate variability and change under a multi-level governance framework". Finally, in chapter 65 *Cecilia Conde* (Senior Researcher, Centro de Ciencias de la Atmósfera, UNAM, Mexico City, Mexico) addresses "Coping with climate change impacts on coffee and maize for peasants in Mexico."

In section E on coping with health security issues in chapter 66: *Fátima Flores Palacios* (Research Professor, UNAM, Cuernavaca, Mexico) and *Wolfgang Wagner* (Professor, University of Linz, Austria) address "The Impact of AIDS on women's social life in a Mexican rural community", while in chapter 67: Tanja Wolf (WHO Regional Office Europe, Rome, Italy from Germany), Glenn McGregor (Director, School of Environment, University of Auckland, New Zealand from UK) and Anna Paldy (Deputy director, National Institute of Environmental Health, Budapest, Hungary) offer an "Integrated assessment of vulnerability to heat stress in urban areas".

1.6.6 Coping with Hazards and Strategies for Social Vulnerability and Resilience Building

This part combines five chapters by authors from Germany, France, Guatemala, the United States and Mexico that are or were recently working for or connected to the *United Nations University's Institute on the Environment and Human Security* (UNU-EHS) in Bonn (Germany). In chapter 68 *Jörn Birkmann* (Academic officer, head, vulnerability assessment section, UNU-EHS from Germany) offers a theory-guided analysis on: "Regulation and coupling of society and nature in the context of natural hazards". In chapter 69: *K. Marre* (Former academic officer, UNU-EHS) and *Fabrice Renaud* (Acting director, head, environmental assessment and resource vulnerability section, UNU-EHS from France) provide an empirical analysis of "Differentials in impacts and recovery in the aftermath of the 2004 Indian Ocean Tsunami: local examples at different scales in Sri Lanka". *Juan Carlos de Villagrán* (Programme officer, UN-SPIDER Programme, UNOOSA, United Nations Office Vienna, Austria; former academic officer and head, risk management section, UNU-EHS, Bonn, Germany from Guatemala) in chapter 70 addresses: "Risks in Central America: Bringing them under control"; while in chapter 71 *Koko Warner* (Academic officer, head, environmental migration, social vulnerability and adaptation section, UNU-EHS from the USA), discusses "Economics and social vulnerability: Dynamics of entitlement and access". Finally, in chapter 72 *Úrsula Oswald Spring* (first chair holder, MRF chair on social vulnerability, UNU-EHS from Mexico) offers a critical discussion on "Social vulnerability, discrimination and resilience-building in disaster risk reduction".

1.6.7 Coping with Global Environmental Change: Scientific International and Regional Political Strategies, Policies and Measures

This part includes 16 chapters that address in three sections the scientific research goals (section A, chapters 73 to 78) and strategies for coping with GEC, especially the global (section B, chapters 79 to 82) and regional (section C, chapters 83 to 86) and national (section C, chapters 87 to 89) strategies, policies and measures for coping with climate change.

Section A on scientific research goals and strategies for coping with GEC starts with chapter 73 by *Gordon McBean* (Professor and director of policy studies, Institute for Catastrophic Loss Reduction, University of Western Ontario, London, Canada) on "Coping with global environmental change – Need for an interdisciplinary, integrated approach".

The next five chapters provide an overview on the international GEC scientific programmes. In chapter 74 *Rik Leemans* (Professor, Wageningen University;

director, WIMEK graduate school; chair, *Earth System Science Partnership* (ESSP), the Netherlands), *Martin Rice* (ESSP, Paris from UK, PhD Student at Sydney University, Australia), *Ann Henderson-Sellers* (Professor, Macquarie University, ARC Professorial Research Fellow, Climate Risk Concentration of Research; former director, *World Climate Research Programme* (WCRP), Australia) and *Kevin Noone* (Professor, Department of Applied Environmental Science and Stockholm Resilience Centre, Stockholm University; Director, Global Environmental Change Secretariat, Royal Swedish Academy of Sciences, Stockholm, Sweden from the USA) summarize and assess the "Research agenda and policy input of the Earth System Science Partnership for coping with global environmental change".

In chapter 75 *Louise von Falkenhayn* (former Academic Officer, *International Human Dimensions Programme on Global Environmental Change* (IHDP) from Australia), *Andreas Rechkemmer* (Lecturer, University of Cologne and Guest professor Beijing Normal University; former Executive Director, IHDP, from Germany) and *Oran R. Young* (Professor, Bren School of Environmental Science and Management, University of California, Santa Barbara, USA; chair, Scientific Committee, IHDP) give an overview on the activities of "The International Human Dimensions Programme on Global Environmental Change: Taking stock and moving forward".

In chapter 76 *Bruno A. Walther* (Visiting assistant professor, Taipei Medical University Taipei, Taiwan; former science officer, Diversitas from Germany), *Anne Larigauderie* (Executive director, Diversitas, Paris from France) *and Michel Loreau* (Professor, McGill University, Montreal, Canada; chairman, Scientific Steering Committee, Diversitas from Canada) review the activities of "DIVERSITAS: Biodiversity science integrating research and policy for human wellbeing".

In chapter 77 *Kevin J. Noone* (Professor, Department of Applied Environmental Science and Stockholm Resilience Centre, Stockholm University; Director, Global Environmental Change Secretariat, Royal Swedish Academy of Sciences), *Carlos Nobre* (Director, Centro de Previsão de Tempo e Estudos Climáticos – CPTEC, Brazil; chairman, Scientific Steering Committee, IGBP from Brazil) and *Sybil Seitzinger* (Executive Director of the International Geosphere-Biosphere Programme from the USA) assess the "Scientific research agenda of the International Geosphere-Biosphere Programme: Coping with global environmental change".

Finally, in chapter 78: *John A. Church* (Professor, CSIRO, Centre for Australian Weather and Climate Research, Antarctic Climate and Ecosystems Cooperative Research Centre; director, *World Climate Research Programme* (WCRP) from Australia), *Ghassem R. Asrar* (Director, WCRP's Joint Planning Staff from the USA), *Antonio J. Busalacchi* (Professor and director *Earth System Science Interdisciplinary Center* (ESSIC), University of Maryland, USA; Chair, Joint Scientific Committee, WCRP from the USA) and *Carolin E. Arndt* (Programme officer, IPCC Secretariat; scientific consultant, WCRP's Joint Planning Staff from Germany) analyse the "Climate information for coping with environmental change: Contributions of the World Climate Research Programme".

In section B four chapters (79 to 82) review global strategies, policies and measures for coping with climate change focusing on the activities of the IPCC, of UNESCO and UNDP. In chapter 79: *Martin Parry* (Professor, Imperial College, University of London; former Co-Chair, Working Group II, IPCC, FAR from the UK), *Osvaldo Canziani* (Professor, University of Buenos Aires, University of Asunción and La Molina; former Co-Chair, Working Group II, IPCC, FAR from Argentina), *Jean Palutikof* (Professor, Griffith University, Queensland, Australia; former staff director, Working Group II, IPCC, FAR from the UK) and *Clair Hanson* (Senior research associate, University of East Anglia, UK; former deputy head, IPCC Technical Support Unit, UK Met Office, Working Group II, IPCC, FAR from the UK) summarize the "Key IPCC conclusions on climate change impacts and adaptations". In chapter 80 *Peter Bosch* (Former coordinator and editor, Working Group III, IPCC, AR4 from the Netherlands) and *Bert Metz* (Former co-chairman (1997–2008), Working Group III, IPCC, AR4 from the Netherlands) offer an overview on the "Options for mitigating climate change results of IPCC working group III of the Fourth Assessment Report of the IPCC".

In chapter 81 *Walter Erdelen* (Assistant Director-General for Natural Sciences, UNESCO since 2001 from Germany) and *Badaoui Rouhban* (Director, Section, Disaster Reduction, Natural Sciences Sector, UNESCO from Lebanon) review and analyse "Global climate change, natural hazards and the environment: an overview of UNESCO's activities". Finally, in chapter 82 *Yannick Glemarec* (Executive coordinator, UNDP's Global Environment Facility from France), *Veerle Vandeweerd* (Director, Environment and Energy Group, UNDP from Belgium) and *Vivienne Caballero* (Programme officer, UNDP-UNEP Poverty

and Environment Initiative, Regional Office for Latin America and the Caribbean; former climate change programme specialist, Environment and Energy Group, Bureau for Development Policy, UNDP from Colombia) give an overview on the "Climate Change and Development: UNDP's Approach to Helping Countries Build a New Paradigm".

In section C four chapters (83 to 86) discuss regional strategies, policies and measures for coping with climate change. In chapter 83: *Christian Egenhofer* (Senior Fellow, *Centre for European Policy Studies* (CEPS) from Germany), *Arno Behrens* (Research Fellow, CEPS from Germany) and *Anton Georgiev* (Researcher, CEPS from Bulgaria) review "EU strategies for coping with global environmental change: Perspective beyond 2012". In chapter 84 *Paul Harris* (Lingnan University, Hong Kong) assesses efforts for "Coping with climate change in East Asia: Vulnerabilities and responsibilities". In chapter 85 *Ricardo Zapata-Marti* (CEPAL from Chile) reviews and discusses "Strategies for coping with climate change in Latin America: Perspective beyond 2012". In chapter 86 Ariel Macaspac Penetrante (a coordinator of the programme of international negotiation processes at IISA from Germany) discusses "Politics of Equity and Justice in Climate Change Negotiations in North-South Relations".

In section D three chapters (87 to 89) review different national perspectives of the USA, China and Japan. In chapter 87 *Yu Hongyuan* (Assoc. Professor, Shanghai Institutes for International Studies, PR China) and *Paul J. Smith* (Assoc. Professor, US Naval War College, Newport, Rhode Island) analyse the policies of "Climate change: Long-term security implications for China and the international community". In chapter 88 *Hiroshi Ohta* (Professor, Waseda University, Japan) offers an overview on the "Japanese climate change policy: Moving beyond the Kyoto Process". Finally, in chapter 89 *Narichika Kanie* (Assoc. Professor, Tokyo Institute of Technology, Department of Value and Decision Science, Graduate School of Decision Science and Technology) *Hiromi Nishimoto* (Ph.D. student, Graduate School of Global Environmental Studies, Kyoto University), *Yasuaki Hijioka* (Senior Researcher of the National Institute of Environmental Studies in Japan), and *Yasuko Kameyama* (Senior Researcher, National Institute for Environmental Studies) analyse the evolution "Implications of Equity Consideration and Emission Reduction Targets: Lessons from the Case of Japan's Mid-Term Target".

1.6.8 Vulnerability Mapping and Environmental Security Indicators

The following two chapters introduce two technical tools into the environmental security analysis, remote sensing and indicators. In chapter 90 *Juan M. Quiñonero-Rubio* (PhD candidate, University of Murcia; researcher, Technical University of Cartagena, Spain), *Francisco López-Bermúdez* (Professor, University of Murcia), *Francisco Alonso-Sarría* (Research associate, *Institute of Water and Environment* (INUAMA), University of Murcia) and *Francisco J. Gomariz-Castillo* (Lecturer, University of Murcia; subdirector, INUAMA) offer an empirical analysis on: "Land use and flood risk changes in coastal areas in South-eastern Spain". From an economic perspective in chapter 91 *Jochen Jesinghaus* (Economist and engineer, European Commission, Joint Research Centre (JRC), Ispra, Italy from Germany) suggests in a conceptual analysis "Monitoring conflict risk: The contribution of globally used indicator systems".

1.6.9 Improved Early Warning of Conflicts and Hazards

These two chapters address improved early warning of conflicts and hazards that represent different research communities that have so far hardly interacted although in many so-called 'complex emergencies' natural hazards have impacted on conflict prone regions, as the case of the December 2004 tsunami has shown for Sri Lanka where the conflict intensified after the tsunami while it was resolved in the case of the Aceh province in Sumatra (Indonesia) with the assistance of an outside mediator.[49] In chapter 92 *Patrick Meier* (Doctoral research fellow, *Harvard Humanitarian Initiative* (HHI), Harvard University; PhD candidate, Fletcher School, Tufts University, USA) analyses "Networking disaster and conflict early warning in responses to climate change" in a case study on CEWARN in East Africa, while in chapter 93 *Juan Carlos Villagrán de León* offers a "Vulnerability assessment in Sri Lanka and the context of tsunami early warning".

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49 See the poster by Úrsula Oswald Spring and Hans Günter Brauch: "Mainstreaming Early Warning of Hazards and Conflicts", presented at the Third International Conference on Early Warning (EWC III): From Concept to Action, Bonn, Germany, 27–29 March 2006; at: <http://www.afes-press.de/pdf/Brauch_Oswald,%20final. pdf>.

1.6.10 Summary and Conclusions

In chapter 94 *Hans Günter Brauch, Simon Dalby* (Professor, Carleton University, Ottawa, Canada) and *Úrsula Oswald Spring* develop a new policy-focused "Political geoecology for the Anthropocene" and finally in chapter 95 *Hans Günter Brauch* and *Úrsula Oswald Spring* suggest in the concluding chapter for "Coping with global environmental change: Sustainability revolution towards a sustainable peace".

1.7 Concluding Remark

These three volumes of this *Global Environmental and Human Security Handbook for the Anthropocene* (GEHSHA) offer a global mapping of the manifold and diverse reconceptualizations of security that have been triggered by the end of the Cold War, the impact of the globalization process and by the new dangers and concerns posed by multiple issues of GEC for the security and survival of humankind, less for the 'top billion' of the people in OECD countries but especially for the rest of the world, most particularly for those that were excluded from economic growth since the end of World War II. The rethinking of their political and ecological spokespersons matters and should not be ignored any longer during the 21st century.

2 Concepts of Security Threats, Challenges, Vulnerabilities and Risks

Hans Günter Brauch

2.1 Introduction[1]

The reconceptualization of security has been triggered by the end of the Cold War, by the process of globalization, and by the gradual transition from the Holocene to the Anthropocene phase of earth history (Brauch 2008, 2009, chap. 1 by Brauch/Oswald Spring above). From a philosophical perspective, in the contemporary security discussion the "dual moment of prevention and compensation of genuinely social and technical uncertainties" (Makropoulos 1995: 745–750) becomes decisive. These new uncertainties are no manifest or latent dangers emerging from individuals and societal groups that can be prevented by police and political measures but 'societal risks'. This implies that security is no longer a situation free of dangers, but rather an 'insurance' as a 'technology of risks' becomes a disposition of the social steering of modern societies. With the shift of focus from protection against concrete dangers towards insurance in the context of abstract risks, security has become "a general 'societal idea of value' (*Wertidee*) and a universally employed 'normative concept', that is used with different meanings in an affirmative manner" (Makropoulos 1995: 749).

Today 'security' as a political value, at least in Western thinking, has no independent meaning and is related to individual or societal value systems. As a social science concept, "*security* is ambiguous and elastic in its meaning" (Art 1993: 820–22). Wolfers (1962) pointed to two sides of the security concept: "Security, in an *objective* sense, measures the absence of threats to acquired values, in a *subjective* sense, the absence of fear that such values will be attacked". From the perspective of social constructivist approaches in international relations (Adler 1997; Fearon/Wendt 2002; Risse 2003; Wendt 1992, 1999) 'security' is conceived as an outcome of a process of social and political interaction where social values and norms, collective identities and cultural traditions are essential. From this perspective, security is always *intersubjective* or "security is what actors make of it" (Wendt 1992).

For Wolfers security refers to an *absence of objective dangers*, i.e. of security 'threats', 'challenges', 'vulnerabilities' and 'risks', and of *subjective fears or concerns*, and to the *perception thereof*. From a realist perspective, *objective* security is achieved when the dangers posed by manifold threats, challenges, vulnerabilities and risks are avoided, prevented, managed, coped with, mitigated and adapted to by individuals, societal groups, the state or regional or global international organizations. From a social constructivist approach, security is achieved once the perception and fears of security 'threats', 'challenges', 'vulnerabilities' and 'risks' are allayed and overcome. While objective factors in the security perception are necessary, they are not sufficient. Subjective factors influence security perceptions. The *perception* of security dangers depends on the worldviews or traditions of the analyst (Bull 1977, Wight 1991) and on the mind-set of policymakers (Booth 1979, 1987: 39–66) that have often distorted the assessment of 'new challenges' and that "freeze international relations into crude images, portray its processes as mechanistic responses of power and characterize other nations as stereotypes" (Booth 1987: 44; 1998: 28). Influenced by these worldviews and mind-sets, security is a concept of *s* (Buzan/Hansen 2009) and of *peace and conflict research* (Albrecht/Brauch 2008, 2009).

Since 1990 new debates have emerged between traditional approaches, critical security studies, and

1 This chapter is based on several earlier papers of the author most particularly on two reports he wrote for UNU-EHS (Brauch 2005, 2005a), several chapters he wrote for volume 39 of *UNESCO's Encyclopaedia of Life Support Systems* (Brauch 2007, 2007a, 2007b, 2007c), as well as on a contract report he wrote for UNESCO (Brauch 2006, 2008a). The permission of these institutions to use the previous material is kindly acknowledged. The author appreciates the very useful comments of three reviewers.

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constructivist approaches. While *national security* has the state as the major referent, *human security* has human beings and humankind as the referent. The answers to the questions of security for whom, from whom, by whom, of what values, from what threats and by what means differ fundamentally between both concepts.

On the background of the observed widening, deepening and sectorialization of the security concept, this chapter reviews four *objective security dangers* and *subjective security concerns* often referred to as security 'threats' (2.2.), 'challenges' (2.3), 'vulnerabilities' (2.4) and 'risks' (2.5), and the use of these basic concepts in different scientific research communities, especially those working on global environmental change, climate change, as well as hazards and disasters. It discusses the relevance of these four concepts for the 'environmental' security dimension (2.6) and for 'human security' (2.7) approaches. The goal of this chapter is to enhance synergies and to mainstream related efforts to strengthen proactive policy initiatives (2.8).

2.2 Reconceptualizing 'Security Threats'

2.2.1 'Threat' as a Political Term

The English term 'threat', or 'menace' (Latin: 'trudere' or to push, thrust; French: 'menace'; Italian: 'minaccia'; Spanish: 'amenaza' or: 'conminación'; Portuguese: 'ameaça'; German: 'Drohung' or 'Bedrohung') refers to "a communication of a disagreeable alternative to an individual or group by one in authority or who pretends to be" (Koschnik 1992: 210). According to *Webster's Dictionary* a 'threat' is "1. a statement or expression of intention to hurt, destroy, punish, etc. in retaliation or intimidation", and 2. "an indication of imminent danger, harm, evil etc.; as, the threat of war" (McKechnie 1979: 1901). Langenscheidt-Longman (1995) defines 'threat' as: "1. a statement that you will cause someone pain, unhappiness, or trouble...; 2. the possibility that something very bad will happen (famine, attack etc.)...; 3. someone or something that is regarded as a possible danger". For the *Compact Oxford English Dictionary* threat means: "1. a stated intention to inflict injury, damage, or other hostile action on someone; 2. a person or thing likely to cause damage or danger; 3. the possibility of trouble or danger" (Soanes 2000: 1199). For the *Shorter Oxford English Dictionary* threat refers to "1. A throng or crowd of people; a troop, a band. ... 2. Oppression, compulsion; torment; distress, misery; danger. ... 3. A declaration of an intention to make some hostile action, esp. a declaration of an intention to inflict pain, injury, damage, or other punishment in retribution for something done or not done. ... An indication of the approach of something unwelcome or undesirable; a person or thing regarded as a likely cause of harm etc." (Oxford ^{5}2002: 3251). Thus, in the common use of the term in contemporary British and American English the word 'threat' has multiple meanings.

2.2.2 'Threat' as a Scientific Concept

In security policy and studies 'threat' is used as a 'political term' and as a 'scientific concept' that remains undefined in many social science dictionaries. Robertson (1987: 304–305) used the concept 'threat assessment' as an analysis of "the reasons behind an opponent's armament programmes" that was often made during the Cold War "on a worst case basis", where "besides personnel and hardware totals" the opponent's strategic doctrine had also to be taken into account.

During the Cold War, within the framework of *national security*, Buzan (1983: 57) pointed to a dual threat to state institutions by force (capabilities) and ideas (ideology). The state's territory "can be threatened by seizure or damage, and the threats can come from within and outside of the state". For Buzan different components of the state are vulnerable to different types of threats where strong states are primarily threatened by outside forces while weak states may be challenged both from within and outside. From a national security perspective, Buzan (1983: 75–83) distinguished between *military threats* (seizure of territory, invasion, occupation, change of government, manipulation of policy), *economic threats* (export practices, import restrictions, price manipulations, default on debt, currency controls etc., and those to domestic stability), and *ecological threats* (damaging the physical base of the state). These threats, Buzan (1983: 88) argued, "define [the state's] insecurity, and set the agenda for national security as a security problem". These threats require to understand the state's vulnerabilities. Weapons development as a combination of capabilities and intentions has been semi-independent from threats. Dealing with specific threats, an international security strategy focuses on "the sources and causes of threats, the purpose being not to block or offset the threats, but to reduce

or eliminate them by political action" (Buzan 1983: 218).

This type of 'threat' has disappeared in Europe with the end of the East-West conflict in 1990, and thus the threat perception has fundamentally changed. Already during the first (1969–1975) and second détente (1986–1989) the classic threat concept lost in importance. Since 1990, threat is also defined as referring to the dangers the planet earth is confronted with due to the manifold destructive potentials of the environment and its global and societal consequences. Steiner (2001) pointed to the fundamental change in the risks, dangers and threats since 1990, which has increased the dangers of violent domestic wars and has reduced the effectiveness of arms control regimes. But outside Europe, e.g. in the Middle East, in South Asia or on the Korean Peninsula, many of the old threats have not been overcome.

However, the increase in asymmetric forms of warfare (Kaldor 1999; Kaldor/Vashee 1997; Münkler 2002, 2005), and of the increasing role of more sophisticated and brutal non-state actors (or terrorist networks) but also the negative global impacts of uncontrolled financial activities (by greedy speculators and hedge funds as a kind of 'structural terrorism'[2] with non-violent means provoking new forms of personal and structural violence) have made the security dangers more complex and the security risks less calculable and predictable.

2.2.3 Redefining the Concept of 'Threat' to Security since 1990

Two decades after the end of the Cold War, Buzan and Hansen (2009: 11–12) referred to four key questions that structure *international security studies* (ISS) focusing on the state as the key referent object, on including internal and external threats that have been increasingly blurred by globalization, on the widening beyond the military dimension and the use of force and its close link to "a dynamic of threats, dangers and urgency". While during the Cold War a majority of ISS focused on external threats, since its end "ethnic conflict and civil wars came to the fore, so did questions of domestic stability and cohesion (Posen 1993; Van Evera 1994; Kaufmann 1996)" (Buzan/Hansen 2009: 29) that were discussed in the concept of 'societal security' introduced by the Copenhagen School (Wæver/Buzan/Kelstrup/Lemaitre 2003; Buzan/Wæver/de Wilde 1998; Wæver 2008a).

The threat concept as the basis for military planning and legitimating military programmes – at least among many NATO countries – has fundamentally changed after 1990. With the widening of the security concept from the traditional military and diplomatic security, to the new economic, societal and environmental dimensions, the threat concept has also widened and been applied to a series of new threats not only to the 'state' but also to the other referents of new security concepts, from human beings to global security.

The early proponents of environmental security have extended 'threats' from the military to the environmental realm. Ullman (1983: 133) defined a national security *threat* as "an action or sequence of events that: 1) threatens drastically and over a relatively brief span of time to degrade the quality of life for the inhabitants of a state; or 2) threatens significantly to narrow the range of policy choices available to the government of a state or to private non-governmental entities (persons, groups, corporations) within the state". For Mathews (1989) and Myers (1989, 1989a) the *new security threats* of the future included population growth, resource scarcity, and environmental degradation.

The Brundtland Commission (1987) also referred to two great threats facing humankind: "The first is that of nuclear exchange. ... The second is that of environmental ruin worldwide". In 1988 President Gorbachev stressed: "The relationship between man and the environment has become menacing. ... The threat from the sky is no longer missiles but global warm-

2 The term 'structural terrorism' has been inspired by Galtung's (1969, 1975) differentiation between personal and structural violence. This term has been used by Kapitan (2004) for states: "States, in particular, accomplish such *structural terrorism* by forcibly implementing or impeding institutions, laws, policies, and practices that result in harm to noncombatants." F.H. Knelman: "Who Are the Terrorists" (October 2001), in: Nuclear Peace Foundation; at: <http://www.wagingpeace.org/articles/2001/10/00_knelman_who.htm> (16 May 2010) referred to "internal or structural terrorism derived from poverty, disease, murder, hunger and deprivation of all kinds". The term 'structural terrorism' is used here in a different meaning by pointing to non-state economic actors and processes that have contributed to the worst global financial crisis since 1929 and that have added with speculation on food commodities to price hikes in basic food staples and the resulting food riots causing many casualties from protests and more who died of hunger.

ing". Brundtland (1993: 189–194) pointed to the new 'threats' to security that "may be caused by social unrest caused by poverty and inequality, by environmental degradation, by internal conflicts leading to new flows of refugees". She noted that "the pressure on the environment from a rapidly growing world population will increase the likelihood of such conflicts. Climate change, desertification, deforestation, massive loss of species and biological diversity, depletion of freshwater resources and soil erosion are global trends that are not sustainable". As most serious she saw "the threats to the world's atmosphere".

In 1992, Senator Al Gore referred to several environmental threats from the local (tactical) to the global (strategic) level such as global warming and ozone depletion. In 1997, Eilen Claussen defined as global environmental threats those "which are human-caused and have, or can be expected to have serious economic, health, environmental, and quality of life implications for the United States". Irrespective of the application of this concept to environmental problems, this author suggested to limit the threat concept to hardware related military problems, and to describe dangers posed by the environment as "environmental security challenges, vulnerabilities and risks" (Brauch 2005a, 2008a). However, in political practice, e.g. in the US national security strategy papers (see chap. 12 by Brauch below); this suggestion could not be observed.

2.2.4 Application of a Widened Concept of Security Threats

Several countries reacted in their national defence white papers and national strategic documents to the fundamental change in the nature of threats with an extended security concept that included many new non-military soft security threats such as: economic vulnerabilities, environmental challenges, political and societal instabilities (e.g. German Defence White Paper; BMVg 1994: 25–26) pointing to a "multitude of risk factors of a different nature with widely varying regional manifestations". The official German document suggested that "risk analysis of future developments must be based on a broad concept of security ... They must include social economic and ecological trends and view them in relation to the security of Germany and its allies."[3]

In the United States, several national security strategy papers of the Clinton administration have pointed to the fundamental change in security threats (Matthew/Mc Donald 2009). The administration of George W. Bush in its *Quadrennial Defense Review Report (*QDR) of 30 September 2001 announced: "to shift the basis of defence planning from a 'threat-based' model that has dominated thinking in the past to a 'capabilities-based' model in the future [that] ... focuses more on how an adversary might fight rather than specifically who the adversary might be or where a war might occur" (Brauch 2003b, chap. 12 by Brauch). The first QDR of the Obama Administration of 1 February 2010 referred to "Climate change and energy [as] two key issues ... in shaping the future security environment". It further acknowledged that

> climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fragile governments. Climate change will contribute to food and water scarcity, will increase the spread of disease, and may spur or exacerbate mass migration. While climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world. In addition, extreme weather events may lead to increased demands for defense support to civil authorities for humanitarian assistance or disaster response both within the United States and overseas. ... DoD has undertaken environmental security cooperative initiatives with foreign militaries that represent a nonthreatening way of building trust, sharing best practices on installations management and operations, and developing response capacity (DoD 2010: 85).

The Pentagon now considers climate change as a "legitimate national security concern" (Parthermore/Rogers 2010), even though not yet specifically as a 'national security threat'. This is also reflected in the first *National Security Strategy* of the Obama Administration (chap. 12 by Brauch).

The guarantee of "international peace and international security" was emphasized in the Covenant of the League of Nations (28 April 1919) and in the United Nations Charter (26 June 1945) "to maintain international peace and security". But in 1919 and in 1945, "development" and "environment" were not yet political concepts.

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3 The most recent German Defence White Paper refers to new opportunities as well as risks and threats posed by globalization and it notes among the strategic framework conditions "global challenges, opportunities, risks and dangers" (BMVg 2006: 20–23) and lists among them: globalization, terrorism, proliferation and armament tendencies, regional conflicts, illegal arms trade, impediments for development and fragile statehood, transportation routes, resources, communication, energy security, migration and pandemics.

The UN Charter distinguished among three security systems: a universal system of *collective security* (Chap. VI: Art. 33–38; Chap. VII: Art. 39–50); "*regional arrangements or agencies*" (Chap. VIII: Art. 52 to 54); and a right of "*individual or collective self-defence*" (WEU, NATO; WTO) in Art. 51. While the first two systems deal with "threats to peace and international security" from within, among member states, the third is oriented against an outside threat. They perform three functions: peaceful settlement of disputes, peace enforcement and peacekeeping. Art. 1.1 of the UN Charter calls on its members "to take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace", "to develop friendly relations among nations" and "to achieve international co-operation in solving international problems of an economic, social, cultural, or humanitarian nature". The UN Charter relies on a narrow 'nation'-centred concept of 'international security' and on a concept of 'negative peace', although Art. 1.1, 1.2, and Art. 1.3 "indicate that peace is more than the absence of war" (Wolfrum 1994: 50).

During the Cold War, collective self-defence prevailed while collective security was paralysed (Brauch/Mesjasz/Møller 1998). After 1990, collective security was temporarily strengthened, but with the failure to solve the Gulf War (1990–1991) and to cope with the post-Yugoslav conflicts (1991–1999) within the framework of the UN, NATO and the EU emerged as key security institutions. Since 1990 the UN Security Council decisions on humanitarian interventions and the debate on 'environmental' and 'human' security have moved beyond these constraints and also the meaning of peace and security has significantly changed (Bothe 2008).

The Report of the Secretary-General's High-level Panel on Threats, Challenges and Change (2 December 2004) reflects this widening of the 'security' concept pointing to new tasks for the UN system in the 21st century. In the new emerging security consensus, collective security rests on three basic pillars (Synopsis of the Report):

> Today's threats recognize no national boundaries, are connected, and must be addressed at the global and regional as well as the national levels. No State, no matter how powerful, can by its own efforts alone make itself invulnerable to today's threats. And it cannot be assumed that every State will always be able, or willing, to meet its responsibility to protect its own peoples and not to harm its neighbours. ... Differences of power, wealth and geography do determine what we perceive as the gravest threats to our survival and well-being. ... Without mutual recognition of threats there can be no collective security. ... What is needed is nothing less than a new consensus. ... The essence of that consensus is simple: we all share responsibility for each other's security.[4]

The High-level Panel distinguished among six clusters of threats, ranging from economic and social threats (including poverty, infectious disease and *environmental degradation*, interstate and internal conflict, weapons of mass destruction, terrorism and transnational organized crime. Thus, for the first time "environmental degradation" is listed among the threats confronting the UN that require preventive action "which addresses all these threats". Development "helps combat the poverty, infectious disease and environmental degradation that kill millions and threaten human security". The High-level Panel (§ 53) claims:

> Environmental degradation has enhanced the destructive potential of natural disasters and in some cases hastened their occurrence. The dramatic increase in major disasters witnessed in the last 50 years provides worrying evidence of this trend. More than two billion people were affected by such disasters in the last decade, and in the same period, the economic toll surpassed that of the previous four decades combined. If climate change produces more flooding, heat waves, droughts and storms, this pace may accelerate.

The High-level Panel notes that "rarely are environmental concerns factored into security, development or humanitarian strategies" and it points to the lack of effective governance structures to deal with climate change, deforestation and desertification, as well as to the inadequate "implementation and enforcement" of regional and global treaties. In the discussion of the legitimacy of the use of military force, the High-level Panel distinguishes between "harm to state or human security". Two of the 101 recommendations of the High-level Panel deal with environmental issues, with renewable energy sources and with the Kyoto Protocol. The High-level Panel mentioned 'human security' several times, but its main focus remained on the 'state' as the cause and as a key actor in dealing primarily with military and societal threats.[5]

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4 See for download of the complete report and press releases at: <http://www.un.org/secureworld/>.

5 For an assessment of the High-level Panel see von Einsiedel, Nitzschke and Chhabra (2008); on the 'security development' nexus see Sending (2008), Katseli (2008), Klingebiel and Roehder (2008) and most recently see Tschirgi, Lund and Mancini (2010).

On 21 March 2005, in his own report: "*In larger freedom: towards development, security and human rights for all*", Kofi Annan (2005) drew both on the High-level panel and on the assessment of the *Millennium project*. He analysed the three key goals of development as 'freedom from want', of security as 'freedom from fear', and human rights as 'freedom to live in dignity'. With regard to security, Annan (2005: 24) noted a lack of consensus on the assessment of the threat. He has listed among the present threats to peace and security:

> international war and conflict ..., civil violence, organized crime, terrorism and weapons of mass destruction. They also include poverty, deadly infectious disease and environmental degradation since these can have equally catastrophic consequences. All of these threats can cause death or lessen life chances on a large scale. All of them can undermine States as the basic unit of the international system. ... In our globalized world, the threats we face are interconnected. The rich are vulnerable to the threats that attack the poor and the strong are vulnerable to the weak, as well as vice versa. A nuclear terrorist attack on the United States or Europe would have devastating effects on the whole world.

Following his High-level Panel, Annan discussed four threats in detail: a) preventing catastrophic terrorism; b) organized crime; c) nuclear, biological and chemical weapons; and d) reducing the risk and prevalence of war.

The *European Union Security Strategy* (European Council 2003) also referred to five key threats: "terrorism, weapons of mass destruction, regional conflicts, state failure, and organized crime". But this strategy also pointed to new global challenges and vulnerabilities confronting the European Union. Since 2007, both the UN and the EU have repeatedly stated that climate change poses new threats to international security (chap. 1 by Brauch/Oswald Spring).

2.3 Reconceptualizing 'Security Challenges' .

2.3.1 The Political Term of 'Challenges' for Security

For 'challenge' (Lat.: 'calumnia', false accusation; Fr.: 'defi'; Sp.: 'desafío', 'reto'; Port.: 'desafio'; It.: 'sfida'; Ger.: 'Herausforderung') the synonyms are "confrontation, defiance, interrogation, provocation, question, summons to contest, test, trial, ultimatum", as well as "questioning, dispute, stand opposition; difficult task, test trial". *British* English dictionaries offered these meanings of the term challenge: "1. something difficult ... that tests strength, skill, or ability...; 2. questioning rightness: a refusal to accept that something is right and legal; 3. invitation to compete: a suggestion to someone that they should try to defeat you in a fight, game etc.; 4. a demand to stop: a demand from someone such as a guard to stop and give proof who you are, and an explanation of what you are doing"; or: "a demanding task or situation"; as well as: "call to try one's skill or strength; demand to respond or identify oneself; formal objection"; or: "a call to engage in a fight, argument or contest; a questioning of a statement or fact; a demanding or stimulating situation, career, etc."

2.3.2 The Political and Scientific Concept of 'Security Challenges'

The term 'challenge' has often been used for security and global issues but it has hardly been defined, and in many cases it is used synonymously with 'threat' (chap. 12 by Brauch).[6] Dodds and Schnabel (2001: 42–43) pointed to 'new' and 'non-traditional' security challenges as a major concern in the post-cold war security environment. They argued "that the general public's conception of the security environment has altered so dramatically as we enter the new millennium is an indicator of how significantly this environment may have actually changed". They see as major forces for the reconceptualization of security "the increasing level of globalization" that "has engendered a growing sense of vulnerability to ... remote threats, such as distant conflicts, contagions, crop failures and currency fluctuations".

2.3.3 Application of the Concept of 'Security Challenges'

Van Ginkel and Velásquez (2001: 58–70) pointed to these environmental challenges: a) ozone depletion; b) impact of toxic chemicals on the global ecosystem; and c) increasing greenhouse emissions and their negative reinforcements as well as to "uncertainty about

6 *Security Challenges* is the name of Australia's leading peer-reviewed journal on future security issues that "reaches a wide audience of established military, government, commercial and academic experts as well as up-and-coming younger players in the security field" that aims for "innovative thinking about future challenges to the security (broadly defined) of Australia and other countries in the Asia Pacific region. See at: <http://www.securitychallenges.org.au/index.html>.

the future and an element of surprise", especially if associated with natural and man-made environmental disasters. They stressed eight sub-themes: "global environmental governance, water, urbanization, industry and sustainability, global food security, energy requirements for the next millennium, global governance of biological diversity, land degradation, and the atmosphere".

In a report of the Trilateral Commission, Slaughter, Bildt and Ogura (2004) tried "to integrate traditional understandings of state security ... with an appreciation of the magnitude and importance of 'global security issues': terrorism, environmental degradation, international crime, infectious diseases and refugees". They organized the many ideas and proposals in five basic dichotomies: "State security versus human security; hard versus soft interventions; legality versus legitimacy; pre-emption versus prevention; and states versus non-state actors" (Slaughter 2004).

The former director of the Stockholm International Peace Research Institute (SIPRI), Amb. Alyson J.K. Bailes (2003; also chap. 6 below), in a talk on "New Security Challenges for the EU" noted several human security challenges confronting Europe: "such as the collapse of the environment, pollution of food and natural resources, human and animal disease and genetic manipulation, employment, health care and social security in general". These are not just subjective but also scientific perceptions. She referred to many non-military, non-intentional threats, such as:

> greenhouse effect, depletion of ozone, badly-handled migration, ageing of the population, and an energy crisis as well as the ... case of a nuclear accident. ...The lesson is that many aspects of life in the EU which do fall within the Union's competence but are not normally thought of as security matters are indeed highly relevant to the survival and welfare of our populations, and the more so precisely because of the high level of development and interdependence we have attained. The ... harmonized approaches ... should ... be extended ... to deal e.g. with climatic damage (drought, heat, storm and flood), major cases of pollution, and the interruption of any type of energy supplies.

This comprehensive list of security challenges for the EU in the post-Cold War period indicates a basic shift since 1990 away from primarily military threats from the rival superpower to a broad range of manifold challenges from all dimensions of a widened security concept. Security challenges may refer to less urgent and sometimes non-violent *soft security* problems, such as migration, human and drug trafficking. These issues are less on the external and primarily on the internal security agenda, and thus a topic for the home and justice ministries and agencies, such as national and international police organizations and of the courts but also of non-governmental societal groups. Migration may be a consequence of domestic conflicts emerging from environmental degradation and resource depletion but it will remain difficult to distinguish *push* and *pull* factors.

2.4 Reconceptualizing 'Security Vulnerabilities'

While the concepts of threats and challenges are often used synonymously for hard and soft security dangers, the vulnerability concept has been utilized more widely by many different policy and scientific communities with different meanings.

2.4.1 The Political and Societal Term of 'Vulnerability'

English dictionaries refer to these synonyms 'vulnerability' (Lat.: 'vulnus' or: 'vulnerabilis'; Fr.: 'vulnérabilité'; It.: 'vulnerabile'; Sp.: 'vulnerabilidad'; Port.: 'vulnerável'; Ger.: 'Verwundbarkeit') or 'vulnerable' as: "accessible, assailable, defenceless, exposed, open to attack, sensitive, susceptible, tender, thin-skinned, unprotected, weak, wide open"; and: "1. in danger: in peril, in jeopardy, at risk, endangered, unsafe, unprotected, unguarded; wide open; undefended, unfortified, unarmed, helpless, pregnable; 2. exposed to: open to, liable to, prone to, prey to, susceptible to, subject to, an easy target for; as well as: "non-immunity, susceptibility, danger of, insecurity, exposure, nakedness, helplessness".

According to *Webster's* 'vulnerability' is "the state or property of being vulnerable" where vulnerable refers to: "1. capable of being wounded or physically injured...; 2. open to criticism or attack...; 3. open to attack or assault by armed forces. ...; 4. in contract bridge, liable to increase penalties and entitled to increased bonuses"; or "the quality or state of being vulnerable". *British* dictionaries offer additional meanings: "someone who is vulnerable is easily harmed or hurt emotionally, or morally"; "susceptible to injury, exposed to damage by weapon, criticism, etc."; as well as: "open to temptation, censure etc."; as "unprotected against attack; liable to be hurt or damaged".

2.4.2 Vulnerability as a Scientific Concept

The vulnerability concept is defined in encyclopaedias in the geosciences where the referent object of 'vulnerability' are both human beings, especially children, and the environment. The vulnerability concept is used in the global change literature (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004), on climate change impacts (IPCC 2001a, 2007a) and in the disaster community (ISDR 2004). Vulnerability results from "poverty, exclusion, marginalization and inequities in material consumption", and it is generated by "social, economic and political processes" (Barnett 2001: 132–133). In the context of the precautionary principle O'Riordan (2002: 369) defined vulnerability at the societal level as: "the incapacity to avoid danger, or to be uninformed of impending threat, or to be so politically powerless and poor as to be forced to live in conditions of danger".

For Oliver-Smith (2004: 10) "vulnerability is fundamentally a political ecological concept". As a theoretical framework "vulnerability can become a key concept in translating that multi-disciplinarity into the concrete circumstances of life that account for a disaster". He argues that disasters "are channelled and distributed in the form of risk within society to political, social and economic practices and institutions". Wilches-Chaux (1989: 20–41, 1993) identified 11 types of vulnerability, "natural, physical, economic, social, political, technical, ideological, cultural, educational, ecological and institutional vulnerability". For Oliver-Smith (2004: 11) "vulnerability is conceptually located at the interaction of nature and culture" that also links "social and economic structures, cultural norms and values and environmental hazards". He discussed four questions: 1) the "general contributions of the cultural construction of nature to the social production of disaster"; 2) "how the political and economic forms and conditions that characterize vulnerability are inscribed in an environment"; 3) "the relationship between cultural interpretation and the material world of risk, threat and impact of disasters"; and 4) "how do we theorize the linkages among these three issues, particularly in the context of current patterns of globalization". Nathan (2009: 1125) pointed to a dual vulnerability:

> on the one side ... a tendency to undergo damages, i.e. a state of fragility, or a set of conditions, that raise the susceptibility of a community to the impact of a damaging phenomenon. On the other side, vulnerability is an incapacity to anticipate, cope with, resist to, adapt to and recover from hazards. Vulnerable units are either not resistant, i.e. not capable to withstand the shock (without adapting); and/or not resilient, i.e. not capable to absorb the shock and adapt to come back to an acceptable state.

Nathan (2009: 1125) characterized vulnerability "as a *complex* process encompassing multiple intricate dimensions" that is constantly changing. In his view vulnerability is:

> often *cumulative*, causing disasters that in turn aggravate it, or adding to vulnerabilities to other risks (such as socio-economical risks, etc.). Furthermore, vulnerability is both *hazard-related* ... and *subject-related*. ... Therefore, one has to specify which vulnerability one is talking about, and at which level of analysis (individual, group, society). ... Vulnerability is also highly *differentiated*: different subjects, even at the same 'level', have different vulnerabilities. ... Generally, the most miserable and isolated suffer most, as well as the less organized. ... Vulnerability is *context-dependent*, be it an individual exposed to natural hazards at the household level, or mankind at a global level. These 'transversal' features of global vulnerability apply to each component of vulnerability (Nathan 2009: 1125).

Nathan (2009: 1126) distinguished among two features of vulnerability: *exposure* and *insufficient capacities*.

> a) *physical exposure*: presence and density of the people, habitat, networks, goods and services in risk zones, defining potential losses or damages, both human and non-human (stakes); and b) *socio-ecological*: human-induced ecosystemic perturbations aggravating the natural hazard – such as deforestation, land degradation, street pavement, some engineering practices, climate change, etc.

Furthermore, he pointed to "insufficient capacities to prevent, prepare for, face and cope with hazards and disasters" he separated as:

- *physical weakness*: physical incapacity to resist or recover from a hazard's impact;
- *legal vulnerability*: weak state of the legislative and judiciary regulations to prevent, mitigate, prepare for, face and recover from disasters;
- *organizational vulnerability*: weak state of the organizational disposals, at all levels, to prevent, mitigate, prepare for, face and recover from disasters;
- *technical vulnerability*: inadequate knowledge and/or use of risk management techniques;
- *political vulnerability*: weakness of the political powers, their legitimacy and control. Inadequacy of the control schemes, policies and planning, or broad political conditions;

- *socio-economical vulnerability*: socio-spatial segregation, large inequalities of wealth and of access to the security disposals, misery, anomie and social disorganization, poor social position and social isolation of exposed people, existence of higher social risks undergone by people;
- *psychological and cultural vulnerability*: inadequate security paradigm or risk perceptions; cultural anomie or weakness; attachment to risk zones or risky behaviour, non-willingness or incapacity to protect oneself (Nathan 2009: 1126).

Nathan (2009: 1126; see chap. 30 below) concluded that "the overall vulnerability of an element (or stake) to one or several hazards is a mix of these particular vulnerabilities".

Cardona (2004: 37–51; see also chap. 3 below) proposed to rethink vulnerability and risk from a holistic perspective arguing that in developing countries often social, economical, cultural and educational aspects are "the cause of the potential physical damage". For Cardona "vulnerability of human settlements is intrinsically tied to different social processes. It is related to fragility, susceptibility or lack of resilience of the exposed elements. On the other hand, vulnerability is closely linked to natural and human environmental degradation at urban and rural levels". Cardona (2004: 49) argued that from a social view "vulnerability signifies a lack or a deficiency of development" that often contribute to "disaster vulnerability". He pointed out that population growth, rapid urbanization, environmental degradation, global warming, international financial pressures and war have all increased vulnerability. Cardona argued that vulnerability originates in:

- *Physical fragility* or *exposure*: the susceptibility of a human settlement to be affected by a dangerous phenomenon due to its location in the area of influence of the phenomenon and a lack of physical resistance;
- *Socio-economic fragility*; the predisposition to suffer harm from the levels of marginality and social segregation of human settlements, and the disadvantageous conditions and relative weakness related to social and economic factors; and
- *Lack of resilience*: an expression of the limitations of access and mobilization of the resources of human settlement, and its incapacity to respond when it comes to absorbing the impact.

He pointed to the closely interrelated nature of efforts reducing hazard or vulnerability, thus contributing to risk reduction, and the possibility of future disaster (chap. 3 by Cardona).

According to Heijmans (2004: 115–127) disaster agencies have often focused on physical and economic vulnerability. Based on the literature she distinguished three strategies to address vulnerability:

1. *Nature as cause* → technological, scientific solutions: Reduce vulnerability by early warning systems, technologies to withstand negative impacts (monitor seismic activity, weather forecasting, remote sensing for drought, fire, water control systems, building codes, etc.).
2. *Cost as cause* → economic and financial solutions: Costly prediction and mitigation technologies; reduction of vulnerability by national safety nets, insurance and calamity funds.
3. *Social structure as cause* → political solutions: Socio-economic factors that generate vulnerability, require political and development solutions that transform the social and political structures breeding poverty.

Heijmans (2004: 117ff.) discussed the conceptual relationship between vulnerability and empowerment, argued that the people's perspectives are missing in all three strategies, and also in the perception of vulnerability by the aid agencies. According to Wisner (2004: 183–193) vulnerability is used in the hazard community as:

- Structural engineering vulnerability;
- Lifeline infrastructural vulnerability;
- Communications systems vulnerability;
- Macro-economic vulnerability;
- Regional economic vulnerability;
- Commercial vulnerability; and
- Social vulnerability.

Wisner distinguished four approaches on social vulnerability: a) demographic; b) taxonomic; c) situational; and d) contextual or proactive approach. He criticized that many studies on social vulnerability have devalued local knowledge and coping capacities and he supported efforts to empower people to reclaim their local knowledge (chap. 52 by Laureano). Frerks and Bender (2004: 194–205) argued that the societal focus on vulnerability has shifted from disasters as a natural event to exposure and a complex socially constructed process.

Pelling (2003: 5; also in chap. 29) analysed the vulnerability of cities to natural disasters and the role of social resilience. He defined vulnerability as "exposure to risks and an inability to avoid or absorb poten-

tial harm", *physical* vulnerability as that "in the built environment", *social* vulnerability as that "experienced by people and their social, economic and political systems", and *human* vulnerability as the combination of "physical and social vulnerability".

The 'vulnerability' concept has been widely used, often with different meanings, by the global change research (2.4.3), by the climate change (2.4.4), by the natural hazard (2.4.5) and by the environment, development and early warning community (2.4.6), while the concept of 'social vulnerability' is intensively employed both in the hazard and development research and policy communities (2.4.7). The 'vulnerability' concept was also widely used in the security and strategic community (2.4.8) while the concepts of 'economic' (Crawford 1992, 1993, 1995) and 'financial' vulnerability have become crucial research and policy objects for the economic and policy communities (see chap. 5 and 6 by Czeslaw and Lidia Mesjasz).

2.4.3 Vulnerability as a Scientific Concept in the Global Change Research Community

Steffen, Sanderson, Tyson, Jäger, Matson, Moore III, Oldfield, Richardson, Schellnhuber, Turner and Wasson (2004) address the consequences of changes in the Earth System due to human activities for human well-being. The vulnerability concept offers a useful framework for the study of consequences of global change on human societies. Using a scenario-driven approach they discuss linear projections and non-linear surprises resulting from an integrated assessment approach: "Scenario-driven approaches to impact assessment, even the most sophisticated of the integrated assessment methods, do not allow the vulnerability or resilience of the impacted systems to be assessed directly" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004: 204).

While impact assessment selects one specific environmental stress and seeks to identify the most important consequences for social and ecosystem properties on environmental stress, vulnerability assessment tries to assess the risk of diverse outcomes for a unit of concern (e.g. landless farmers) "in the face of a variety of stresses and identifies a range of factors that may reduce response capacity and adaptation to stressors" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004: 205). While impact assessment offers little guidance among the many environmental stresses,

> vulnerability assessment offers a maturing strategy to provide such guidance. Vulnerability to global environmental change has been conceptualized as the risk of adverse outcomes to receptors or exposure units (human groups, ecosystems and communities) in the face of relevant changes in climate, other environmental variables, and social conditions. ... Vulnerability is emerging as a multi-dimensional concept involving at least *exposure* – the degree to which a human group or ecosystem comes into contact with particular stresses; *sensitivity* – the degree to which an exposure unit is affected by exposure to any set of stresses; and *resilience* – the ability of the exposure unit to resist or recover from the damage associated with the convergence of multiple stresses. ... Vulnerability can increase through cumulative events or when multiple stresses weaken the ability of a human group or ecosystem to buffer itself against future adverse events, often through the reduction in coping resources and adaptive capacities (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004: 205).

Steffen et al. (2004) point to the scale- and space-dependent property of systems and thus differ on the local, regional and global level. Complex vulnerability analyses can address "multiple causes of critical outcomes rather than only the multiple outcomes of a single event". Thus, scenario development becomes a crucial element of vulnerability analysis. An important precondition for the quantification of vulnerability parameters could be vulnerability indicators. Along these lines, Comfort, Wisner, Cutter, Pulwarty, Hewitt, Oliver-Smith, Wiener, Fordham, Peacock and Krimgold (1999) developed a "standardized all-hazards vulnerability index". Others have suggested an Index of Human Insecurity (Lonergan/Gustavson/Carter 2000). Steffen et al. (2004: 209) admit that the current status of vulnerability research and assessment "exhibit both a potential for substantial synergy in addressing global environmental risks ... as well as significant weaknesses which undermine the potential". A major driver of GEC has been climate change where the 'vulnerability' concept has been extensively discussed.

Brklacich, Chazan and Bohle (2010: 36–37) developed "a conceptual framework for understanding human vulnerability to GEC and other stressors" by combining existing frameworks into a "comprehensive human vulnerability-security model". While human vulnerability has been extensively researched (Burton/Kates/White 1993; Mitchell 1989, 1990; Emel/Peer 1989; Watts/Bohle 1993; Adger 1999) they proposed to move "from a state of human vulnerability to one of human security" (Bohle 2001; Twigg/

Bhatt 1998; O'Brien/Vogel 2004). Earlier Bohle (2001) had pointed to the "double structure of vulnerability" linking external or environmental with internal or social vulnerability. While the external side (structure) of vulnerability refers to exposure to social and environmental stressors, the internal side (agency) points to the policy response or the capacity to mitigate, cope with, recover from, and adapt to stressors with the goal to achieve human security. While the 'structure' is influenced by the ecological and geographic context, the 'agency' depends on the institutional context and both rely on the distribution of rights and resources as well as on the control over and access to assets. For the analysis of the linkages between human vulnerability and security they suggest research on four interrelated drivers "control of and access to assets, institutional factors, distribution of rights and resources, and ecological and geographic conditions" (Brklacich/Chazan/Bohle 2010: 42). These drivers are influenced by *environmental change* (change in type, frequency, and scale of environmental threats) and by *societal change* (change in economic, political, social and demographic conditions). They concluded arguing that

> Movement along the continuum from vulnerability to security is most likely influenced by context-specific, local interactions between multi-scale stressors, exposure to threats, capacity for response, and socio-environmental drivers. This contextual nature of vulnerability supports trends towards micro-level approaches to vulnerability assessment (Brklacich/Chazan/Bohle 2010: 49).

In analysing the linkages between environmental change and violent conflict, Barnett and Adger (2010: 120) listed among the factors affecting violent conflicts besides poverty, migration, and weak states also 'vulnerable livelihoods' that directly influence water, agricultural productivity, the frequency and intensity of extreme events and the distribution of diseases. "These affect livelihoods by exposing people to risks, thereby increasing their vulnerability. The impacts are more significant in sectors of the population with high resource-dependency, and located in more environmentally and socially marginalized areas."

Barnett, Matthew and O'Brien (2010a: 308ff.) pointed to several areas of future research on GEC, vulnerability and human security, such as 1) social causes of vulnerability (including gender differentiations) to environmental change; 2) the mediating role of perceptions between GEC and policy responses and the roles of values, beliefs and worldviews, 3) the interface of GEC and human health, 4) shift to peaceful responses to the linkage of GEC and human security (e.g. environmental peacemaking), 5) the impacts of violent conflict on human security and vulnerability to environmental change, 6) need for more consideration to linkages among human rights, human security and GEC, and 7) to reflect on the coping capabilities and resilience of the affected people.

2.4.4 Vulnerability as a Political and Scientific Concept in the Climate Research Community

Climate change impacts, adaptation and *vulnerability* have been analysed by the second IPCC working group (1990, 1996a, 2001a, 2007a) whose mandate is "to assess the vulnerability of ecological systems, socio-economic sectors, and human health to climate change". The IPCC also distinguishes between *sensitivity*, *adaptive capacity* and *vulnerability* ("the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes").

In *The Regional Impacts of Climate Change: An Assessment of Vulnerability*, the IPCC (1998) explores potential consequences of climate change for ten regions based on "assessing sensitivities and vulnerabilities of each region, rather than attempting to provide quantitative predictions of the impacts of climate change", i.e. to assess "the extent to which climate change may damage or harm a system" taking into account the sensitivity of the region to climate and the adaptive ability. The report tries to explain: "how projected changes in climate could interact with other environmental changes (e.g. biodiversity loss, land degradation, stratospheric ozone depletion, and degradation of water resources) and social trends (e.g. population growth, economic development and technological progress" (IPCC 1998: ix). It calls for more research on "interlinkages among environmental issues". This IPCC report assessed the vulnerability of natural and social systems of major regions to climate change with qualitative methods. These regional assessments focus on: a) ecosystems, b) hydrology and water resources, c) food and fibre production, d) coastal systems, human settlements, human health, and other sectors or systems including the climate system of relevance for the 10 regions analysed.

In the *Third Assessment Report* (TAR), the WG II examines "climate change impacts, adaptations and vulnerabilities of systems and regions" with the goal "to provide a global synthesis of cross-system and cross-regional issues", and "in the context of sustaina-

ble development and equity" (IPCC 2001a: 22–25). In its regional assessment, the IPCC (1998) explores potential consequences of climate change by "assessing sensitivities and vulnerabilities of each region, rather than attempting to provide quantitative predictions of the impacts of climate change". The IPCC cautions: "The estimates ... serve as indicators of sensitivities and possible vulnerabilities" (IPCC 1998: 4). The report suggests an "anticipatory adaptation in the context of current policies and conditions" and so-called "win-win" or "no-regrets" options by adding that: "adaptation will require anticipation and planning. ... Additional analysis of current vulnerability to today's climate fluctuations and existing coping mechanisms is needed." As has been argued, the vulnerability concepts in the GEC and in the climate change communities have differed significantly from those concepts that have been employed in the hazard research community, but even within this research community conceptual differences have existed.[7]

In the *Fourth Assessment Report* (AR4), the WG II has extensively used the concepts of 'vulnerabilities', 'vulnerability assessment' and 'vulnerability hotspot' (IPCC 2007a: 974–975) with regard to Africa, Amazonia, Asia, Australia and New Zealand, Latin America, coastal systems and mega-deltas. For the AR4:

> Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change. The term 'vulnerability' may therefore refer to the vulnerable system itself (e.g. low-lying islands or coastal cities), the impacts to this system (e.g. flooding of coastal cities and agricultural lands or forced migration), or the mechanisms causing these impacts (e.g. disintegration of the West Antarctic ice sheet). Based on a number of criteria in the literature (i.e., magnitude, timing, persistence/reversibility, potential for adaptation, distributional aspects, likelihood and 'importance' of the impacts, some of these vulnerabilities might be identified as 'key'. Key impacts and resultant key vulnerabilities are found in many social, economic, biological and geophysical systems (IPCC 2007a: 73).

These potential key vulnerabilities are to help decision-makers to identify "levels and rates of climate change that may be associated with '*dangerous anthropogenic interference*' (DAI) with the climate system". The Technical Summary of the AR4 also points to the link with "systemic thresholds where non-linear processes cause a system to shift from one major state to another". Besides these potential 'tipping points' of the climate system (Lenton/Held/Kriegler/Hall/Lucht/Ramstorf/Schellnhuber 2008) key vulnerabilities may be linked to "'normative thresholds' defined by stakeholders or decision-makers (e.g. a magnitude of sea-level rise no longer considered acceptable by low-lying coastal dwellers" (IPCC 2007a: 73). AR4 argues that "some key vulnerabilities have been associated with observed climate change", such as "increases in human mortality during extreme weather events, and increasing problems associated with permafrost melting, glacier retreat and sea-level rise". AR4 distinguished among three different climate change regimes associated with a global mean temperature increase of up to 2°C, between 2 to 4°C, and above 4°C until the end of the 21st century.[8]

With regard to security risks posed by climate change, the WBGU (2008: 242) defined vulnerability as "the susceptibility of a social group or (environmental) system to →crises and pressures" by distinguishing between social and biophysical vulnerability. The report of the UN Secretary-General on "Climate change and its possible security implications" (UN-SG 2009: 1) approached this linkage "from a perspective of interdependence between human vulnerability and national security" and it identified 'vulnerability' among the five channels through which climate change could affect security, arguing that "Climate change threatens food security and human health, and increases human exposure to extreme events," especially for the poor countries that "are among the most vulnerable, and the best way to reduce their vulnerability is to help lift them out of poverty". The use of the vulnerability concept by the climate community

7 There is an extensive literature on the vulnerability concept as used by the climate change community, see e.g. Füssel (2007); O'Brien, Eriksen, Nygaard and Schjolden (2007); Roberts and Parks (2007); Adger (2006); Kates and Millman (1990); Kates and Millman (1990); Füssel and Klein (2006); Watts and Bohle (1993); Bohle (2001); Bohle, Downing, Watts (1994); Ribot (1995); Turner II, Matson, McCarthy, Corell, Christensen, Eckley, Hovelsrud-Broda, Kasperson, Luers, Martello, Mathiesen, Naylor, Polsky, Pulsipher, Schiller, Selin and Tyler (2003).

8 Table TS.8 in the Technical Summary of WG II of the Fourth Assessment Report of the IPCC (2007a: 74) offers an overview of the key vulnerabilities of the global social, regional, biological and geophysical systems as well as of the risks from extreme events for global average temperature changes from 0°C up to 5°C above 1990.

partly overlaps with its employment by the natural hazard community.

2.4.5 Vulnerability as a Political and Scientific Concept in the Hazard Research Community

From the perspective of the hazard research community, Blaikie, Cannon, Davis and Wisner (1994) redefined vulnerability commonly used as "being prone to or susceptible to damage or injury". Their working definition is:

> By 'vulnerability' we mean the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society. ... We use the term to mean those who are more vulnerable. When used in this sense, the implied opposite of vulnerable is sometimes indicated by our use of the term *secure*. ... Our definition of vulnerability has a time dimension built into it. Since it is damage to livelihood and not just life and property that is at issue, the more vulnerable groups are those that also find it hardest to reconstruct their livelihoods following disasters. ... Our focus on vulnerable people leads to give secondary consideration to natural events as determinants of disasters. Normally, vulnerability is closely correlated with socio-economic position.

In the context of the research on hazards the concept of *vulnerability assessment* was used to refer to an: "evaluation of the sensitivity of a particular ecosystem, resource or activity to a broad range of environmental and socio-economic stresses" (Bass 2002: 346–347). According to Hewitt (2002: 299) a vulnerability perspective "considers especially how communities are exposed to dangers, the ways in which they are readily harmed, and the protection that they lack". Vulnerability to a hazard is to a large extent created by the respective social order on the division of labour, cultural values and on legal rights. Thus, according to Hewitt (2002: 300), vulnerability is a "relative condition, and can only be defined and assessed in relation to the safety which others actually enjoy".[9]

The *International Strategy on Disaster Reduction* (ISDR 2002: 24, 342) defined *vulnerability* "as a set of conditions and processes resulting from physical, social, economical, and environmental factors, which increase the susceptibility of a community to the impact of hazards". These conditions are shaped "continually by attitudinal, behavioural, cultural, socio-economic and political influences at the individuals, families, communities, and countries". Vulnerability is closely linked to development.

Physical factors include the location and susceptibility of the built environment and are often influenced by the "density levels, remoteness of a settlement, its sitting design and materials used for critical infrastructure and for housing". Among the *social factors*, at the level of individuals, communities and society, ISDR (2002: 47) listed "levels of literacy and education, the existence of peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, knowledge structures, customs and ideological beliefs, and over all collective organizational systems". Vulnerability highly depends on *economic factors*, including poverty, "individual, community and national economic reserves, levels of debt and the degree of access to credit and loans as well as insurance", but also access to communication networks and socio-economic infrastructure. Finally, among the *ecological factors*, ISDR (2002: 47, 60) referred to the "very broad range of issues in the inter-acting social, economic and ecological aspects of sustainable development as it relates to disaster risk reduction" and distinguished among: "1) the extent of natural resource depletion; 2) the state of resource degradation; 3) loss of resilience of the ecological systems; 4) loss of biodiversity; and 5) exposure to toxic and hazardous pollutants."

Efforts to increase the ability of people "to cope effectively with hazards, and that increase their resilience, or that otherwise reduce their susceptibility, are considered as *capacities*" (ISDR 2002: 23–24). Vulnerability to hazards is higher in many developing countries, where they are "exacerbated by socio-economic and environmental conditions", including "the occupation of hazard-prone areas, the concentration of industrial infrastructure and critical facilities" (ISDR 2002: 62–64).

For disaster reduction, vulnerability and capacity assessment is essential (ISDR 2002: 69–78) which was addressed initially by the ISDR Interagency Task Force Working Group 3 on Risk, Vulnerability and Impact Assessment which has become the Global Platform for Disaster Reduction.[10] A lot of work has been

9 See for more recent literature on vulnerability and disasters: Cannon (2000); Downing (1991); Kasperson, Dow, Archer, Caceres, Downing, Elmqvist, Eriksen, Folke, Han, Iyengar, Vogel, Wilson and Ziervogel (2005); Smucker and Wisner (2008); Cannon, Twigg and Rowell (N.d.. 2003?); Wisner, Blaikie, Cannon and Davis (^{2}2004).

done on methodologies and instruments for *Vulnerability and Capacity Assessment* (VCA) and in the framework of a *Capabilities and Vulnerability Analysis* (CVA), together with the International Federation of the Red Cross (IFRC 2002) as a major proactive promoter. The ISDR (2002: 78) considered hazard, vulnerability and capacity as "the operational basis for a culture of prevention" with four priority areas:

- Risk assessment for decision-making;
- Terminology, data and methodology;
- Higher visibility and priority to reduce vulnerability and strengthen capacities; and
- Addressing new trends in hazard and vulnerability.

ISDR (2002) defined vulnerability as: "a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards", while UNDP (2004) stressed "a human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard". The ISDR (2002) definition juxtaposed vulnerability with its complementary component capacity, which is defined as "a combination of all strengths and resources available within a community or organization that can reduce the level of risk or the effects of a disaster".

Bohle (2001, 2002) distinguished between *external* (environmental) and *internal* (human) vulnerability,

> thus clearly identifying vulnerability as a potentially detrimental social response to environmental events and changes. Vulnerability can cover susceptibilities to a broad range of possible harms and consequences; it implies a relatively long time period, certainly exceeding that of the extreme event itself, which might have triggered its exposure. This interpretation of vulnerability is unavoidably related to resilience, the ability to return to a state similar to the one prevailing prior to the disaster. Thus, vulnerability is not only ill-defined, but its manifestation and magnitude depend on many partially unknown factors and their coincidence.

Plate (2002) recommended a critical index of vulnerability measured as the distance between the part of the GNP per person needed for maintaining minimum social standards and the available GNP per person. This index would focus on the financial resources available within a society or a community, or even an individual household that can reduce the effect of a disaster. This vulnerability measure would cover only some problems, while the environmental dimension cannot adequately be expressed in monetary terms.

Bogardi and Birkmann (2004) analysed the potential of vulnerability assessment for sustainable risk reduction, given the uncertainty of the vulnerability concept that was defined by Wisner (2002) as the "likelihood of injury, death, loss, disruption of livelihood or other harm in an extreme event, and/or unusual difficulties in recovering from such effects". They call for more direct indicators of national and regional scale which could be linked to strategic goals and instruments of vulnerability assessment. For them "an interdisciplinary approach will be essential to take into account economic, social and environmental consequences as well as different objects of protection (individual, community features). While the potential economic losses caused by floods can often be quantified and estimated, methods and data to measure social, cultural, institutional and environmental features of vulnerability and coping capacity are still not sufficiently developed". The vulnerability concept has also been used by those researchers who have worked on early warning of hazards while other concepts have been used by those who work on early warning of conflicts.

With regard to cities, for Satterthwaite, Huq, Reid, Pelling and Romero Lankao (2009: 19):

> vulnerability to climate change is understood to mean the potential of people to be killed, injured or otherwise harmed by the direct or indirect impacts of climate change. This is most obvious with regard to risk from extreme events (such as storms or floods); but it includes risk from direct impacts – for instance, declining freshwater availability or livelihoods dependent upon climate sensitive resources.

Sherbinin, Schiller and Pulsipher (2009: 131) framed vulnerability of global cities to climate hazards as "the degree to which a system or unit is likely to experience harm due to exposure to perturbations or stresses". They argued that by using this concept it became clear

> that the ability of a system to attenuate stresses or cope with the consequences through various strategies or

10 See at: <http://www.preventionweb.net/english/hyogo/GP/>. The Global Platform is the main global forum for representatives of governments and other stakeholders ... to: 1. Assess progress made in implementation of the Hyogo Framework for Action. 2. Enhance global awareness of disaster risk reduction. 3. Share experiences among countries and learn from good practice. 4. Identify remaining gaps and actions needed to accelerate national and local implementation of the Hyogo Framework.

> mechanisms constituted a key determinant of system response, and ultimately, of system impact. ... Vulnerability in the social sciences is typically identified in terms of three elements: systems exposure to crises, stresses and shocks; inadequate system capacity to cope; and consequences of attendant risks of slow (or poor) system recovery. ... The most vulnerable individuals, groups, classes and regions or places are those that experience the most exposure to perturbations or stresses; are the most sensitive to perturbations or stresses (i.e. most likely to suffer from exposure), and have the weakest capacity to respond and ability to recover.

They aimed at 'gap analysis' of areas of exposure and vulnerability pointing "to areas of greatest need for strengthened adaptive capacity and risk management" (Sherbinin/Schiller/Pulsipher 2009: 132). By linking a scenario-based 'top-down' approach with 'bottom-up' assessments using vulnerability mapping techniques they reached a better understanding "of likely future climate impacts while assessing the resilience of the current socio-ecological system in the face of bundles of stresses that are partly related to climate impacts and partly to fragilities in the system itself" (Sherbinin/Schiller/Pulsipher 2009: 152).

In an extensive review of the vulnerability concept in disaster management, environmental change and development research, Birkmann (2006: 16) stated that "the concept is still somewhat fuzzy and often used with different connotations" and that it would be "misleading to try to establish a universal definition". In his review of the literature, Birkmann (2006: 17–39) distinguished among five key spheres of the vulnerability concept: a) vulnerability as an internal risk factor (intrinsic vulnerability); b) vulnerability as the likelihood to experience harm (human centred); c) vulnerability as a dualistic approach of susceptibility and coping capacity; d) vulnerability as a multiple structure: susceptibility, coping capacity, exposure, adaptive capacity; and e) multi-dimensional vulnerability encompassing physical, social, economic, environmental and institutional features. After a review of the different conceptual and analytical frameworks pertaining to vulnerability Birkmann (2006: 39–40) distinguished among at least six different schools:

- the school of the double structure of vulnerability (Bohle 2001, 2002);
- the analytical framework for vulnerability assessment of the disaster risk community (Davidson 1997; Bollin/Cárdenas/Hahn/Vatsa 2003);
- the analytical framework for vulnerability assessment in the global change community (Turner/Kasperson/Matson/McCarthy/Corell/Christensen/Eckley/Kasperson/Luers/Martello/Polsky/Pulsipher/Schiller 2003);
- the school of political economy, which addresses the root causes, dynamic pressures and unsafe conditions that determine vulnerability (Wisner/Blaikie/Cannon/Davis 2004);
- the holistic approach to risk and vunerability assessment (Cardona 1999a, 2001, chap. 3 below; Cardona/Barbat 2000; Carreño/Cardona/Barbat 2004, 2005a, 2005b);
- the BBC conceptual framework, which places vulnerability within a feedback loop system and links it to the sustainable development discourse (Bogardi/Birkmann 2004; Cardona 1999, 2001).

However, the use of the 'vulnerability concept' has not been limited to these six schools but it was also in the broader environment, development and early warning community (2.4.6) and in peace research and security studies (Albrecht/Brauch 2008, 2009; Buzan/Hansen 2009) and in security policy both during the Cold War period and less in the post-Cold War US national security strategy documents (chap. 12 by Brauch).

2.4.6 Vulnerability in the Environment, Development and Early Warning Community

The vulnerability concept has also been widely used in the broader environment, in the development (Naudé/Santos-Paulina/Mc Gillivray 2009) and also in the two early warning communities with regard to natural hazards and conflicts and by officials in the respective offices of international organizations (UNDP, UNEP, UNISDR et al.).

Pascal Peduzzi (2000: 2), head of the Early Warning Unit at UNEP/DEWA/GRID-Europe and of a team of authors have contributed together with UNEP to the development of key indicators for 'global vulnerability and risk mapping'. Initially he defined *risk* as "a measure of the expected losses due to hazard event of a particular magnitude occurring in a given area over a specific time period" (Tobin/Montz 1997) and *vulnerability* as "the degree of loss to each element should a hazard of a given severity occur" (Coburn/Spence/Pomonis 1991: 49) and as the "expected percentage of population loss due to socio-politico-economical context".

In their feasibility study report on "*G*lobal *R*isk *a*nd *V*ulnerability *I*ndex", Peduzzi, Dao, Herold, Rochette and Sanahuja (2001) and their 'GRAVITY-Team' defined vulnerability as: "the extent to which a

community, structure, service or geographic area is likely to be damaged or disrupted by the impact of a particular hazard" (Tobin/Montz 1997). They separated vulnerability into *geophysical* (low evaluation along the sea, high vulnerability to Tsunami), *socio-economical* parameters (cultural, technical, economic factors using indicators as: GDP, literacy, life expectancy, corruption, population density, and (urban population growth), and *mitigation capacities*.

Vulnerability cannot be directly measured but estimated "by a set of socio-economic variables and compared to actual disaster losses as reported by CRED" (*Centre for Research on Epidemiology of Disasters* in Louvain, Belgium). It "measures how easily the exposed people, physical objects and activities may be affected in the short or long-term". Vulnerability can be defined as "what turns a hazard into a disaster" (Peduzzi/Dao/Herold/Rochette/Sanahuja 2001: 45). They distinguish between *economic* (impact of a disaster on the economy), *human* (human losses and injuries) and *social vulnerability* (social structure influences the impact of a hazard, e.g. on women, families etc.). Vulnerability is specific to a hazard and a region. To measure vulnerability they used disaster data (especially on observed damages) from the CRED database and socio-economic indicators.

In their report on "Phase II: Development, analysis and results" Peduzzi, Dao, Herold (2002: 4–5) and the GRAVITY-Team noted that the vulnerability concept "is perhaps the most difficult to approach" (Coburn/Spence/Pomonis 1991: 49) and "depends on socio-politico-economical context of this population" where vulnerability factors are "socio-economic factors having an influence on the level of losses for a given hazard type".

In their report on "Phase III: Drought analysis", Peduzzi, Dao, Herold and Muton (2003: 4–5) and the GRAVITY-Team focused both on the natural and human induced (conflicts, bad governance) causes of this complex hazard and developed indicators for drought and food insecurity. They distinguished among eight vulnerability indicators, which they grouped as a) *economic* (GDP, HDI); b) *type of economic activities* (percentage of agriculture's dependency for GDP, of labour force in agricultural sector); c) *dependency and quality of the environment* (human induced soil degradation: GLASOD); d) *development* (HDI); and e) *health and sanitation* (percentage of people with access to safe water, mortality rate of under five-year-olds).

In their report on "Phase IV: Annex to WVR and Multi Risk Integration", Dao and Peducci (2003: 1) described the "concepts, data and methods applied to achieve the Disaster Risk Index (DRI)". They offered two definitions of vulnerability. The first is reflecting "the range of potentially damaging events and their statistical variability at a particular location" (Smith 1996), and the second is pointing to "the degree of loss to each element should a hazard of a given severity occur" (Coburn/Spence/Pomonis 1991: 49). As a specificity of their research they noted "the discrepancies of casualties induced by different vulnerabilities are used to identify socio-economical indicators reflecting such vulnerabilities".

They also broadened the scope of their *vulnerability indicators* and distinguished them for two types of hazards: drought, and floods, cyclones and earthquakes; and nine categories of vulnerability: 1) *economic* (GDP, HDI, debt, inflation, unemployment); 2) *type of economic activities* (arable land, urban population, percentage of agriculture's dependency for GDP, of labour force in the agricultural sector); 3) *dependency and quality of the environment* (forests, woodlands, per cent of irrigated land, human induced soil degradation: GLASOD); 4) *demography* (population growth, urban growth, population density, age dependency ratio); 5) *health and sanitation* (calorie supply per person, access to sanitation, safe water, physicians, hospital beds, life expectancy, mortality rate of under five year of age); 6) *politics* (corruption); 7) *early warning capacity* (number of radios); 8) *education* (illiteracy, school enrolment, secondary, labour force with primary, secondary or tertiary education); and 9) *development* (HDI).

The UNDP (2004) report on *Reducing Disaster Risk – A Challenge for Development* includes a *Disaster Risk Index* (DRI) – developed by the GRAVITY-Team – which provides decision-makers with an overview of risk and vulnerability levels in different countries. This risk is measured in terms of the number of deaths during disasters. The Report has defined 'human vulnerability' as a

> human condition process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard. In the DRI, human vulnerability refers to the different variables that make people more or less able to absorb the impact and recover from a hazard event. The way vulnerability is used in the DRI means that it *also* includes anthropogenic variables that may increase the severity, frequency, extension and unpredictability of a hazard (UNDP 2004: 98).

Based on their previous work, Dao and Peducci (2004) discussed methodological aspects of the *Disaster Risk Index* (DRI) in the UNDP (2004) report on

Reducing Disaster Risk. The report is based on the assumption "that differences in risk levels faced by countries with similar exposures to natural hazards are explained by socio-economic factors, i.e. by the population's vulnerability" with a special focus on "socio-economical indicators reflecting human vulnerability to hazards". They used a total of 38 variables dealing with economic features, dependency on environment quality, demography, health and sanitation, politics, infrastructure, early warning and capacity of response, education and development, and they discussed the global risk and vulnerability patterns for four hazards: cyclones, droughts, earthquakes, and floods. The concept 'social vulnerability' has been extensively used both in the development and in the hazard community.

2.4.7 'Social Vulnerability' in the Hazard and Development Research and Policy Community

'Social vulnerability' has been used in many definitions in the hazard research community to distinguish the social and societal factors from the manifold physical, economic, political and human aspects (Adger 1999; Cutter/Boruff/Shirley 2003; Downing/Patwardhan 2005; Warner 2007). In the development policy community in the UK, a DFID (Department for International Development) White Paper (1997) and a policy paper (1999: 4) focused on socio-economic factors that made people vulnerable to disasters. It listed among its humanitarian policy goals "to save lives and relieve suffering, hasten recovery, and protect and rebuild livelihoods and communities, and reduce risks and vulnerability to future crises" thus stressing the link between "the sustainability approach and vulnerability reduction". Cannon, Twigg and Rowell (2003: 4) argue that vulnerability analysis can "become an integral part of humanitarian work ... [and] enable [this] work to be more closely integrated with the SL [sustainable livelihood] approach, by using vulnerability analysis in both the operation of emergency preparedness and reducing poverty". In their view:

> *[V]ulnerability* should involve a *predictive* quality: it is supposedly a way of conceptualizing what may happen to an identifiable population under conditions of particular risks and hazards. ... VA should be capable of directing development aid interventions, seeking ways to protect and enhance peoples' livelihoods, assist vulnerable people in their own self-protection, and support institutions in their role of disaster prevention (Cannon/Twigg/Rowell 2003: 4).

Disasters occur when a natural hazard affects a population unprepared to recover without assistance. The impacts of hazards differ for people at different levels of preparedness, resilience, and with varying capacities for recovery.

> *Vulnerability* ... involves much more than the likelihood of their being injured or killed by a particular hazard, and includes the type of livelihoods people engage in, and the impact of different hazards on them. ... Social vulnerability is the complex set of characteristics that include a person's
>
> - *initial well-being* (nutritional status, physical and mental health, morale);
> - *livelihood and resilience* (asset pattern and capitals, income and exchange options, qualifications);
> - *self-protection* (the degree of protection afforded by capability and willingness to build safe home, use safe site);
> - *social protection* (forms of hazard preparedness provided by society more generally, e.g. building codes, mitigation measures, shelters, preparedness); and
> - *social and political networks and institutions* (social capital, but also role of institutional environment in setting good conditions for hazard precautions, peoples' rights to express needs and of access to preparedness) (Cannon/Twigg/Rowell 2003: 5).

According to the DFID study, the vulnerability conditions are distant from the impact of a hazard. Vulnerability variables are connected with peoples' livelihoods and poverty. Thus, development work should reduce disaster vulnerability and make people become more resilient to hazards by

- the strengthening of peoples' 'base-line' conditions (nutrition, health, morale ...);
- reinforcement of their livelihood and its resilience to possible hazard impacts;
- peoples' own efforts ... to reinforce their home and workplace against particular hazards;
- or by access to proper support ... by institutions of government or civil society (Cannon/Twigg/ Rowell 2003: 6).

Livelihoods are influenced by *social and political networks* that may have varying levels of cohesion and resilience in the face of hazards. When disasters occur, relief and recovery is tied with the restoration of livelihoods, and the strengthening of self-protection. Vulnerability can be seen as a term that encompasses all levels of exposure to risk. There are two separate approaches to vulnerability and capacity. The first conceives people who have a high degree of vulnerability and are low in capacity. The second perceives them as two distinct sets of factors. A capacity

might include institutional membership, group cohesion or literacy. Vulnerability can include poverty, house quality, or illiteracy. Some capacities are not the opposite of vulnerabilities, and some low-level vulnerability characteristics are not amenable to being considered capacities.

The concept of 'capabilities' (Sen 1981, 1999; Comin/Qizilbash/Alkire 2008) emerged in response to the term 'vulnerability'. It was suggested that speaking of people as being vulnerable ignored many capacities which make them competent to resist hazards. Some characteristics may be considered capacities when they score well, and vulnerabilities when they score badly, even when they are in fact opposite ends of a scale. There can be high and low levels of vulnerability without implying victimhood.

One of the reasons why capacities seem to be often separated from vulnerability is that capacities are regarded as dependent on groups or some form of social organization, while vulnerabilities are socially-determined. One way around the problem is simply to acknowledge that high capacities likely reduce the vulnerability. If we accept that measuring vulnerability includes any factor or process that can alter the exposure of a person or household to risk, then capacities can also be considered as scaled factors leading to greater danger (vulnerability) when they are low, and reduced danger when they are high.

Vulnerability analysis offers DFID the opportunity to integrate development work with disaster preparedness, prevention and recovery. By adopting a *vulnerability assessment* (VA) approach, disaster prevention, preparedness and recovery work should be integrated with development work. With VA as a means of integrating its development and disaster work, DFID may also be able to foster a better integration and convergence of the wide range of vulnerability and capacity methods what can assist in its work of creating partnerships.

Since 2005, the MunichRe Chairs on Social Vulnerability of UNU-EHS have made significant contributions to the theoretical and conceptual development of social vulnerability, in relation to *Gender and Disasters* (Oswald Spring 2008, 2001), on *Livelihoods and Human Security in Risky Environments* (Bohle 2007), and on *Sea Level Rise and the Vulnerability of Coastal Peoples* (Oliver-Smith 2009) and on *Nature, Society, and Population Displacement* (Oliver-Smith 2009a). In the first three summer academies of UNU-EHS, PhD candidates from many disciplines and all parts of the globe provided theoretical and empirical inputs to the debate on social vulnerability with a focus on *Perspectives on Social Vulnerability* (Warner 2007); on *Megacities - Resilience and Social Vulnerability* (Bohle/Warner 2008) and on *Linking Environmental Change, Migration & Social Vulnerability* (Oliver-Smith/Shen 2009).[11]

From the review of many scientific vulnerability concepts used in the global change, climate change, hazard, environment, development and early warning communities no consensus has emerged on a definition, on criteria and indicators for the measurement of vulnerability. For the hazard community, vulnerability is the combination of additional contributing factors causing a hazard due to natural variability or human inducement to a disaster. The selection and inclusion of these contributing factors is configured by the worldview, mind-set, perception, the theories and models of the analyst. Thus, vulnerability is always socially constructed. 'Vulnerability' is how the analyst or policy-maker has defined it, and which definition has become accepted by a consensus within the respective research community.'

2.4.8 The Vulnerability Concept in Strategic and Security Studies

During the Cold War period, the concept of vulnerability was widely used for technical systems (e.g. of the land based strategic deterrent with regard to both intercontinental bombers and fixed land-based ICBMs), critical military and command, control and communication infrastructure but also of urban centres and the highly sensitive industrial and transportation systems. Since the global turn of 1990, at least in US national security guidance papers this concept has been used much less and with a specific meaning (chap. 12 by Brauch).

2.5 Reconceptualizing 'Security Risks'

2.5.1 The Term 'Risk'

For the term 'risk' (Lat.: 'risicare' navigate around cliffs; Fr.: 'risque'; It.: 'risico, risco'; Sp.: 'riesgo'; Port.:

11 Selected contributions by participants are included in part IV of this book (see chap. 30–38 by Fabien Nathan (France); Mabel-Cristina Marulanda and Carmen Lacambra (Colombia); Monalisa Chatterjee, Reena Singh and Nanda Kishor (India) Xiaomeng Shen (China); Sidika Tekeli-Yesil, and Ebru Gencer (Turkey).

'risco'; Ger.: 'Risiko') many synonyms are used: danger, peril, jeopardy, hazard; chance, gamble, possibility, speculation, uncertainty, venture; unpredictability, precariousness, instability, insecurity, perilousness, riskiness, probability, likelihood, threat, menace, fear, prospect.

For *Webster's Third International Dictionary* 'risk' means "1. the possibility of loss, injury, disadvantage, or destruction: contingency, danger, peril, threat ...; 2. someone or something that creates or suggests a hazard or adverse chance: a dangerous element or factor ...; 3. the chance of loss or the perils to the subject matter or insurance covered by the contract; the degree of probability of such loss; amount at risk; a person or thing judged as a specified hazard to an insurer; an insurance hazard from a cause or source (war, disaster); 4. the product of the amount that may be lost and the probability of losing it" (Gove 2002: 1961). Langenscheidt-Longman (1995) defines 'risk' as: "1. possibility of bad result: the possibility that something bad, unpleasant, or dangerous may happen ...; 2. take a risk: to decide to do something even though you know it may have bad results; 3. at risk: be in a situation where you may be harmed ...; 4. run a risk: to be in a situation where there is a risk of something bad happening to you ...; 5. at the risk of doing something: used when you think that what you are going to say or do may have a bad result, may offend or annoy people etc.; 6. at your own risk: if you do something at your own risk, you do it even though you understand the possible dangers and have been warned about them; 7. cause of dangers: something or someone that is likely to cause harm or danger...; 8. insurance/business: a person or business judged according the danger involved in giving them insurance or lending them money" (Langenscheidt-Longman 1995). *The Oxford Guide to the English Language* gives this concise definition: "possibility of meeting danger or suffering harm; person or thing representing a source of risk" (Weiner/Hawkins 1985).

Besides these many meanings of this term in contemporary American and British English, the 'risk' concept has been employed in many natural and social science disciplines as a concept that is also widely used by policy-makers to justify specific policy goals and programmes.

2.5.2 Risk as a Political and Scientific Concept in Encyclopaedias

As a scientific concept, risk is defined in major encyclopaedias and scientific dictionaries in many disciplines, including philosophy, political science, sociology, psychology, economics and in the geosciences. The *Brockhaus Enzyklopädie* ([19]1992, XVIII: 440–444) offers a detailed assessment of the different meanings of the term 'risk', of its historic development, as well as 'risk measures', 'risk assessment', 'risk factors' and 'risk indicators', 'risk society', 'risk capital, 'risk policy and management' and 'risk premiums'. The *Brockhaus* distinguishes among these meanings of risk": 1. a possibility that an action or activity causes damage or loss of material or persons; and 2. risk is used when the consequences are uncertain. The *Brockhaus* differentiates among *pure* (crash of an airplane), *speculative* (stock market), *insured* and *technical risks* (of equipment).

For the quantitative measurement of risks, often simple risk indicators are used: 'Risk estimates' always involve a prospective estimate based on the probability, frequency and intensity of damages that are often based on specific 'risk analyses'. 'Risk assessment' is used in the daily practice in many disciplines and it is often influenced by the personal risk acceptance. The risk assessment e.g. of nuclear technologies differs among groups and countries. The concept 'risk factors' is used in social medicine, public health and epidemiology to point to factors which may increase the probability to get affected by a disease, while risk indicators may also be indirect contributing factors (e.g. social conditions for the breakout of a disease). Beck's (1986, 1992, 1999, 2007, preface essay by Beck) concept of an (international) 'risk society' initiated a global debate in the social sciences that impacts on security risks. 'Risk policy and politics' as well as 'risk management' comprise all measures of an enterprise to improve its financial performance.

2.5.3 Risk as a Political and as a Scientific Concept in Scientific Dictionaries

The term 'risk' evolved since the 15th century referring to the financial danger associated with trade. This concept was primarily used with reference to insurance in economic activities. The term is widely employed in the *probability theory* (Bernoulli 1738, Laplace 1816), in *economics* (A. Smith 1776, Ricardo 1821, J.S. Mills 1848, Knight 1921), in *existential philosophy* (Kierkegaard 1844, Heidegger, Jaspers 1932, 1956, Sartre 1948, Camus 1958) and in *decision-making theory* (Neumann/von Morgenstern 1944). The risk concept is used as a political term in nuclear technology for estimating how much security of technology is needed and how much insecurity is acceptable

for society. Here risk is equated with the expectation of security contributing to risk acceptance. Since the 1970's the concept has been intensively discussed in economics, psychology, sociology and political science (Rammstedt VIII, 1992: 1049). Koschnick (1993: 1325) refers to 'risk' in the context of decision-making theory where

> risk is defined as imperfect information, leading to a situation in which one is forced to take chances that certain outcomes or events will occur. Risk can range from risk that is close to perfect uncertainty to risk that approaches perfect uncertainty. ... In face of risk, one may proceed in three stages. First, one evaluates the various possible consequences of alternative policies on their merits. Second, one specifies the probability relationships between given policies and these evaluated outcomes. And finally, one tries to rank policies by the probabilistically weighted values of the consequences to which they may lead.

As complete certainty is hardly possible, Llewllyn (1996: 744–746) argues that "risk and uncertainty are an integral part of most human behaviour", especially in economics and finance: "*Uncertainty* arises when the future is unknown but no actual probabilities (objective or subjective) are attached to alternative outcomes. *Risk* arises when specific numerical probabilities are attached to alternative outcomes." *Risk analysis* relies on probability theory.

> Behaviour is ... influenced both by the risk of an event to occur or outcome and the potential seriousness if it occurs. This ... gives rise to the concept of *disaster* myopia. ... Risk analysis is applied to situations which have multiple, uncertain outcomes. .... Risk analysis and management for a bank involves five key processes: first, identification and measurement of risk...; second, what can be done to lower the probability of default; third, measures to limit the damage in the event that the risk materializes...; fourth, action to shift risk to others, that is, risk-sharing, and fifth, how the residual risk is absorbed. ... The same principles apply in all risk analysis. ... Risk analysis is inseparable from risk management.

An economic dictionary (Grüske/Recktenwald 1995: 528–529) includes 'risk', 'risk premium', 'risk theory' and 'risk management' where 'risk' is defined

> as an economic and social danger of loss in reputation, position, wealth resulting from the market dependence of the entrepreneur and the financier. In the economy it is closely linked with responsibility. Knight distinguishes between risk, where the probable distribution of results of possible actions is known and insecurity where this is not the case. Thus, insecurity cannot be measured and cannot be insured against, while risks may be insured against. In the literature the risk concept is manifold: 1) the danger to make a loss, or the distance between possible profit and loss; 2) risk expresses the positive and negative deviation from the expected value, or 3) risk as the difference between the planned data and the facts. ... The risk policy of companies tries to remove unnecessary risks, ... as a result of careful market analyses and to secure it legally. ... Decision theory has developed ... procedures, to constrain risks (Grüske/Schneider 2003: 456).

Grüske and Schneider (2003: 456) defined risk management as: "The analysis of risks as well as the implementation of measures to manage risks". This covers insurance contracts of households, strategies of companies to differentiate production, and speculation in money markets as part of risk management. A major task of risk management is risk limitation.

In psychology 'risk' (Städtler 2003: 937–938) is used in decision-making theories, especially for decision situations taken under risk, synonymously for decision and decision behaviour. Risk implies that individuals show in decisions variance preferences that do not always follow the principle of maximizing benefits, but also reflect the relationship between maximum gain and loss. The portfolio theory of risks by Coombs (1975) implies a preference function for risks where the optimal value of risk is to find a balance between greed, challenge and fear. Some theories try to explain the risk-taking behaviour of humans given possible cognition of dangers.

The risk concept was gradually introduced in sociology, with a reference to environmental issues. In a German dictionary of sociology (Endruweit/Trommsdorff 1989) the term 'risk' was still missing, while in a sociological lexicon (Fuchs/Klima/Lautmann/Rammstedt/Wienold 1978, 1988) 'risk' was included as "readiness to take risks" (*Risikobereitschaft*), as "risk population" and as "risky shift". In the dictionary of sociology (Hillmann 1994: 740–741) risk is defined as a decision situation with incomplete information. In game and decision-making theory risk is distinguished from uncertainty. Subjective risk perceptions have often differed from the objective level of risk (Nathan 2010; chap. 30 in this vol.).

2.5.4 The Debate on 'Risk' and 'Risk Society' in the Social Sciences

The concept of risks has been used in the social sciences and especially in sociology, with a special reference to environmental issues.[12] Löfstedt and Frewer (1998, 2004: 3–27) reviewed the debates on 'risk management' tracing the origin of risk analysis to the response of psychologists to an engineer's work on

technological risks, and to the Chicago school of geography and argued that the people's response to hazards depended on their experience and knowledge. The debate on risk perception was provoked by Starr who pointed to the importance of contextual factors in risk perception pertaining to natural and technological hazards.

In the 1990's, a new school doubted the existence of objective risks pointing to the social construction of risk that influenced risk perceptions and risk-taking behaviour. Others have criticized risk comparisons because they ignored the societal risk context. A cultural theory of risks emerged in the UK but the empirical results in other countries were mixed. In the 1980's and 1990's research moved from 'risk perception' to 'risk communication' including the role of the media and of the social amplification of risk. In analysing the failure of risk communication initiatives, research increasingly has focused on the lack of trust towards policy-makers with regard to hazardous industrial plants and installations.

One reason for distrust has been the growing relevance of globalization (Giddens 1990, 1994).[13] The concept 'risk society' was introduced by Ulrich Beck (1986, preface essay above) and has widely influenced the debate in the social sciences.[14] Beck (1986, 1992) has argued that risk is increasing with the complexity of technology. Regaining trust requires competence and credibility of policy-makers. Research on mental models gained in importance focusing on misperceptions regarding different kinds of risks. Others have focused on the optimistic bias or the unreal optimism that has become a major barrier to effective risk communication. Due to the crisis of confidence, the requests on social scientists have increased to contribute to an improved risk management. Löfstedt and Frewer (1998, 2004: 19–20) argue on the future of risk research that the model of social amplification of risk should be developed further, as well as the research on risk perception and risk communication, and on public responses to transboundary risks.

In his book *On Risk*, Bonß (1995) reviewed the development of the 'sociology of risk' that has gradually emerged since the late 1960's in response to the disasters of Seveso, Harrisburg, Bhopal or Chernobyl which Luhmann (1990: 138) has described as an "articulated displeasure". With his theory of a 'risk society', Beck tried to place the problem of risk in the context of a theory of modernity focusing primarily on technical dangers and less on social action. Bonß (1995: 18–19) suggested to broaden the sociological risk debates in two respects: 1) the linkage between risk and technology must be dissolved and it should be analysed as a problem of insecurity; and 2) from a historical perspective the treatment of uncertainty should be reconstructed. He offered a systematic history of the discourse on the risk concept as a social and cultural construct with a special focus on the transition from a reactive towards an active orientation of insecurity. Among several classifications of risk concepts Bonß pointed to two alternatives to analyse risk as a social phenomenon from an action (*ex ante*) or systems (*ex post*) perspective. From an action perspective, risks are reduced to risk decisions, while from a systems perspective risks are treated as threats or danger of loss. Bonß suggests analysing risks in the context of the social construction of uncertainties. While uncertainties due to dangers exist irrespective of human actions, uncertainties as risks include both the intentions and implementation of action. Thus, risks are often the result of decisions made under uncertainty.

12 Keith Smith (^{3}2001: 6) noted that risk is sometimes used synonymously with hazards whereby "risk has the additional implication of the chance of a particular hazard actually occurring. ... *Risk* is the actual exposure of something of human value to a hazard and is often regarded as the product of probability and loss".

13 Tester (1996: 747) noted that risk is a major theme in Giddens's works who "distinguishes pre-modern (traditional) and modern environments of risk: 'The risk environment of traditional cultures was dominated by hazards of the physical world' while the modern risk environment is 'structured mainly by humanly created risks' (Giddens 1990). Giddens stresses the importance of the environment, war and personal relationships in modern experiences and construction of risk. In so doing, Giddens makes plain that 'risk is not just a major individual action. There are environments of risk that collectively affect masses of individuals'".

14 Tester (1996: 747) summarized and interpreted Beck's key concept of risk' and risk society': "In a risk society the future has become uncertain. Possible events which technology unintentionally generates cannot be insured against because they have unimaginable implications. ..... *The residual risk society has become an uninsured society* (Beck 1992a: 101). Instead of belief in progress and the future, risk society is experienced in terms of short-term calculations of danger: 'In this sense, one could say that the calculus of risk exemplifies a type of ethics without morality, the mathematical ethics of the technological age (Beck 1992a: 99). ... He has faith in the potential of a self-critical technological enterprise to solve risk problems. Secondly, Beck emphasizes the sociological significance of the environment and ecology".

Jaeger, Renn, Rosa and Webler (2001: 9) reviewed the thinking of risk, uncertainty and rational action. In their view "risk developed over the past several decades as the key analytical lens for attempting to anticipate the consequences of our purposive actions on the environment and ourselves". Risk has always been constitutive of the *conditio humana*. However, the nature of risks has changed, while they were originally local in impact, today many risks are eco-centric (i.e. they are linked to environmental problems or related to environmental conditions), and global. They are increasingly perceived as common risks, be it as systematic cumulative environmental risks, often affecting the globe as a whole (e.g. climate change), and the increasing risk consciousness of high technology. With the adoption of 'risk' as the imprimatur of our age, as suggested by Beck and Giddens, the direction of Western thought has shifted from "the expectation of progress, of continued improvement in the social world" to an epoch "in which the dark sides of progress increasingly come to dominate social debate", shifting from the 'goods' of modernization to the often unintended 'bads' (Jaeger/Renn/Rosa/Webler 2001: 15).

In Giddens' terminology (1984, 1991) social fabric produces "ontological security"[15], he specified as "the confidence that most human beings have in the continuity of their self-identity and the constancy of the surrounding social and material environments of action" (1991: 92). Today they often "take the form of uncertainties, and risks associated with them", i.e. increasing these risks results from human choice threatening both environmental conditions and individual identity.

For Jaeger, Renn, Rosa and Webler (2001: 16) "reducing uncertainties in order to maintain ontological security is clearly a task worthy of sociological investigation". With a special focus on risks, they discuss first rational action, as the dominant worldview "for understanding and managing risk", and then shift to alternative approaches: "reflexive modernization, critical theory, systems theory, and postmodernism". While there are many meanings of risk, they argue that "all conceptions of risk presuppose a distinction between *predetermination* and *possibility*" (Jaeger/Renn/Rosa/Webler 2001: 17).

Risk implies uncertainty, an indispensable element of risk. Risk "is present only to the extent that uncertainty involves some feature of the world, stemming from natural events or human activities that impacts human reality. Risk, in human terms, exists only when humans have a *stake in outcomes*". Jaeger, Renn, Rosa and Webler (2001: 17) defined risk as "a situation or event in which something of human value (including humans themselves) has been put at stake and where the outcome is uncertain".

In the late 20th century, for industrialized societies the new risks have reached a level that could endanger human life and survival on the planet. Technological and industrial developments have created new dangers that could endanger life in all its forms. These new risks for survival cannot be geographically limited nor can they be insured against. The competition on the division of resources has partly been replaced by the management of these global risks of survival. They require a reflexive modernization where prevailing views, values, norms, conventions and behavioural patterns are an object of sociological reflection (Hillmann 1994). Ulrich Beck (1999: 3–4) defined 'risk' as

> the modern approach to foresee and control the future consequences of human action, the various unintended consequences of radicalized modernization. It is an (institutionalized) attempt, a cognitive map, to colonize the future. Every society has ... experienced dangers. But the risk regime is a function of a new order: it is not national, but global. ... Risks presuppose decision. These decisions were previously undertaken with fixed norms of calculability, connecting means and ends or causes and effects. These norms are precisely what 'world risk society' has rendered invalid. ... What has given rise to the prominence of risk? The concept of risk and risk society combines what once was mutually exclusive – society and nature, social sciences and material sciences, the discursive construction of risk and the materiality of threats.

15 Giddens (1991) calls the need for stable expectations, e.g. of states, 'ontological security'. According to Mitzen (2005: 3) this refers to a "need to secure one's identity. Actors do this through cognitive and behavioural routines; and because the resulting routines stabilize the self, actors become attached to them". Based on Huymans (1998) and Mc Sweeney (1999), Mitzen (2005) argues that states also need ontological security and she proposes "that states achieve ontological security by routinizing relations with other states and apply that argument to entrenched interstate conflict. This reveals another, second 'security dilemma' in international politics: ontological security can impede physical security". If states try to break out of security dilemmas, Mitzen (2005: 3–4) argues that this could "generate ontological insecurity". Thus, "parties may prefer to remain in security dilemmas, even if offered credible opportunities for escape. In short, ontological security turns security dilemma logic on its head, suggesting that the persistence of conflict is rooted not in uncertainty but in the certainty such dilemmas offer their participants".

Beck (1999: 55–57) distinguished between predictable *risks* and unpredictable *threats* and offered a typology of three types of global threats: 1) *wealth-driven* ecological destruction and technological-industrial dangers (ozone hole, global warming, regional water shortage) and the unpredictable risk of genetic engineering; 2) risks related to *poverty* (environmental destruction); and 3) *weapons of mass destruction*.

Zürn (1995: 51) saw an essential difference between environmental destruction as a result of well-being and poverty: "Whereas many wealth-driven ecological threats stem from the externalization of production costs, in the case of the poverty-driven ecological destruction it is the poor who destroy themselves with side-effects for the rich." Thus, wealth-driven environmental destruction becomes international only through side-effects in the medium term.

Beck (1999: 36) argued that ecological destruction may promote war either as an outgrowth of resource scarcity (water) or because Western eco-fundamentalists use force to stop ongoing destruction. Such ecological destruction may trigger mass emigration which may lead to war. This may result in a spiral of destruction where different crisis phenomena converge. In the world risk society, these

> 'global threats' have together led to a world where the basis of established risk-logic has whittled away, and where hard to manage dangers prevail instead of quantifiable risks. The new dangers are removing the conventional pillars of safety calculation. Damage loses its spatio-temporal limits and becomes global and lasting. It is hardly possible any more to blame definite individuals for such damage. ... Often, too, financial compensation cannot be awarded for the damage done; it has no meaning to insure oneself against the worst-case effects of spiralling global threats (Beck 1999: 36).

The analysis of risk has become an objective of many disciplines. While the calculation of risk as a function of the probability that an event becomes real is a task of the natural science, of medicine and applied mathematics, the response of human beings to risky situations is an area for psychology, anthropology and the social sciences and how organizations and whole societies regulate risks is being analysed by political science, sociology and of law departments (Renn/Schweizer/Dreyer/Klinke 2007: 13).

These authors distinguished among seven scientific risk concepts of: 1) of the expected risk (tool: statistics; application: insurance companies); 2) risk assessment (tool: modelled risk expectance in toxicology and epidemiology; application: health, environmental protection); 3) probabilistic risk assessment (tool: event, error tree analysis; application: security analysis); 4) economic risks (tool: portfolio analysis; application: preparation of decisions); 5) risk perception (tool: psychometric experiments); 6) social risk assessment (tool: group surveys, structural analysis); 7) culture and risk assessment (tool: network analysis). The likely application of the last three risk concepts is as risk policy and regulation, conflict management, risk communication (Renn/Schweizer/Dreyer/Klinke 2007: 25; Renn 2008: 15). Renn (2008: 24–40) further distinguished among seven "social science-based theoretical approaches to risk":

1. the *rational choice approach* (Renn/Schrimpf/Büttner/Carius/Köberle/Oppermann/Schneider/Zöller 1999; Renn/Sirling/Müller-Herold/Fisher/Dreyer/Losert/Klinke/Morisini/van Zwanenberg 2003; Jaeger/Renn/Rosa/Webler 2001);
2. the *reflexive modernization approach* by Beck (1986, 1992) and Giddens (1991, 2000);
3. the *systems theory approach* of Luhmann (1986, 1989, 1993);
4. the *critical theory approach* based on Habermas (1984, 1987);
5. the *post-modern perspective* introduced by Foucault (1982) and further developed by Ewald (1986), Burchell, Gordon, Miller (1991) and Dean (1999);
6. a *cultural theory* approach, originally introduced by Douglas (1966, 1985) and Douglas and Wildavsky (1982), recently re-presented by Adams (1995) and Lupton and Tulloch (2002);
7. the framework of the *social amplification of risk* as an example of an integrative framework that promises to link psychological, social and cultural risk theories (Kasperson/Renn/Slovic/Kasperson/Emani 1988; Kasperson/Kasperson/Pidgeon/Slovic 2003; Renn/Webler 1992; Breakwell 2007).

Since the mid 1990's, the concept of 'risk society' (Beck 1986, 1992) and 'world risk society' (Beck 1999, 2007, preface essay) also became a new concept in political science and in international relations (M.G. Schmidt 1995, 2004). Beck's concept of risk society has also triggered a debate on 'risk policy' in political science.

2.5.5 From Security and Defence Policy to the Management of Political Risks

In security policy (Brauch chap. 12) and in national and *international security studies* (ISS) in the post-Cold War era the management of global risks has become a major security task arguing "that risk rather

than security captured the nature of the post-Cold War era (Rasmussen 2001b, 2004; Beck 2002; Coker 2002; Griner 2002; Heng 2002, 2006; M.J. Williams 2008)" (Buzan/Hansen 2009: 250). By focusing both on 'every day risk management' and on catastrophic risks, Buzan and Hansen (2009: 205–251) argued that risk analysis was a topic of ISS before the events of 11 September 2001, but since then many risk theorists argued that risk analysis was better suited for dealing with issues of terrorism and migration.

Furio Cerutti (2007: 27) raised the question whether the two major global challenges of nuclear war and global warming are risks whereby he defined risk "as a function, that is, the product of the probability and size of loss", where risk is understood as risk-taking and where the selection of damage is culturally determined. Facing risks implies two kinds of uncertainty: "one regards the probability of a loss, the other our evaluation of its size and significance" (Cerutti 2007: 28).

Cass R. Sunstein (2007: 9) pointed to uncertainties in specifying the probabilities of a worst-case scenario of a dangerous climate change. In comparing the two major security dangers posed by terrorism and climate change, Sunstein (2007: 53) pointed to a specific risk perception of many Americans, for whom "the idea of terrorism conjures up intense images of disaster, as the idea of climate change does not". For Kahan and Braman (2006) and Slovic (2000) these different risk-related judgements are a product of a 'cultural cognition' or of cultural orientations that may help to explain "public reactions to numerous risks, including those associated with climate change" (Sunstein 2007: 66–67).

Henry N. Pollack (2003: 6) addressed the ambivalence between uncertainty in science and risk-taking that is referred to in "many cultures as an attribute of a successful person. But risk arises precisely because of uncertainty. The willingness and the ability to formulate and take action and accept risk in the face of uncertainty is considered a character strength. ... An unwillingness to be motivated by uncertainty is indeed a real barrier to progress." But he also noted that "science can never produce absolute certainty, and definitely not on a schedule" (Pollack 2003: 213). With regard to the tipping points in the climate system, Pollack (2003: 232) acknowledged that "climate scientists do not yet know how to identify the thresholds for such events, and the uncertainties remain formidable".

The *Millennium Ecosystem Assessment* (MA 2005: 193–195) noted the problems in dealing with risk and uncertainties that are inherent in all human activity and cannot totally be eliminated. Ecological risk assessment has many tools and a large "potential for informing the decision process" by providing 1) analysis and a knowledge base for supporting sound decisions; 2) deliberation based on a consultation process and stakeholder involvement; 3) and relying increasingly on the precautionary principle.

A group of German scholars at the Free University of Berlin developed a new concept of 'international risk policy' for dealing with the new dangers in international relations, such as nuclear proliferation and terrorism, as well as the soft security challenges of migration, climate change, computer crime, drug trafficking and dealing with financial markets. Daase (2002: 9–35) argued that these new dangers require a paradigmatic change in security policy from defence against threats to crisis prevention. He distinguished between risks due to transformation and globalization and new political and international risks. Since 1990, the traditional threat triangle of an actor, his intentions and capabilities, has been replaced with different dangers that are often indirect, non-intended and uncertain. The fundamental difference between security threats and risks, in his view, has been that the certainty of expectation has disappeared with the departure of a clearly defined threat. Instead of reacting to perceived security threats, a proactive security policy should focus on the prevention of the causes and effects of risks. This would lead to four ideal-type strategies of international risk policy that may be described as cooperation, intervention, compensation and preparation to contain risks.

The goal of the first strategy is to reduce the probability of risks becoming reality by reducing misperceptions and by fostering a cooperative risk management;[16] the second intends reducing the probability of a future damage occurring by using political and military coercion; the third aims at a cooperative reduction of the level of the probable future damage by risk sharing strategies; and finally, the fourth strategy aims at a repressive reduction of the level of probable future damage by an efficient use of political, economic, legal and military measures that try to prevent

16 Such a strategy may lead to the creation of new institutions, e.g. of the crisis prevention centre of the OSCE, or to the adaptation of existing institutions to new tasks, e.g. of NATO. The task of scientific efforts is to review the methods and procedures of risk assessment (e.g. of prognoses, projections, estimates of probabilities) to point to shortcomings and to proposed alternative procedures (Daase 2002: 19).

follow-on damages. He distinguished economic, psychological, technical, and sociological approaches for dealing with risks. This paradigm was applied in several case studies on non-proliferation, migration, climate change, terrorism, drug trafficking, computer crimes and financial markets – but none on hazards. These studies focused on risk perception, risk policy, and a risk paradox.

Daase, Feske and Peters (2002: 267–276) concluded on risk perception that while material factors played a role in the perception of dangers, socio-cultural factors determined the different risk perceptions of states. Risk perception is not stable and it may change during a political process or as a result of scientific discourses. Risk perception is a process. It is an important but not the only factor for the explanation of risk policy. To justify proactive political action the danger is often oversold, a threat is being created and several risks are combined.

2.5.6 'Reflexive Security' and 'Risk Society' as Key Concepts of Security Studies

The sociologists Giddens and Beck have stimulated in parts of the international relations research community a debate on 'ontological security' (Giddens 1991; Huymans 1998; Mc Sweeney 1999; Mitzen 2005) as well as an emerging debate on 'reflexive security'. Rasmussen (2004: 381–395) outlined a research programme on 'reflexive security' by applying Beck's 'risk society' to security studies. While during the Cold War the balance of power and deterrence theory constituted an expert system with its own rationality and bureaucracy, since 1990 and especially 2001 they were challenged by new non-state actors, new military technologies and terrorists who "fight for values other than those of national interests". Rasmussen asks whether the transatlantic debate focuses more on different means than on goals, or on the scale, degrees and urgency of risks.

> 'Risk society' is one way to explain what is missing in the debate between soft and hard security. The point is not on how to apply the concept of security, but that the concept of security itself is changing. Surveying the history of the concept of security from the Romans to the present, Ole Wæver (2002) thus argues that today's considerations of safety are increasingly about managing risks rather than achieving perfect security. The focus on risk society turns the 'broad conception of security' inside out. It is not only the case that security policy needs to take many more issues into consideration, it is argued, but along with the many other policy areas, the way security issues are being handled politically is being transformed (Rasmussen 2004: 388–389).

Rasmussen (2004: 389–395) proposes to apply the sociological theories of reflexive modernity to "reflexive security studies"[17] and to translate the empirical findings back to sociological theory.[18] However, the social science debate on the concepts of 'risk' and 'risk society' was largely detached from the specific issues addressed in the environment and hazard communities to which we turn next. While some authors of international security studies argued that

> risk rather than security captured the nature of the post-Cold War era (Rasmussen [2001a, 2001b, 2002], 2004, [2006]; Beck 2002; Coker 2002; Griner 2002; Heng 2002, 2006; M.J. Williams 2008). ... Risk analysis had been brought into ISS prior to 9/11, but the surprise attack on 9/11 as well as the utility of 'everyday risk management' to identify the enactment of anti-terrorism and anti-migration policies made risk theorists hold that they offered a better account of security and terrorism (Buzan/Hansen 2009: 250).

Buzan and Hansen argued that the risk literature is an inherent part of ISS while many traditional American reviews of security studies have ignored the discourse

17 Rasmussen (2004) has mapped "the current achievements and future challenges of this emerging research programme on risk arguing that it offers a way to overcome the debate about whether to apply a 'broad' or 'narrow' concept of security; a debate which is stifling the discipline's ability to appreciate the 'war on terrorism' as an example of a new security practice. Discussing the nature of strategy in a risk environment, the paper outlines the consequences for applying the concept of reflexive rationality to strategy". See also: Shlomo Griner (2002).

18 Rasmussen (2004: 389–395) identified three research themes on: 1. globalization; 2. region and individual level of non-sate actors; and 3. study of specific strategies. He argues that reflexive security studies that make conceptual change an empirical matter "offer one possibility for taking account of the transformation of practice". This requires a clear definition of this scope: "Are reflexive security studies about certain 'risky' policy areas or has it something to say about the entire security agenda?" He argues that the polarized debate on the policy response to 9/11 illustrates "one of the basic facts of life in reflexive modernity: that the way by which we try to solve problems ... become a 'theme and a problem itself'." He points to a need "to develop a shared discourse on how to manage risks that takes account of strategic necessities, as well as concerns of world order, legitimacy and human rights. ... It highlights the need for security studies to catch up with the present practices of security policy and help develop a vocabulary that enables a reflexive debate on security priorities in the future".

provoked by Beck. In *The Politics of Climate Change* Anthony Giddens (2009: 7) argued that "climate change politics is all about risk and how to manage it" and that "the long-term thinking needed to counter climate change has to operate against the backdrop of uncertainty". To develop such a forward looking politics of climate change, Giddens (2009: 8) suggested several new concepts that of the "*ensuring state*" that acts as a "facilitator, an enabler" and "*political* and *economic convergence*".

> The first refers to how far climate change policy overlaps in a positive way with other values and political goals. Political convergence is crucial to how far climate change policy becomes innovative and energetic, but also to whether it receives widespread support. ... In the developed countries, we can no longer equate progress with economic growth. ... Economic convergence concerns how far economic and technological innovations that are developed to combat global warming also generate competitive advantage to those who deploy them (Giddens 2009: 8–9).

Giddens calls for "a positive model for a low-carbon future" that requires a transition strategy towards sustainable development (Grin/Rotmanns/Schot 2010) that should aim at a "Fourth Green Revolution" (chap. 95 by Oswald Spring/Brauch). In moving towards that end, Gidden's (2009: 12–13) advice to policy-makers is:

1. Promote political and economic convergence wherever possible and do so in an active way. ...
2. Look first and foremost to embed a concern with climate change to people's everyday lives, while recognizing the formidable problems involved in doing so. ...
3. Avoid making political capital out of global warming. ...
4. Set up detailed risk assessment procedures, stretching into the long run, since the implications of climate change policy are complex. We have to construct a future in which renewable sources will comprise the bulk of energy use. It will be a far-reaching transition indeed, with a whole raft of complex social and economic effects.

In conclusion, Giddens (2009: 229–230) argues that "coping with climate change could be a springboard for creating a more cooperative world. It might be a means of reinvigorating the UN and other institutions of global governance". But he cautioned that "all governments face deep dilemmas in reconciling climate change with energy policy with sustaining popular support, especially in times of economic difficulty". However, "technological innovation is one of the several major jokers in the pack", where a quantum leap is needed to move humankind towards a new enlightenment and to avoid new Dark Ages.

This requires from the social sciences conceptual contributions to develop strategies for an ecological transition (Grin/Rotmanns/Schot 2010) to cope with the projected impacts of climate change during the 21st century with a complex set of adaptation and mitigation measures. Toward that end, Nair, Tanner and Bhadwal (2009: 399ff.) in a study by TERI, IISD and CICERO suggested a "climate risk screening" with an "evaluation of adaptation to climate change" that includes a portfolio screening using the ORCHID (*Opportunities and Risks of Climate Change and Disaster*s process) methodology (chap. 64 by Nair).

Finally, from an economic perspective, Nicholas Stern (2009: 12) suggested to include ethical considerations in the long-term thinking on "how to reduce risks for future generations". Given the lack of knowledge, "policy on climate change involve decision-making under risk and uncertainty" (Stern 2009: 16–19), where 'risk' refers to an estimated probability and 'uncertainty' to the impossibility to make educated guesses on the probability. But besides risks, Stern (2009: 135) refers to the many economic opportunities due to the "transformation of energy systems from high- to low-carbon" that creates "new, multibillion-dollar markets, which are now attracting significant capital".

2.5.7 Global and Regional Environmental Risk as a Scientific Concept

In security and environment policy, the risk concept is sometimes used without a clear delineation from the other concepts of threats and challenges. From an environmental perspective, Kasperson and Kasperson (2001: 1) tried to combine all four basic concepts: "global environmental *risk* is about *threat*; it is also about opportunity". The goal of their book is to take stock of "distinctive *challenges* posed by global environmental *risks*, the ability of the knowledge system to identify and characterize such *threats*, and the capability of societies to address the management of *challenges*" (emphasis added).

They distinguish between *systemic* risks (e.g. of global warming) and *cumulative environmental change* that may cause both short- and long-term consequences. They used risk synonymously with hazard, referring to "human beings and what they value". For them, *global environmental risk* "refers to threats ... resulting from human-induced environmental change, either systemic or cumulative, on the global scale".

They focus on five themes: 1) Global environment *risk* is the ultimate *threat*. 2) *Uncertainty* is a persistent feature both of understanding process and causation as well as predicting outcomes. 3) Global environment risk manifests itself in different ways at different spatial scale. 4) *Vulnerability* is a function of variability and distribution in physical and socio-economic systems, the limited human ability to cope with additional and sometimes accumulating hazard, and the social and economic constraints that limit these abilities. 5) Futures are not given, they must be negotiated.

The authors claim that global environmental risks "threaten international security and peaceful relations among states" contributing to differentiation of wealth and "increasing competition, tensions, and conflict". They refer to five risk sources: a) disputes arising from human-induced local environmental degradation; b) ethnic clashes arising from population migration and deepened social cleavage due to environmental scarcity; c) civil strife caused by environmental scarcity that affects economic productivity and, in turn, people's livelihoods, elite groups, and the ability of states to meet changing demands; d) scarcity-induced interstate war over, for example, water[19]; and e) North-South conflicts over mitigation of, adaptation to, and compensation for global environmental problems (Homer-Dixon 1999: 5). On the environmental security debate they admit "that such frameworks and models remain very limited in providing satisfactory interpretations" and that "causal linkages between environmental change and attributes of environmental security are yet poorly defined and understood".

Kasperson, Kasperson, Turner, Dow and Meyer (1995: 5–8) distinguished between *geocentric* and *anthropocentric* approaches to the study of environmental criticality which they defined as "a state of both environmental degradation and associated socio-economic deterioration". A *critical region* refers to "an area that has reached such a state of interactive degradation". The *geocentric* approach defines criticality "in terms of changes in physical attributes or social dimensions" due to human-induced perturbations that have altered the biophysical system. While the *geocentric* approach focuses purely on the physical environment, the *anthropocentric perspective* focuses solely on human inhabitants. Therefore, the authors suggest an integrative, holistic approach to the criticality of environmental threats which they describe with the conflicting terms – sensitivity, resistance, resilience, marginality, fragility, and vulnerability. Any analysis of criticality requires an assessment of what and who is threatened by environmental degradation. From the literature and their discussion they drew several lessons for the study of 'environmental criticality' of relevance for a regional approach:

> Human-environment trajectories appear particularly likely to lead to criticality in situations that have some combination of:
>
> - economies of high sensitivity and low resilience to environmental change;
> - human societies with high social and economic vulnerability;
> - economies strongly dependent upon local environmental resources;
> - frontier areas exposed to new forms of use; and
> - close linkage with, and dependent position *vis-à-vis*, global markets or distant political authority (Kasperson/Kasperson/Turner/Dow/Meyer 1995: 22–23).

Non-linear environmental change may exacerbate societal diagnosis and delay responses. Criticality refers to situations where emerging environmental degradation may lead to a loss of a capability to survive. The 'critical region' concept does not adequately capture the identifiable situations, rather additional categories are needed. A lot of the change inflicted by human pressures on the environment may impose costs on future generations that must be included in approaches to endangerment and criticality. But many of the currently perceived environmental threats may disappear in the near future. These authors differentiate "criticality" from lesser degrees of environmental threats such as environmental endangerment and impoverishment. The 'critical regions' are characterized by *environmental degradation* (water, air, soil, biomass productivity), *wealth* (GNP, income, savings), *well-being* (longevity, mortality, infant mortality, nutrition, environmentally induced disease) and *economic and technological substitutability* (cash-crop dependency, technological monocultures, innovation, economic diversity). Before a region reaches a status of environmental criticality, many warning signals alert experts and the society to impending or recurring damage. The degree of response depends largely on the political and societal sensitivity but also on the resources available to cope with these challenges.

19 While both international officials and national policymakers, journalists and defence officials have used the water war argument, this hypothesis has been disputed by many recent scientific publications in the social sciences (e.g. Wolf 2002; WWAP 2003; Kipping/Lindemann 2005).

Based on nine case studies they concluded that a) external factors were more important than internal ones; and b) state policy and institutions were key factors of change while the I = PAT formula (*Impact = population – affluence – technology*) was criticized for overstressing affluence and neglecting poverty. In most third world cases "poverty rather than affluence has driven unsustainable resource use". On the regional level, they pointed to "three aspects of environmental and socio-economic conditions [that] suggest an increasing potential for higher or catastrophic losses: 1. *Vulnerability and overshoot* ... 2. *market conditions and overcapitalization*... [and] 3. *loss of options and safety nets*" (Turner/Kasperson/Kasperson/ Dow/Meyer 1995: 560). They discussed different societal responses, symptoms of emerging criticality, spatial and temporal categories. Contrary to global environmental change, the trajectories of change

> in these threatened areas provide a warning, ... that supplements those recent discoveries ... at the global scale. In nearly all these regions, trajectories of change are proceeding to greater endangerment, ... while societal efforts to stabilize these trajectories and to avert further environmental deterioration are lagging and are generally only ameliorating the damage rather than intercepting the basic human driving forces of change. ... The trajectories of change in most ... regions are rapidly outstripping societal responses. ... The future populations ... are being environmentally impoverished by these trends. ... The trajectories suggest growing long-term costs of regional substitution, adaptation, and remedial measures. ... In the future, these trends will also eclipse regional societal capabilities to respond (Turner/Kasperson/Kasperson/Dow/Meyer 1995: 580).

They noted a rich variety of human causation and they argued that no single dominant human driving force can explain "the historical emergence of environmental degradation", nor could the *grand theories* offer satisfying interpretations. They conclude that "the regional dynamics of change – the interplay among the trends of environmental change, vulnerabilities and fragility, human driving forces, and societal responses – must be examined within their cultural, economic, and ecological contexts". For them "the most satisfying interpretations ... recognize the shifting complexes of driving forces and responses over time, tap diverse social science theory, and are firmly grounded in ... empirical work". The regional trajectories of change and associated regional dynamics must be analysed in the broader framework of extra-regional linkages, such as processes of economic globalization, including trade policies in the WTO framework that have a major environmental impact.

In conclusion, Turner, Kasperson, Kasperson, Dow and Meyer (1995: 582–583) suggest a regional tailoring of global initiatives:

> The regional dynamics of change ... reveal a recurring disjuncture between the fast rate of environmental change and the slow pace of societal response. ... The global scale reveals a much more mixed picture where societal responses to such changes as stratospheric ozone depletion, global warming, and industrial accidents have often been quite rapid, if less than totally effective. Still, signals of environmental threat have been processed with considerable speed and coping actions undertaken. But the trajectories of change ... provide considerable confirmation of the argument of overshoot ... by Donella Meadows and her colleagues (1972, 1992).

This debate on risk in the environmental research community has been developed further with a slightly different focus in the international scientific and political hazard community.

2.5.8 Risk as a Scientific Concept in the Hazard Community

A major area of the debate on risks in many scientific disciplines have been natural, human-induced natural, man-made hazards, technical calamities and manifold disasters or catastrophes that have focused on problems of 'risk perception', 'risk analysis', 'risk assessment' and 'risk management'. Slovic (2000) summarized the results of a research team that examined "the gap between expert views of risk and public perceptions", how these perceptions have evolved and changed over time, increasingly recognizing "the importance and legitimacy of equity, trust, power and other value-laden issues underlying public concern". They described "new methods for assessing perceptions of risk" and they discussed "the implications for regulation and public policy". In a follow-up study Pidgeon, Kasperson and Slovic (2003) analysed "how both social and individual factors act to amplify or dampen perceptions of risk and through this created secondary effects such as stigmatization of technologies, economic losses, or regulatory impacts". They focus on "risk perception and communication" and draw lessons "for public policy, risk management, and risk communication practice".

Posner (2004) offers an interdisciplinary perspective that combines the insights of a lawyer, a social and physical scientist in weighing risks and possible responses to a major catastrophe such as global warming, bioterrorism or a major accident. He argues that the risks of global catastrophe have grown due to the

technological advance and industrial applications, the growth of the world economy and population, and the rise of apocalyptic global terrorism that are often underestimated due to low probability that they may happen in the near future. However, there is a difference in public attention and response between creeping natural disasters (climate change) and intended catastrophes, such as nuclear attacks, bioterrorism, and cyber terrorism that have become an objective of the military and of criminal justice. Posner calls for a mutual rethinking of the liberals "in the face of technological terrorism" and of the conservatives on global warming, many of them deny that these global challenges and risks require a global response based on international cooperation.

Blaikie, Cannon, Davis and Wisner (1994) as well as Wisner, Blaikie, Cannon and Davis (2004)[20] offered a comprehensive theoretical framework on the challenges of disasters, on disaster pressure and release models, and access to resources and coping in adversity as well as an empirical analysis of famine and natural hazards, biological hazards, floods, coastal storms, earthquakes, volcanoes and landslides and on action for disaster reduction. They look for "the connections between the risks people face and the reasons for their *vulnerability* to hazards". For them disasters "are not only natural events that cause them. They are also the product of the social, political, and economic environment ... because of the way it structures the lives of different groups of people". Many disasters are a complex mix "of natural hazards and human action". In their definition:

> A disaster occurs when a significant number of vulnerable people experience a hazard and suffer severe damage and/or disruption of their livelihood system in such a way that recovery is unlikely without external aid. By recovery we mean the psychological and physical recovery of the victims, the replacement of physical resources and the social relations required to use them (Blaikie/Cannon/Davis/Wisner 1994: 21).

To understand risk in terms of their vulnerability analysis, they use two models of disaster: a) a *pressure and release* model (PAR), and b) an access model that relates to both *human vulnerability* and *exposure* to physical hazard. In the PAR model they distinguish three stages of vulnerability: a) the *root causes* (access to power, structure, resources; ideologies, political and economic systems); b) *dynamic pressures* (lack of local institutions, training, skills, local investment and markets, press freedom; macro forces: population growth, urbanization, arms expenditure, debt repayment, deforestation, decline in soil productivity); and c) *unsafe conditions* (fragile physical environment: dangerous location, unprotected buildings, infrastructures; fragile local economy: livelihoods at risk, low income levels; vulnerable society: special groups at risk, lack of local institutions; public actions: lack of disaster preparedness, prevalence of endemic disease). They refer to hazards of a *biological* (virus, pest), *geophysical* (earthquake, volcano) or *hydro-meteorological* (storms, floods, drought) nature. They defined risk as hazard + vulnerability (R=H+V). Thus, vulnerability refers to "unsafe conditions".

Wisner, Blaikie, Cannon and Davis (2004: 10) differed from the conventional approach to disasters that in their view stressed "the 'trigger' role of geo-tectonics, climate or biological factors arising in nature (... Bryant 1991; Alexander 1993; Tobin/Montz 1997; K. Smith 2001)". They argued that other authors "focus on the human response, psychosocial and physical trauma, economic, legal and political consequences (Dynes/DeMarchi/Pelanda 1987; Lindell/Perry 1992; Oliver-Smith 1996; Platt 1999)". Both approaches from the natural and from the social sciences "assume that disasters are departures from 'normal' social functioning, and that recovery means a return to normal". Wisner, Blaikie, Cannon and Davis (2004: 10) do

> not deny the significance of natural hazards as trigger events, but [their book] puts the main emphasis on the various ways in which social systems operate to generate disasters by making people vulnerable. In the 1970's and early 1980's, the vulnerability approach to disasters began with a rejection of the assumption that disasters are 'caused' in any simple way by external natural events, and a revision of the assumption that disasters are 'normal'. Emel and Peet (1989), Oliver-Smith (1986) and Hewitt (1983a) review these reflections on causality and 'normality'. A competing vulnerability framework arose from the experience of research in situations where 'normal' daily life was itself difficult to distinguish from disaster. This work related to earlier notions of 'marginality'.

To overcome the separation of the hazard from the social system (figure 2.1), they have developed a second access model that focuses on "the way unsafe conditions arise in relation to the economic and polit-

20 Parts of the revised second edition are available at: <http://www.unisdr.org/eng/library/Literature/7235.pdf>. In the introduction the authors discuss more recent literature on the basic idea and some variations, on Beck's theory of risk society, on various deconstruction approaches as well as on vulnerability and normal, daily life. Wisner, Blaikie, Cannon and Davis (2004: 8) outlined their approach in a figure on the social causation of disasters.

ical process that allocates the assets, income, and other resources in a society" (Blaikie/Cannon/Davis/Wisner 1994: 46) and to include "nature in the explanation of hazard impacts". For them vulnerability is a hypothetical term "which can only be 'proved' by observing the impact of the event when, and if, it occurs. By constructing the household access model for the affected people we can understand the causes and symptoms of vulnerability" (Blaikie/Cannon/Davis/Wisner 1994: 58).

In the second edition, Wisner, Blaikie, Cannon and Davis (2004: 13-) referred to four new streams of thought on vulnerability (e.g. by Wilches-Chaux 1992; Jeggle/Stephenson 1994; Davis 1994; Buckle 1998/99; Buckle/Marsh/Smale 2000; Currey 2002) since the early 1990's: a) emphasizing the people's 'capacity' to protect themselves rather than just the 'vulnerability' that limits them (Hewitt 1997: 167); b) quantifying vulnerability as a tool of planning and policy-making (Gupta/Kakhandiki/Davidson 1996; Davidson/Gupta/Kakhan-diki/Shah 1997; Davidson/Villacis/Cardona/Tucker 2000; Hill/Cutter 2001; UNDP 2003; Gheorghe 2003); c) pointing to the cultural, psychosocial and subjective impacts of disasters (Rosa 1998; Perry/Mushkatel 1986; Oliver-Smith/Hoffman 1999; Johns 1999; Tuan 1979); and d) shifting from 'vulnerable groups' to a concern with 'vulnerable situations' (Harding 2001).

In the first edition they distinguish several types of coping strategies: a) preventive strategies; b) impact-minimizing strategies; c) creation and maintenance of labour power; d) building up stores of food and saleable assets; e) diversification of the production strategy; f) diversification of income sources; g) development of social support networks; and h) post-event coping strategies.

To release the pressures contributing to vulnerability and thus to reduce disasters, Blaikie, Cannon, Davis and Wisner (1994) suggest to address the root causes, to reduce pressure, and to achieve safe conditions aiming at: no loss of life, no casualties, restricted damage and food security, and to reduce hazards by improved flood control, shelter breaks, etc. The management of vulnerability reduction should follow 12 principles: 1. vigorously manage mitigation; 2. integrate the elements of mitigation; 3. capitalize on a disaster to initiate or develop mitigation; 4. monitor and modify to suit new conditions; 5. focus attention on protection of the most vulnerable; and 6. on lives and livelihoods of the vulnerable; 7. on active rather than passive approaches; and 8. on protecting priority sectors; 9. measures must be sustainable over time; 10. assimilate mitigation into normal practices; 11. incorporate mitigation into specific development projects; and 12. maintain political commitment. They propose efforts "towards sustainable reduction of disasters".

In the second edition, Wisner, Blaikie, Cannon and Davis (2004: 20–35) pointed to new developments in disaster research reflecting the theoretical, practical and institutional work in the framework of the United Nations' *International Decade for Natural Disaster Reduction* (IDNDR, 1990–1999), with a special focus on: a) urban growth and urban concerns; b) changes in earth care, of the climate change negotiations and lessons learned from wildfires, tropical storms, floods and landslides; c) the emergence of the 'precautionary principle'; d) critiques of globalization; e) changes in human development and well-being; f) war and humanitarian relief; g) media and policy selectivity.

In Chinese, the word risk combines the characters meaning 'opportunity' and 'danger' what implies that risks cannot be eliminated but only managed. From a hazard perspective, Smith ([3]2001: 14) defined risk as:

> the actual exposure of something of human value to a hazard and is often regarded as the product of probability and loss. Thus we may define hazard (or cause) as 'a potential threat to humans and their welfare' and risk (or consequences) as 'the probability of a hazard occurring and creating loss'. ... An earthquake hazard can exist in an uninhabited region but an earthquake risk can occur only in an area where people and their possessions exist. Clearly, both hazard and risk can be increased and reduced by human actions.

For Smith (2001: 55) *risk management* "means reducing the threats posed by known hazards, whilst simultaneously accepting unmanageable risks, and maximizing any related benefits". *Risk assessment* "involves evaluating the significance of a risk, either quantitatively or qualitatively". He conceptualizes: *risk = hazard (probability) x loss (expected) : preparedness (loss mitigation).* Both risk assessment and management depend on value judgments that are conditioned by beliefs and circumstances. Perceived risks are often distinguished as 1. *involuntary risks* (in a hazard prone environment); and 2. *voluntary risks* (more susceptible to control). Based on Kates and Kasperson (1983) for Smith (2001: 59) risk assessment comprises three steps:

1 The identification of local hazards likely to result in disasters, what hazardous events may occur?
2 The estimation of the risks of such events, that is, what is the probability of each event?

3 The evaluation of the social consequences of the derived risk, that is, what is the likely loss created by each event?

Risk is thus defined as the product of probability and loss: R = p x L. While risk assessment depends on expert assessments, risk perception depends on an individual's intuition, estimation and evaluation. It may be determinate, dissonant or probabilistic.

From a natural hazard perspective Tobin and Montz (1997: 281–283) defined risks as a part of hazard but both are not synonymous.

> Risk is an important component of hazard analysis and risk analysis forms an important subdivision of the study of natural hazards. ... Frequently risk is seen as the product of some probability of occurrence and expected loss. ... To get a better assessment of hazard risk, details of vulnerability must be incorporated in the analysis. Statistically, this relationship can be expressed as:
>
> *Risk = probability of occurrence x vulnerability.*
>
> This formula ... fails to incorporate geographic differences in population size and density (or ... exposure) as well as communal adjustments undertaken to minimize loss. Mitchell (1990) conceptualizes hazards as a multiplicative function of risk, exposure, vulnerability, and response:
>
> Hazard = f (risk x exposure x vulnerability x response) where
>
> risk = the probability of an adverse effect
>
> exposure = the size and characteristics of the at-risk population
>
> vulnerability = the potential for loss
>
> response = the extent to which mitigation measures are in place.
>
> Just as risk is only one component of hazards.... It comprises two elements that must be considered separately and together. These are (1) a choice of action and (2) an outcome, which includes a probability of occurrence and a consequence (or magnitude).

For Tobin and Montz (1997: 331–332) a combination of physical characteristics and political factors defines risks. "By contrast, vulnerability is determined by all the elements in various combinations; this suggests that if we alter one of the elements, we have altered vulnerability. ... Risk and vulnerability are a part of the context, and they are changed when any one element in any of the three categories is changed." This is crucial for hazard mitigation efforts that focus on reducing exposure, risk, economic losses and death as well as stress. Structural changes in society can reduce vulnerability and thus impact on reducing economic losses, death and stress. The above quotes indicate that within the natural hazard community no consensus exists on the definition of the risk concept. This definition has been used in several studies by the 'GRAVITY team' of UNEP/DEW/GRID and by the UNDP/BCPR Report on *Reducing Disaster Risk* (2004).

2.5.9 Risk as a Practical Concept in the Hazard Research Community

For the practical and policy-oriented hazard community 'risk' has been the key operative concept. In July 1979, a UN expert meeting suggested a framework for the analysis of risks and natural disasters (UNDRO 1980) and in 2009, the *International Standardization Organization* (ISO) published ISO 31000 (2009) on principle and guidelines of risk management.

From an American perspective, the American Society of Civil Engineers (Haimes/Stakhiv 1989) reviewed 'risk analyses', 'risk communication decision-making', 'environmental risk analysis' and health hazards, global warming and climate change, as well as 'risk management strategies' for natural and technological hazards.[21] The US *National Research Council* (NRC 2000) analysed the application of 'risk analysis' techniques for US institutions, especially for the US Army's Corps of Engineers, and the U*S Federal Emergency Management Agency* (FEMA).[22] Risk analysis should deal with temporal and spatial natural variability, knowledge uncertainty (parameters, models), and decision model uncertainty (time preferences, values, objectives). Based on a review of global disaster reduction initiatives, UN-ISDR (2002: 24) defined 'risk' as:

> The probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable/capable conditions.

21 In the introductory chapter, W.D. Rowe (1989: 1–2) defined risk as "the downside of a gamble" [that] "implies a probability of outcome, and the gamble may be involuntary or voluntary, avoidable or unavoidable, controllable or uncontrollable. The total gamble in which risk is imbedded must be addressed if the risk is to be analyzed, both the upside (benefits) and downside."

22 The NRC Study (2000: 179) defined "risk as the probability of failure during a flood event. For reaches without levees, failure means exceeding a target stage. For reaches with levees, it means a levee failure." And residual risk as: "the portion of the flood risk that still exists with the flood damage reduction project implemented".

> Conditionally risk is expressed by the equation Risk = Hazards x Vulnerability/Capacity.

In the second edition (ISDR 2004, II: 6) a slightly different definition of 'risk' is offered:

> Conventionally risk is expressed by the notation: Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability. Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes.

ISDR (2004: II: 6) described 'risk assessment and analysis' as:

> A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend. The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability, and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capacities pertinent to the risk scenarios.

However, the social contexts are crucial in which risks occur, and thus often the perceptions of risks and of their causes differ (Nathan 2001). Accordingly, the process of risk assessment relies on a review of both technical features of hazards and of the physical, social and economic dimensions of vulnerability, reflecting the different coping capabilities. ISDR (2002: 24) defined 'risk assessment and analysis' as: "A process to determine the nature and extent of risk by analysing conditions of vulnerability/capacity that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend."

Based on Tobin and Montz (1997), Peduzzi, Dao, Herold, Rochette and Sanahuja (2001: 9–10) defined risk as "a measure of the expected losses due to hazard event of a particular magnitude occurring in a given area over a specific time period" – The GRAVITY--team focused on risks "faced by population, in terms of wounded and killed while confronted to natural disasters". This risk definition includes: "the probability of occurrence and severity of a specific hazard for a given area and length of time, the vulnerability of the population and the capacity of mitigation, this last could be introduced in the vulnerability or taken separately, depending on authors". They offer this formula of risk:

$$Risk_i = (Hazard_i - Prevention_i) \times [Population \times (Vulnerability_i - Mitigation_i)]$$

As no data were available on both preparedness and mitigation, they proposed a simplified model:

$$Risk_i = Hazard_i \times Population \times Vulnerability_i$$

Where the hazard multiplied by the population represents the physical exposure, risk is also:

$$Risk = Physical\ exposure \times Vulnerability\ or$$
$$Risk/Physical\ exposure = Vulnerability$$

In their second report, Peduzzi, Dao and Herold (2002: 3) used the term 'risk': "to describe potential losses resulting from expected future hazard". Their research focused on human aspects (i.e. persons killed) from natural hazards, and they relied on the database of *the Centre for Research on Epidemiology of Disasters* (CRED) in Louvain, Belgium for 'killed', 'wounded', 'homeless', 'affected' and 'total affected', but due to a high variation they only used the number of persons killed as risk indicators. Based on a definition by the *United Nations Disaster Relief Coordinator* (UNDRO 1979) for them risk results from three components: "*hazard occurrence probability*, defined as the probability of occurrence of a specified natural hazard as a specified severity level in a specified future time period, *elements at risk*, an inventory of those people or artefacts which are exposed to the hazard and *vulnerability*, the degree of loss to each element should a hazard of a given severity occur" (Coburn/Spence/Pomonis 1991: 49). Peduzzi, Dao and Herold (2002: 3) proposed for modelling risk to multiply the three factors explaining risk: *Risk = Hazard x Population x Vulnerability.* Thus, there is no risk if no hazard exists or nobody lives in the affected area, or if the vulnerability is reduced by preparedness and mitigation measures.

In the fourth report of the GRAVITY-Team, Dao and Peduzzi (2003: 3) repeated their previous definitions and they used as risk indicators the "number of killed, percentage of killed, percentage of killed as compared to the exposed population with their respective advantages and inconveniences". The *Disaster Risk Index* (DRI) is based on a combination of the first two indicators. In a brief article, Dao and Peduzzi (2004: 2) relied on the definition of risk by UNDRO (1979) that "refers to the expected losses from a particular hazard to a specified element of risk in a particular future time period" that may occur in

terms of "human lives, or building destroyed or in financial terms". Thus, if risk represents the losses, then "hazard can be defined as a potential threat to humans and their welfare" (Smith 1996). As extreme events, hazards "may create risk and potentially turn into disasters if the exposed elements are vulnerable".

The UNDP Report (2004: 2): *Reducing Disaster Risk – A Challenge for Development* has applied the methodology and the DRI developed by the GRAVITY-Team of UNEP. In responding to the *Millennium Development Goals* (MDGs), the UNDP report tried to mainstream disaster reduction and developing concerns by a) a collection of basic data on disaster risk and the development of planning tools; b) collection and dissemination of best practice in development planning; and c) galvanizing of political will to reorient both the development and disaster management sectors. The initial *Disaster Risk Index* (DRI) points to three limitations by a) focusing only on the risk of death; b) examining only risks associated with large- and medium-scale disasters; and c) representing risks associated with earthquakes, tropical cyclones and floods.

2.5.10 From Yokohama to Kobe: Global Policy Goals for Natural Disaster Prevention, Preparedness, and Mitigation

Since the adoption of the *Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action* in 1994 significant conceptual and practical policy progress has been made. The *Review of the Yokohama Strategy* (A/Conf.206/L.1) listed five major accomplishments and remaining challenges, dealing with governance, risk identification, knowledge management, reducing underlying risk factors and preparedness for effective response and recovery. Under risk identification they referred to assessment, monitoring and early warning. The review stressed a need for "greater awareness of the social and economic dimensions of vulnerability", for improved data and analytical tools, it pointed to *emerging risks* (urban risks and exposure of complex infrastructure, greater attention to the interaction between natural and human-induced hazards (technological risks), including climate change impacts. With regard to *reducing underlying risk factors*, the review addressed (i) environmental and natural resource management; (ii) social and economic development practices; (iii) land-use planning and other technical measures; and (iv) advanced technologies (including remote sensing).

The *World Conference on Disaster Reduction* (WCDR) in Kobe (18 to 22 January 2005), in its *Hyogo Framework for Action 2005–2015* promoted "a strategic and systematic approach to reducing vulnerabilities and risks to hazards" by underscoring "the need for ... building the resilience of nations and communities to disasters" (A/Conf.206/L.2/Rev.1: 3). The final document maintained:

> Disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities. Events of hydro-meteorological origin constitute the large majority of disasters. Despite the growing understanding and acceptance of the importance of disaster risk reduction and increased disaster response capacities, disasters and in particular the management and reduction of risk continue to pose a global challenge.

At the Kobe conference, among the five main areas where gaps for action for 2005 to 2015 were identified, two dealt with "risk identification, assessment, monitoring and early warning" and with "reducing underlying risk factors". To achieve these aims, the conference adopted three strategic goals of which the third called for "the systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response, recovery programmes for disaster affected communities". The *Hyogo Framework for Action 2005–2015* proposed enhanced international cooperation and assistance in the field of disaster risk reduction, including knowledge transfer, sharing of research results, enhance governance, financial assistance to reduce existing risks and setting-up of governance systems that "can avoid the generation of new risk". The strategy called for preventive and proactive measures (early warning efforts and systems).

In order to identify, assess and monitor disaster risk and enhance early warning, the Kobe strategy listed among the key activities: i) *National and local risk assessments* (risk maps, indicators of disaster risk and vulnerability); ii) *early warning* (people-centred, information systems, institutional capacities, better cooperation); iii) *capacity* (support for infrastructures, databases, support for methods and capacities); and iv) *regional and emerging risks* (cooperation, early warning, research on long-term changes: climate trends, diseases, land-use, environmental hotspots, slope deforestation, demographic changes and density, rapid urbanization, relevant trade factors). For reducing underlying risk factors, the document has referred to: i) *environmental and natural resource management*; ii) *social and economic development*

practices; and iii) *land-use planning and other technical measures*.

On a regional European level, the Commission of the European Communities, in its "Strategic Objectives 2005–2009 – Europe 2010: A Partnership for European Renewal: Prosperity, Solidarity and Security" (26 January 2005) stated that the security of the citizen "can be put at risk by natural disasters, environmental or health crises and transport and energy threats". The President of the Commission stated that "the Union has a role to play at all stages: risk prevention, early warning, crisis management, and acting in solidarity with the victims of disasters". One of the five key security themes will be: "managing risk in the modern world". The Commission documents as the first of three tasks:

> Environmental and health risks such as the increased threats of floods or droughts following climate change, the fallout from potential biological, chemical or radiological attacks of serious outbreaks of disease have immediate EU-wide implications. They must be tackled in two ways: by the ability to offer early warning and immediate response to a particular crisis, and by long-term prevention. Information and surveillance networks need to be effective if they are to cope adequately with cross-border threats.

With regard to "Europe as a world partner", the strategic objectives of the European Commission called for: 1) a stronger actor in the world economy; 2) global solidarity; and 3) making security work worldwide to enable Europe "to tackle stability and security issues at their root by strongly promoting sustainable development through both multilateral and bilateral channels".

The security part of the EU Commission's "Strategic Objectives" reflected the debate on reconceptualization of security by shifting the focus from narrow military threats to: a) non-military security challenges for justice and home affairs (to counter crime, terrorism, human and drug trafficking); b) natural disasters, environmental and health risks; c) energy supply crises and vulnerability of traffic and energy infrastructure; and d) promoting global solidarity with sustainable development.

These declaratory policy goals of the UN's *Hyogo Declaration* and the EU's *Strategic Objective*s reflect both a reconceptualization and a redefinition of security 'threats', 'challenges', 'vulnerabilities' and 'risks' with an application to natural hazards. In 2005, the Hyogo Framework for Action 2005–2015 requested the UNISDR secretariat to "update and widely disseminate international standard terminology related to disaster risk reduction". In the 2009 version, the terms were revised and are now defined by a single sentence (table 2.1).[23]

These adopted definitions apply to the risk related activities of many international organizations and they are also used by many governments for guidance.

2.6 Environmental Security Threats, Challenges, Vulnerabilities and Risks

The contextual change since 1990 and the scientific changes in several disciplines have contributed to a widening and a deepening of 'security' and accordingly the related concepts of security threats, challenges, vulnerabilities and risks have also changed. Since 1989 a debate has evolved on the 'environmental security dimension' and on 'environmental' or 'ecological' threats, challenges, vulnerabilities and risks for national, international and human security.

2.6.1 The Environment as New 'Threats' to National Security

The scientific debate on environmental security started at the end of the Cold War. Westing (1988: 257–264) pointed to both the military impact on the environment and to environmental factors of security, such as territorial, shared or extra-territorial resources that require mechanisms for the non-violent resolution of resource conflicts. The former Norwegian Foreign Minister Holst (1989: 123–128) saw a triple relationship between conflict and environment: a) *environmental deterioration* (space, atmosphere, lithosphere, hydrosphere, biosphere) as a consequence of armed conflict; b) *environmental degradation* (due to poverty, injustice, population growth) as a *cause* of conflict; and c) *self-reinforcing environmental degradation* (refugees, food riots, urban violence) as a *contribution* to armed conflict. Both environmental impacts of military activities and of wars, and the environment as a cause or contributing factor to hazards, migration, crises and in the extreme case also to conflicts have posed 'threats', 'challenges', 'vulnerabilities' and 'risks' that have been conceptualized since the late 1980's in the context of US 'na-

23 See the complete list of UNISDR key terminology on *Disaster Risk Reduction* at: < http://www.unisdr.org/eng/terminology/terminology-2009-eng.html> that reflects the ISO guide on risk management.

Table 2.1: Selected UNISDR key terminology on *Disaster Risk Reduction*. **Source:** UNISDR; at: <http://www.unisdr.org/eng/terminology/terminology-2009-eng.html>.

Term	Definition	Comment
Acceptable risk	The level of potential losses that a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions.	In engineering terms, acceptable risk is also used to assess and define the structural and non-structural measures that are needed in order to reduce possible harm to people, property, services and systems to a chosen tolerated level, according to codes or 'accepted practice' which are based on known probabilities of hazards and other factors.
Corrective disaster risk management	Management activities that address and seek to correct or reduce disaster risks which are already present.	This concept aims to distinguish between the risks that are already present, and which need to be managed and reduced now, and the prospective risks that may develop in future if risk reduction policies are not put in place. See also Prospective risk management.
Disaster risk	The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.	The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least.
Disaster risk management	The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.	This term is an extension of the more general term 'risk management' to address the specific issue of disaster risks. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness.
Disaster risk reduction	The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.	A comprehensive approach to reduce disaster risks is set out in the United Nations-endorsed Hyogo Framework for Action, adopted in 2005, whose expected outcome is "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries." The International Strategy for Disaster Reduction (ISDR) system provides a vehicle for cooperation among Governments, organizations and civil society actors to assist in the implementation of the Framework. Note that while the term 'disaster reduction' is sometimes used, the term 'disaster risk reduction' provides a better recognition of the ongoing nature of disaster risks and the ongoing potential to reduce these risks.
Disaster risk reduction plan	A document prepared by an authority, sector, organization or enterprise that sets out goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives.	Disaster risk reduction plans should be guided by the Hyogo Framework and considered and coordinated within relevant development plans, resource allocations and programme activities. National level plans need to be specific to each level of administrative responsibility and adapted to the different social and geographical circumstances that are present. The time frame and responsibilities for implementation and the sources of funding should be specified in the plan. Linkages to climate change adaptation plans should be made where possible.
Extensive risk	The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts.	Extensive risk is mainly a characteristic of rural areas and urban margins where communities are exposed to, and vulnerable to, recurring localized floods, landslides storms or drought. Extensive risk is often associated with poverty, urbanization and environmental degradation. See also 'Intensive risk'.

Term	Definition	Comment
Intensive risk	The risk associated with the exposure of large concentrations of people and economic activities to intense hazard events, which can lead to potentially catastrophic disaster impacts involving high mortality and asset loss.	Intensive risk is mainly a characteristic of large cities or densely populated areas that are not only exposed to intense hazards such as strong earthquakes, active volcanoes, heavy floods, tsunamis, or major storms but also have high levels of vulnerability to these hazards. See also 'Extensive risk'.
National platform for disaster risk reduction	A generic term for national mechanisms for coordination and policy guidance on disaster risk reduction that are multi-sectoral and inter-disciplinary in nature, with public, private and civil society participation involving all concerned entities within a country.	This definition is derived from footnote 10 of the Hyogo Framework. Disaster risk reduction requires the knowledge, capacities and inputs of a wide range of sectors and organizations, including United Nations agencies present at the national level, as appropriate. Most sectors are affected directly or indirectly by disasters and many have specific responsibilities that impinge upon disaster risks. National platforms provide a means to enhance national action to reduce disaster risks, and they represent the national mechanism for the ISDR.
Prospective disaster risk management	Management activities that address and seek to avoid the development of new or increased disaster risks.	This concept focuses on addressing risks that may develop in future if risk reduction policies are not put in place, rather than on the risks that are already present and which can be managed and reduced now. See also Corrective disaster risk management
Residual risk	The risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained.	The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery together with socio-economic policies such as safety nets and risk transfer mechanisms.
Risk	The combination of the probability of an event and its negative consequences.	This definition closely follows the definition of the ISO/IEC Guide 73. The word 'risk' has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in 'the risk of an accident'; whereas in technical settings the emphasis is usually placed on the consequences, in terms of 'potential losses' for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks.
Risk assessment	A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.	Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.
Risk management	The systematic approach and practice of managing uncertainty to minimize potential harm and loss.	Risk management comprises risk assessment and analysis, and the implementation of strategies and specific actions to control, reduce and transfer risks. It is widely practised by organizations to minimize risk in investment decisions and to address operational risks such as those of business disruption, production failure, environmental damage, social impacts and damage from fire and natural hazards. Risk management is a core issue for sectors such as water supply, energy and agriculture whose production is directly affected by extremes of weather and climate.

Term	Definition	Comment
Risk transfer	The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.	Insurance is a well-known form of risk transfer, where coverage of a risk is obtained from an insurer in exchange for ongoing premiums paid to the insurer. Risk transfer can occur informally within family and community networks where there are reciprocal expectations of mutual aid by means of gifts or credit, as well as formally where governments, insurers, multilateral banks and other large risk-bearing entities establish mechanisms to help cope with losses in major events. Such mechanisms include insurance and re-insurance contracts, catastrophe bonds, contingent credit facilities and reserve funds, where the costs are covered by premiums, investor contributions, interest rates and past savings, respectively.

tional security' and since the 1990's increasingly also as dangers to 'human security'.

Within the framework of national security Mathews (1989) and Myers (1989, 1989a) argued: "First there was a need to redefine security and to include a new range of threats. ... Second, there was an acceptance that the object of security was no longer simply the state, but ranges to levels above and below the level of the state" (Lonergan 2002: 270–271). Mathews (1989: 162) proposed a "broadening definition of national security to include resource, environmental and demographic issues". She warned that global changes "in the chemical composition of the atmosphere, in the genetic diversity of species inhabiting the planet, and in the cycling of vital chemicals through the oceans, atmosphere, biosphere and geosphere" could lead to irreversible damage. Myers (1989: 23–41) pointed to several environmental factors (soil erosion, ozone layer, climate change) as legitimate causes for international concern that may have repercussions for US security policy. Myers (1993, 1994, 1996: 12) also claimed that the "principal threat to security and peace stems from environmental breakdown" and that environmental problems can "figure as causes of conflict", such as water in the Middle East, desertification in the Sahel, water diversion or flooding in Bangladesh. Myers (1993: 20–21) equated security with "human well-being; not only from harm and injury but access to water, food, shelter, health, employment, and other basic requisites". He warned if the environmental foundations are depleted:

> the nation's economy will eventually decline, its social fabric will deteriorate, and its political structure will become destabilized. The outcome is all too likely to be conflict, whether in the form of disorder and insurrection within a nation or tensions and hostilities with other nations. ... National security is no longer about fighting forces and weaponry alone. It relates to watersheds, croplands, forests, genetic resources, climate, and other factors rarely considered by military experts and political leaders, but that taken together deserve to be viewed as equally crucial to a nation's security as military prowess.

Myers (1996: 22) analysed as environmental factors contributing to conflict: population growth, ozone layer depletion and global warming, mass extinction of species and as a direct consequence: environmental refugees. These 'Neo-Malthusian' (Malthus 1789 [1993]) and 'realist' concerns that focused on the 'state' as the major referent object had a conceptual impact on the US defence and security policy during the Clinton administration but they were discontinued by his successor (Matthew/McDonald 2009).

2.6.2 'Environmental Security Agenda' as an Object of Securitization

Simultaneously the Copenhagen school has widened the scope of security from a 'constructivist perspective'. According to Buzan, Kelstrup, Lemaitre, Tomer and Wæver (1990) "*Environmental security* concerns the maintenance of the local and the planetary biosphere as the essential support system on which all human enterprises depend." Later, Buzan, Wæver and de Wilde (1998: 71–93) noted a scientific and a political agenda on how to analyse and deal with these concerns.

> The scientific agenda underpins securitizing moves, whereas the political agenda is about three areas: (1) state and public awareness of issues on the scientific agenda ...; (2) the acceptance of political responsibility for dealing with these issues; and (3) the political management questions that arise: problems of international cooperation and institutionalization – in particular regime formation, the effectiveness of unilateral national initiatives, distribution of costs and benefits, free-rider dilemmas, problems of enforcement, and so forth (Buzan/Wæver/de Wilde 1998: 72).

On the scientific environmental agenda the following issues are often included (Buzan/Wæver/de Wilde

1998: 74–75): a) *Disruption of ecosystems* (climate change; biodiversity loss, deforestation, desertification, soil erosion; ozone layer depletion; pollution); b) *energy problems* (natural resource depletion, pollution, disaster depletion, nuclear energy, oil transportation, chemical industries, scarcities, uneven distribution); c) *population problems* (population growth, consumption beyond carrying capacity, epidemics, poor health conditions, declining literacy rates, uncontrollable migrations, unmanageable urbanization); d) *food problems (*poverty, famines, overconsumption, diseases related to extremes; loss of fertile soils and water resources; epidemics and poor health conditions; scarcities, uneven distribution); e) *economic problems* (protection of unsustainable production, societal instability leading to cyclical and hegemonic breakdowns, structural asymmetries and inequality); and f) *civil strife* (war-related environmental damage and violence related to environmental degradation). Securitization efforts were made at all levels but the most effective were on the local level. For Buzan (2004), the 'state' and the 'society' remained major referents of securitization, and he was sceptical to the human security concept. More recently, Buzan and Hansen (2009) reviewed the gradual development of environmental security in a broader and systematic context of the evolution of international security studies.

2.6.3 'Environmental Security Issues' as New Causes of Conflicts

So far four phases of research on environmental security issues have been distinguished. Dalby, Brauch and Oswald Spring (2009) have recently reviewed the first three phases of environmental security research and Oswald Spring, Brauch and Dalby (2009; Brauch 2003, 2003a) have suggested to include in the research agenda for the fourth research phase, a human security perspective and to address gender issues and natural hazards. In this volume, Brauch, Dalby and Oswald Spring (chap. 94) suggest a new multidisciplinary approach of a 'political geoecology' and to introduce the 'political' dimension into Earth Systems Science as well as knowledge from the natural sciences into the discourses on environmental and human security.

In the centre of the second empirical phase of the debate on environmental security have been many case studies conducted by two research teams in Toronto (Homer Dixon 1991, 1994, 1999, 2000), and in Zurich and Berne (Bächler/Spillmann 1996, 1996a, 1996b; Bächler 1999; Bächler/Spillmann/Suliman 2002). They focused on the linkages between environmental stress and extreme outcomes: societal crises, domestic or international conflicts and cooperation.

While these case studies focused primarily on environmental scarcity ('*grievance*') other more recent studies have argued that resource abundance (diamonds, coltan et cetera) or 'greed' has been a major cause for the new wars by local war lords (Gleditsch 2001, 2003; Conca/Dabelko 2002; Collier 2000, Bannon/Collier 2003; Collier/Elliott/Hegre/ Hoeffler/ Reynal Querol/Sambanis 2003). A recent study by Kipping (2009) has shown that water scarcity in the Senegal River basin has been the reason for cooperation between Senegal and Mauritania. But after the building of dams and introduction of irrigated agriculture water abundance had became a cause of violent conflict.

John Gerard Ruggie (1998: 155–171) argued on the eco-demographic contexts of emerging new conflicts in developing countries that a part of the populations may experience "institutional barriers long before they encounter absolute physical scarcity" which may result in a spillover of population pressures into international conflict behaviour. On rapid urbanization, Ruggie (1998: 163) emphasized that social turmoil may result from the "insufficient capacity on the part of the cities to service such large increments of population in so short a time. A social turmoil in turn may provide targets of opportunity, either for domestic forces to internationalize the problem or for foreign forces to meddle in domestic affairs". Ruggie concluded that in contrast to the past, the "interplay between socio-economic forces and biophysical factors have reached a planetary scale".

Paul Kennedy (2000: 239–245) stated that environmental pressures "could produce threats to human well-being and social stability" and that, if the projected effects of climate change are accurate, "then mankind will face atmospheric turbulences and environmental hazards in the future that will cause distress: melting of the polar ice caps, rise in sea levels, more extreme weather conditions, greater storm damage, crop displacement, and habitat changes", challenges that could be addressed with regular means, at least in the US. But on the regional and local level these environmental damages could result in unrest and migration often combined with violence. He argued that the new global challenges, including global warming and migration pressure, which are further intensified by demographic and environmental stress, bring some societies to worrying thresholds and thus

could become threats to national and international stability.

Since 2007, climate change has been added to the political and scientific agenda as an object of securitization and as a potential cause of international, national and human security as well as a trigger or force multiplier resulting in different forms of primarily small-scale conflict.[24] At least five different approaches may be distinguished of policy analysis, causal analysis, scenario analysis, discourse analysis (of securitization moves by policy-makers and international organizations) and quantitative correlation analyses.

2.6.4 Environmental Security 'Threats', 'Challenges', 'Vulnerabilities', and 'Risks'

Security with its dual focus is achieved if there is an absence of objective threats and subjective fears to basic values. The ecosystem was introduced as the reference object of '*environmental security*'. Its values at risk are sustainability and the sources of dangers are humankind and global environmental change. The environment is considered both as a cause and an object of specific threats, challenges, vulnerabilities, and risks posed by GEC, by environmental pollution and by natural hazards to the 'objective' and 'subjective' security of human beings and humankind (*human security*), of societal groups (*societal security*), of nation states (*national security*), and of association of states (*European security*) from the impacts in the most affected states outside of the EU, for macro regions (*regional security*), and in a few extreme cases, such as 'abrupt climate change' (NRC 2002) also for the Earth (*global security*). While most securitization efforts have focused on the 'state' or on the 'society' as major referent objects, Westing (1989, 1989a: 129–134) introduced the environment into a 'comprehensive human security' concept that requires both a *protection* (quality of the environment) and a *utilization* requirement (human welfare). In this concept renewable natural resources must be used in a sustainable way.

Table 2.2 provides a heuristic compilation of possible linkages between environmental causes, stressors, impacts or outcomes that may pose security threats, challenges, vulnerabilities, and risks for human beings or humankind within their respective natural environment. Natural and human-induced hazards are rapid onset events also influenced by long-term, creeping or structural factors or processes.

Hazards and hazard-induced distress or forced migration may trigger socio-political consequences beyond the traditional scope of the hazard community, such as societal crises among residents and migrants competing for scarce soil and water for food security and survival.[25] These socio-political consequences have become an object of securitization in the context of a human security approach with the affected human beings as referent objects.

2.6.5 Environmental Factors as Security Threats, Challenges, Vulnerabilities, and Risks

Contrary to the 'state-centred national security' concepts of the realist school, global environmental change, as well as hydro-meteorological hazards, affect primarily the individual or humankind whose perception of 'insecurity' therefore change. Environmental factors, both *rapid-onset* hydro-meteorological hazards and *creeping* challenges posed by global environmental change have increased 'human insecurity' by confronting the highly vulnerable and poor people with a 'survival dilemma' (Brauch 2008b): either to stay at home in their village continuing their traditional livelihood, or to move first to the next major urban centre. The young and those who can afford it have of course a third possibility: to move to a country or a region that offers them better economic conditions and future prospects for survival of their family.

Hazard-induced or environmentally triggered distress migration has become a major 'human' and 'societal' security challenge for the 21st century. In Europe, in the US, but also in India, the counter strategies have been similar in tightening border controls. However, these measures could neither stop nor prevent immigration, they rather increased the number of illegal immigrants from Mexico to the US (Oswald

24 There is rapidly growing political, consultancy and scientific literature on the 'climate change-security-conflict' nexus: BMU 2002; WBGU 2007, 2008; EU 2008; UNSG 2009; Maas/Tänzler 2009; Bushby 2009; Breitmeier 2009; Gleditsch/Nordas 2009; Brauch 2009a; chap. 1 by Brauch/Oswald Spring and 95 by Oswald Spring/Brauch; chap. 41 by Bauer; chap. 42 by Scheffran.

25 See e.g.: Biermann and Boas (2007); Brown (2008); Warner, Afifi, Dun, Stal and Schmidl (2008); Black (2006).

Table 2.2: Compilation of environmental threats, challenges, vulnerabilities, and risks. **Source:** Compiled by the author.

Environmental causes, stressors, effects and natural hazards that pose	**Natural and economic factors**		**Societal impact factors (exposure)**	
	Substantial threats for	**Challenges affecting**	**Vulnerabilities for**	**Risks for**
	Security objects (for what or whom?)			
Climate change • temperature increase (creeping, long-term)	• Human health • agriculture (yield decline) • biodiversity • desertification	• tourism • food security • fisheries • government action • economic action	• infectious disease • damage to crops • natural systems • water scarcity • forest fire	• human populations • the poor, old people and children due to heatwaves
Climate change • sea level rise (creeping, long-term)	• Small island states • marine ecosystem, • indigenous communities, • industry, energy	• deltas • coastal zones • marine, freshwater ecosystems	• coastal cities, habitats, infrastructure, jobs • cities, homes, jobs	• livelihood • poor people, • insurance, • financial services
Climate change • -Extreme weather events: • storms (hurricanes, cyclones, winter storms)	• Habitat, technical infrastructure, transportation, etc	• forests (health of trees) • food security	• coastal ecosystems • forests, settlements • electricity transmission	• human life & property • insurance, • financial services
Climate change • Extreme weather events: floods	• Habitat, technical infrastructure and people	• vulnerable, flood-prone areas	• persons living in flood-prone areas	• human life & property
Climate change • Extreme weather events: drought	• Availability of water and food, survival of people	• decreased crop yield and water quality & quantity	• arid and semi-arid zones, agriculture • forests (tree health)	• human life & animals, property
Tipping points in the climate system (crossing thresholds due to linear climate change impacts)[a)]	• unforeseeable consequences • for water, soil, food and livelihood security	• agriculture, • tourism • urban habitats	• damage to crops • natural systems • water scarcity • forest fire	• human populations • the poor, old people and children due to heatwaves
Abrupt climate change (shutoff of the Gulf Stream in the North Atlantic) • e.g. cooling in Central and Northern Europe, in North America (USA)	• Countries and people in Northern Europe, benefiting from Gulf Stream	• livelihood • survival	• agriculture • habitat • people	• human life & animals, property • forced migration of people
Geophysical hazards • earthquakes, • volcanic eruptions • tsunamis	Hazard prone areas • regional and local affected areas • coastal areas (in Indian Ocean)	• habitat, • technical & economic infrastructure • people	• poor living in hazard prone areas and in vulnerable housing	• poor people with little resilience & disaster preparedness, no insurance
Soil erosion, desertification, drought	• water scarcity • agriculture • habitats	• food security • human livelihood (forced migration)	• livelihoods • rural areas • specific crops	• people & livestock in rural areas • people in slums

Table 2.2: Compilation of environmental threats, challenges, vulnerabilities, and risks. **Source:** Compiled by the author.

Deforestation	• Landscape, cities, habitat	• water availability	• landslides	• informal housing (slums)
Water scarcity and degradation	• Agriculture, food security, people	• econ. behaviour • human health	• poor in slums	• old people, children, poor
Forced Migration	• Resident population, clash on water and food	• overgrazing on marginal soils, • environment	• fragile ecosystems • people on the move	• migrants and their animals

a) Lenton, Held, Kriegler, Hall, Lucht, Ramsdorf, and Schellnhuber (2008: 1186) argued that the term 'tipping point' has been used in discussions of global change "to describe a variety of phenomena, including the appearance of a positive feedback, reversible phase transitions, phase transitions with hysteresis effects, and bifurcations where the transition is smooth but the future path of the system depends on the noise at a critical point". They offered "a formal definition, introducing the term 'tipping element' to describe subsystems of the Earth system that are at least subcontinental in scale and can be switched – under certain circumstances – into a qualitatively different state by small perturbations. The tipping point is the corresponding critical point – in forcing and a feature of the system – at which the future state of the system is qualitatively altered". They pointed to the melting of the Arctic sea-ice, rapid changes in the Greenland and in the West Antarctic ice sheet, a shutoff of the Gulf Stream (Atlantic Thermohaline Circulation), changes in the El Niño-Southern Oscillation (ENSO), in the Indian summer monsoon, in the Sahara/Sahel and West African monsoon, a drying of the Amazon basin and changes in boreal forests. The potential political and security consequences of these non-linear or chaotic perturbations in the climate system once unknown thresholds have been crossed have not yet been analysed and may only be discussed in the context of worst-case impact scenarios.

Spring/Brauch 2005; Verduzco/de Lozano 2010; chap. 26 by Brauch and chap. 47 by Brauch/Oswald Spring).

2.6.6 Proactive Security Response Strategies

Addressing the environmental dangers to security (table 2.2) requires a complex combination of strategic instruments and policies to reduce the vulnerability to natural hazards and the related risks for human beings and affected societal groups. Thus a dual strategy is needed for dealing with: *short-term situational* impacts of extreme weather events and natural hazards; and *longer-term structural impacts* of global environmental change. While the global environmental change, the climate change and the hazard research communities have used different concepts of environmental, social and economic vulnerabilities and risks, a conceptual and a policy-oriented mainstreaming is needed to address both impacts. Three groups of vulnerability and risk indicators are needed: for both climate change and hydro-meteorological hazards; for specific hazards (storms, floods, drought), and for temperature increase and sea-level rise.

Thus, effective climate policies with legally binding obligations may be the most cost-effective solutions to counter the projected increase in extreme weather events. To respond to these complex and manifold environmental security threats, challenges, vulnerabilities, and risks as well as to those posed by manifold hazards, it is primarily *proactive* non-military policies and measures (table 2.3) which are needed. More conceptual work on the linkages between 'environmental' and 'human' security is necessary, but also between economic production and ecosystems (N. Georgescu-Roegen 1971). Mainstreaming efforts are required on the scientific and political tracks with regard to the environmental dimension of human security (conceptualization in the scientific community); and a 'paradigm shift' in the UN system from 'national' towards 'human security' perspectives.

With regard to the work of international organizations, a dual mainstreaming may be needed:

- to incorporate a 'human security perspective' into environmental security initiatives, such as ENVSEC of OSCE, UNEP, UNDP[26] and NATO (Cheterian 2009) into the green diplomacy of the European Union launched at the European Council in Thessaloniki in June 2003; and
- to include an 'environmental security dimension' into the work of the *Human Security Network*

26 See the joint initiative of OSCE, UNEP and UNDP on: *An Environment Agenda for Security and Cooperation in South Eastern Europe and Central Asia*; at: <http://www.iisd.org/natres/security/envsec/>; <www.osce.org/documents/sg/2003/01/324_en.pdf>; and at: <http://www.oecd.org/dataoecd/53/3/33687392.pdf>.

Table 2.3: Human security policies and measures for coping with environmental threats, challenges, vulnerabilities, and risks for ecosystems and sustainability. **Source:** Compiled by the author.

Strategies and means for coping with	Threats of	Challenges for	Vulnerabilities of	Risks of
	Environmental Security for			
Sustainable development policy goals	• Air (climate), soil, water	• agriculture and food security	• vulnerable people (old, children, women, indigenous groups)	
Environment policy (implementation of environmental treaties, regimes)	• Climate change, • soil erosion, • water scarcity and degradation	• economy • agriculture • tourism • health	• rural livelihood • urban habitat • transport & econo- • mic infrastructure	• reducing exposure of people with low resilience
Early recognition (research, education, training, agenda-setting)	• Extreme weather events (storm, flood, drought)	• agriculture (shift in crops)	• city planning • building standards	• enhancing knowledge of these people
Early warning of hazards and disasters	• Hydro-meteorological (storms, floods, drought) and geophysical (earthquake, volcano, tsunami) hazards	• agriculture (specific crops) • public health	• vulnerability mapping of hazard prone areas and housing	• enhancing training of these people
Effective disaster preparedness and rapid disaster response		• (inter)national organizations and resources	• vulnerability mapping of hazard prone areas and housing	• enhancing protection of these people
Humanitarian aid	• Hazards and conflicts	• access to affected areas	• spread of infectious disease	• reducing low recognition
Refugee assistance	• Distress migration	• environment • food supply	• refugees (in times of conflict)	• old, weak and poor

(HSN) focusing primarily on 'freedom from fear', elaborating it further also in the context of the report of the *Commission on Human Security* (CHS 2003) focusing on 'freedom from want' by adding a new pillar of 'freedom from hazard impact' (Brauch 2009b; Fuentes Julio/Brauch 2009);
- to launch a Mediterranean Environmental and Human Security Initiative (MEH-SEC) within the Union for the Mediterranean (Brauch 2010).

Including vulnerability concerns into the human security concept and in their environmental management plans requires the active involvement of other UN agencies and programmes.

2.7 Human Security Threats, Challenges, Vulnerabilities, and Risks

Parallel to the academic debate on environmental security that influenced the policy agenda of several international organizations, the human security concept used by UNDP (1994) triggered a global and ongoing political and scientific debate. UN Secretary-General Kofi Annan (2001) has referred to the need for a human-centred approach to security that must encompass "economic development, social justice, environmental protection, democratization, disarmament, and respect for human rights and the rule of law".

UNESCO (1997, 1998, 1998a, 2001, 2001a, 2003) has been instrumental for initiating and supporting the scientific debate on 'human security' especially in developing countries, by organizing regional conferences in all parts of the world (UNESCO 2008; Goucha/Crowley 2008). These regional conceptual efforts have linked the debate with pertinent security concerns. An intensive debate is continuing in OECD countries and there is a growing debate in developing countries focusing on specific 'human security' (HS) threats, challenges vulnerabilities, and risks (Brauch 2009b).

2.7.1 Towards a Human-centred Environmental Security Concept

What poses a threat, challenge, vulnerability or risk to human security, both to the individual human being

or to humankind, depends on whether a 'wide' or a 'narrow' HS concept is chosen focusing on 'freedom from want' (Japanese concept, CHS 2003), 'freedom from fear' (Norwegian and Canadian concept), 'freedom to live in dignity' (Annan 2005) or 'freedom from hazard impact' (Bogardi/Brauch 2005). GECHS (1999) argued that the following types of environmental change affect *human security*: a) natural disasters, b) cumulative changes or slow-onset changes, c) accidental disruptions or industrial accidents, d) development projects, and e) conflict and warfare.

Barnett (2001: 127) considered a "human-centred environmental security concept" as justified on moral and pragmatic grounds "because addressing the welfare of the most disadvantaged means addressing many of the future sources of environmental degradation" by protecting the rights of the most vulnerable members of society and by enhancing "welfare, peace and justice" on which legitimate institutions should be built which are required "for human and environmental security" (Conca 1994, 1994a). Najam (2003: 1–24) proposed an environment and security discussion around two sources of insecurity (violent conflict and social eruption), and to focus the analysis on state centred and society centred activities. This leads him to four outcomes: 1) *interstate war* (state centred violent conflict); 2) *civil strife* (society centred violent conflict); 3) *institutional failure* (state centred social disruption); and 4) *human insecurity* (as a society centred social disruption).

Barnett, Matthew and O'Brien (2008) and Matthew, Barnett, Mc Donald and O'Brien (2010, 2010a) offered a glimpse on the work the *Global Environmental Change and Human Security* (GECHS) project within the *International Human Dimensions Programme* (IHDP) that has been pursued from 1996 to June 2009 when the project ended with a synthesis conference. Barnett, Matthew and O'Brien (2010: 4) argued that "global environmental change poses new and in some cases unprecedented threats to human security ... that transcend the North-South binary and the 'rich-poor' dichotomy" and they discussed "how a human security orientation to environmental change can contribute to initiatives such as the Millennium Development Goals (MDGs)". In contrast to national or state security, human security "securitizes ...what individuals themselves see as their paramount concerns, and so pluralizes the meaning of security and opens up space for alternative security practices. It adds to the concept of human development ... by focusing on immediate concerns such as basic needs and peace, and by directing attention toward the most vulnerable (Gasper/Truong 2005)" (Barnett/Matthew/O'Brien 2010: 9). They concluded that "global environmental change is adding impetus to the realization that traditional understandings of security are limited and are an inadequate basis for making policy" and that GEC "is raising new and unavoidable question to equity and sustainability, which already underlie every aspect of human security". Finally they called "for greater integration of the security, development, and sustainable development research and policy communities, which have for too long been too distinct".

2.7.2 Human Security Threats, Challenges, Vulnerability, and Risks

From a human security perspective many threats, challenges, vulnerabilities, and risks exist for the major referent: the individual human being or humankind in contrast to the state in prevailing national security concepts. From a human security perspective all five security dimensions and also sectoral security concepts may be analysed. Human security is infringed by underdevelopment ('want'), conflicts and human rights violations ('fear'), by hazards and disasters ('hazard impact') and by the violation of human rights ('to live in dignity'). These four pillars of human insecurity pose threats, challenges, vulnerabilities, and risks to different aspects of human security and call for three different but interrelated strategies for coping and overcoming human insecurity for which different national and international organizations and means are needed.

All four pillars of human insecurity (want, fear, hazard impact, indignity) also impact on health insecurity. Chen and Narasimhan (2003: 3–12) in their human security agenda for global health argued that three factors: 1) conflicts and humanitarian emergencies; 2) infectious crisis (HIV/AIDS); and 3) impoverishment impact on illness, injury, disability, death posing critical pervasive threats to the vital core of human security: human survival and flourishing; livelihood; and dignity. For Leaning, Arie, Holleufer and Bruderlein (2003: 13–30) measuring human security focuses on the fulfilment of basic needs, and home, community and future.

Table 2.4: Compilation of human security threats, challenges, vulnerabilities, and risks**. Source:** Compiled by the author.

Dangers for Human Security Posed by	Human Security			
	Threats to	**Challenges for**	**Vulnerabilities to**	**Risks for**
Underdevelopment ('freedom of want')	• Human well- being, • human health • life expectancy	• social safety nets • human development • food security	• economic crisis and shocks • communicable diseases	those most vulnerable (socially, economically) and exposed to underdevelopment, violence and hazards: • peasants, • poor • women, • children, • old people • indigenous people • minorities.
Conflicts and human rights violations ('freedom from fear')	• Human life and personal safety (from wars) • identity, values	• feeling secure in a community • human rights • democracy	• warlords, criminals • corrupt regime, ruler • human rights abuses, violations	
Hazards and disasters ('freedom from hazard impact')	• Livelihood • survival • settlements, urban slums	• sustainable development • food security	• exposed population • livelihoods, habitat • disease (cholera, dengue, malaria, etc.)	
Violation of basic laws, lack of good governance ('freedom to live in dignity')	• human dignity, • human rights, • basic human needs	• rule of law, • democratic system of rule • peaceful conflict resolution	• corruption and organized crime	• rights of the citizens • human well-being

2.8 Conclusions for Research and Policy Suggestions

This survey reviewed the many political and scientific concepts dealing with four basic dangers undermining security, namely 'threats', 'challenges', 'vulnerabilities', and 'risks'. These concepts have been used in several scientific disciplines (political science, economics, psychology, sociology, international law) and research communities focusing on global environmental change, sustainable development, climate change as well as on hazards and disasters both in policy discourses and declarations.

This survey of scientific concepts has been a part of a scientific effort to reconceptualize security, its five dimensions, its levels of analyses since the global turn of 1989 and 1990 (global security order), since the terrorist attack on the United States of 11 September 2001 resulting in 'personal violence' and wars (Afghanistan, Iraq) and since the global financial crisis of 2008 resulting in 'structural violence' where millions of people lost their homes (e.g. in the United States), their income (rise in global unemployment, loss of pensions), their right to food (price hikes in basic food staples with resulting food riots during 2008 and major increase in hunger in the poor countries and among the poorest people in many countries since 2008 and 2009).

Due to globalization, trade flows, foreign investments and the exchange of information based on new forms of communication have not only increased, but non-state actors and processes beyond the control of the nation states and international organizations have also posed multiple new security threats, challenges, vulnerabilities, and risks that have resulted in new forms of 'invisible' antipersonnel and structural terrorism. While the instigators of the antipersonnel terrorism have become the object of a 'war on terror', those who caused and are responsible for the new 'structural terrorism' that deprived millions of people of their livelihood, income, economic well-being, and that threatened the common European currency have so far remained a part of the system that determined the rules that made this form of structural terrorism possible, and it is unclear whether the rules will or can be changed to permit that they can be brought to justice for violating national laws.

Since 1990 in many countries a widening of security has occurred away from the narrow military, political and economic security of the Cold War towards a

wider scope that has also included societal and environmental dimensions, but also a temporary return to a narrow Hobbesian (1651, [1965], 1658) primarily military security concept. In the 21st century, with regard to the thinking on security and sovereignty, three different contexts have coexisted:

- the *pre-modern* world where state sovereignty and the ability to rule the whole state territory has ceased to exist in so-called 'failing', or 'failed states', many of them having fallen victim to internal conflicts or civil wars where warlords control part of the country and major resources;
- the *modern* world where the defence of the Westphalian state and of its population and territory against undue outside intervention and intrusion is a major goal of 'national security' policies;
- the *postmodern* world where a progressive internal de-borderization (e.g. within the EU) combined with a tightening of external borders has occurred and both integration and globalization processes have reduced the classical *domaine réservé* of the nation state.

In addition, since the early 1990's, influenced by the concerns for 'human development' (UNDP 1994), a shift in the referent object of the security concept has taken place from an exclusive focus on the 'nation state' to 'human beings and humankind' or from the prevailing 'national security' to 'human security'. Since the late 1990's two parallel debates have taken place on 'environmental security' and on 'human security' both in the social sciences and within international organizations that have also been stimulated by several international commissions and high-level expert panels.

Within the UN system, UNU-EHS has started to advance the development of the 'environmental dimension of human security' (Bogardi/Brauch 2005; Brauch 2003, 2005, 2005a, 2008a) trying to bring both scientific and political communities together, and to develop the conceptual ideas of those further (Barnett 2001) who have called for a 'human centred environmental security' concept. Conceptualizing the 'environmental dimension of human security' implies that the victims (human beings and humankind), their social, economic, environmental and political vulnerabilities and risks become the central object of analysis and not only the state, its institutions and governance structures, strategies, policies, and measures.

Since the early 1990's, the scientific and conceptual debate on security concepts has proliferated from the OECD countries to other regions and to developing countries that have been major victims of the interaction between humankind and global environmental change, and where the need to overcome 'want' (development) and 'fear' (cooperation, disarmament, human rights) as well as to reduce the 'impact of hazards' is most severe and where the right to live in dignity and under good governance must still be realized. This survey of the conceptual thinking on *security threats, challenges, vulnerabilities, and risks* has stressed a dual need for:

- *more precise definitions* to reach a consensus on these concepts especially with regard to practical political measures to achieve the agreed goals; and
- *a systematization of the threats, challenges, vulnerabilities, and risks* for military, diplomatic, economic, societal, environmental as well as human, food, health, energy, livelihood, and gender security (Brauch/Oswald Spring/Grin/Mesjasz/Kameri-Mbote/Chadha Behera/ Chourou/Krummenacher 2009).

However, the latter is influenced by the political mindset of policy-makers and by the scientific worldview (chap. 95 by Oswald Spring/Brauch), disciplinary and theoretical approaches and models, as well as by the economic status and by the geographic location of the country concerned but also by the systems of rule and the level of participation of civil society in local, provincial and national decision-making.

For the hazard community, the concepts of vulnerability and risk have been crucial in a wider context that moves from the purely physical aspects of natural hazards to an assessment and ranking of vulnerability through indicators where the *environmental* (air, soil, water, ecosystems, natural resources), the *economic* (development, resources), the *social* (coping capacities), but also the *political* (governance, participation) contexts are fully taken into account.

A major conceptual and policy task could be to develop the new pillar of human security as 'freedom from hazard impact', and to contribute to the implementation of this goal through capacity-building for early warning, developing vulnerability indicators (Birkmann 2006), and vulnerability mapping (Bankoff/Frerks/Hilhorst 2004). While human-induced and natural hazards cannot be prevented, the impact of tragic events, like the Tsunami of 26 December 2004 in the Indian Ocean, Hurricane Katrina in 2005, or the earthquakes in Haiti and Chile in January and February 2010, can be reduced primarily by measures of early warning and better disaster preparedness that address the 'social vulnerability' of those

most exposed to both hydro-meteorological and geophysical hazards. The fourth pillar of human security aiming at 'freedom from hazard impact' would imply that people are empowered to mobilize and use their resources to address sustainable development goals rather than remain in the vicious cycle of a 'survival dilemma' (Brauch 2008b).

Human security as 'freedom from hazard impact' is achieved when people who are vulnerable to these manifold environmental hazards and disasters (floods, landslides, and drought) often intensified by other associated societal threats (poverty), challenges (food insecurity), vulnerabilities and risks (improper housing in highly vulnerable flood-prone and coastal areas) are better warned of impending hazards, prepared, and protected against these impacts and are empowered to prepare themselves effectively to avoid and to cope with the 'survival dilemma' that often occurs during conflicts, natural hazards, and in complex emergencies where both coincide.

3 Disaster Risk and Vulnerability: Concepts and Measurement of Human and Environmental Insecurity

Omar D. Cardona

3.1 Introduction

Disaster risk management is a development strategy that is notably attracting the increasing concern of policymakers and the general public due to the current emphasis on various components of human and environmental security. From the scientific perspective, comprehension of disaster risk is often manifested by compartmentalization of knowledge; in contrast, from the political and social point of view, this situation leads to a fragmented concept of management. The result is decreased effectiveness in terms of disaster risk reduction and, thus, an integrative framework seems essential.

This chapter provides conceptual and methodological contributions as a general guide to a comprehensive risk management base regarding a holistic approach of disaster risk, given a special relevance to the concept and the different dimensions or components of vulnerability. They can be better understood within the notion of human and environmental security. The integration of an appropriate measurement of these individual and collective vulnerability dimensions enables a grasp of the risk complexity while demanding an interdisciplinary approach for the effectiveness of risk management.

The issues are treated below in four parts. First, a state-of-the-art discussion of risk and its theories from different disciplines is summarized to indicate certain difficulties encountered in the conceptualization of the notion of risk (3.2). Second, a conceptual framework of disaster risk is developed from an integrated approach (3.3). The third part focuses the discussion on the vulnerability concept and on its relevance on risk measurement to favour the awareness and the effectiveness of decision-making (3.4). The fourth session presents the territorial safety as the objective of disaster risk management; i.e. security for the society and for the ecosystem in the space of configurations based on their compatibility and the balance of their interactions (3.5).

3.2 Theories of Risk

Theoretical contributions on risk from different disciplinary perspectives may be classified in various categories including: a) *process*, *analogue* or *systemic* models; b) *structural* and *cognitive* explanations; c) *interpretative* representations; d) *quantitative* methods; and e) *taxonomic* frameworks.

The *process model* proposed by Rowe (1977) is widely used in the field of technological risk and toxicology. This approach suggests the existence of four stages: hazard identification, risk estimation, risk evaluation, and risk management. An example of an *analogue model* is provided by Covello, von Winterfeldt, and Slovic (1987) in an attempt to explain risk communication using signal theory. Palmlund (1992) proposed an analogue model with the classic structure of a Greek tragedy (with actors, scenario, drama, and roles) in order to explain the environmental tragedy from a political and social perspective. An example of a *systemic model* is provided by Kates (1971) from the human ecology school of thought. He describes the notion of *adjustment* to natural hazards considering the interactions between nature, humans, and technology. This model attempts to explain the dynamics of the interaction between the components, but does not necessarily provide information on the underlying causes of the process.

A classic *contextual* or *structural explanation*, where risk is seen as an attribute of social structures, is that proposed by Douglas and Wildavsky (1982). A cultural theory of risk is proposed by Rayner (1992). In this category, we may also include those approaches proposed by the *political economy school*, which may be considered constructivist. This is the case in the work of Westgate and O'Keefe (1976), Wi-

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jkman and Timberlake (1984), Susman, O'Keefe and Wisner (1983) and Chambers (1989). These socio-economic approaches defend the idea that risk is socially constructed. The contributions of Wisner (1993), Cannon (1994), Blaikie, Cannon, Davis and Wisner (1996) and those of different members of the Network for the Social Study of Disaster Prevention in Latin America (Maskrey 1994; Lavell 1996; Cardona 1996; Mansilla 1996) may also be considered constructivist, taking a neo-Marxist approach and emphasizing the social construction of vulnerability and, therefore, risk.

A *cognitive explanation* which has been called 'psychometric theory of risk' is provided by Fischhoff, Slovic and Lichtenstein (1979) and Slovic (1992). This theory proposes the existence of *mental models* and *cognitive architecture*. A case of quantitative laws is provided by Starr (1969), who uses three quantitative laws to explain behaviour when faced with risk. His ideas were not well accepted by social scientists but continue to be a necessary point of reference when one talks of the acceptability of risk, and of security norms and codes.

Systematic classifications (*taxonomies*) have also been used to provide order and structure for a range of phenomena and circumstances. Examples may be found in the classification of natural hazards proposed by Burton and Kates (1964), the classification of dangerous materials proposed by Slovic, Fischhoff and Lichtenstein (1985) and the vulnerability classifications developed by Wilches-Chaux (1989) and Aysan (1993). Many of these conceptual proposals have been published in the *Journal of the Society of Risk Analysis*, founded in 1980. This journal was inspired by concerns for technological risk in particular. However, many of the ideas put forward may be extrapolated to the field of risk associated with natural and socio-natural phenomena.

Finally, mention must be made of the *postmodernist* ideas put forward towards the end of the 20th century by social scientists such as Ulrich Beck, Niklas Luhmann, and Anthony Giddens. For these authors, risk is intimately linked to societal development and is influenced by the decision-making and communication processes that occur under the influence of current power relations (Muñoz-Carmona 1997). A theoretical proposal that attempts to integrate all of these categories can be found, for example, in the *theory of the social amplification of risk* proposed by Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson and Ratick (1988). This attempts to lay out a causal process integrating the technical, social, cultural, and psychological dimensions of risk.

On a historical note, the first specialized research centre to be established on the topic of disaster was *the Disaster Research Centre* at Ohio State University, which built on the pioneering geographical research of Gilbert White and his collaborators at the University of Chicago. This centre was founded by sociologists, Enrico Quarantelli and Russell Dynes in 1963, and was later moved to the University of Delaware in 1985. Research here was concentrated on the social response to disaster and on post disaster recovery, following, in the first instance, analogies with response in case of nuclear attacks. However, the first centre to really study risk was the *Centre for Technology, Environment, and Development* (CENTED) at Clarke University. This centre was established by geographers Robert Kates and Roger Kasperson, and physicist, Christopher Hohenemser, in 1972. The centre concentrates on both natural and nuclear risks. Since then, at least six research centres were established in the USA in the 1970's, and at least seven more during the 1980's (Golding 1992). During the 1990's, stimulated by the *International Decade for Natural Disaster Reduction* (IDNDR), innumerable centres and programmes dealing with risks and disasters were founded around the world. The topic gained popularity since then and it was increasingly recognized that the terms hazard, vulnerability, and risk have different meanings and implications from both the methodological and practical angles.

For many years the term risk was used to refer to what is today called hazard, and still currently many references are made to the word vulnerability as if it were the same thing as risk. Notwithstanding, on the whole, the enunciation of a risk notably implies a potential for loss; and when a hazard event occurs and the loss is substantial – as a result of the vulnerability degree of the exposed elements – the term normally used is *disaster*. In the vocabulary of the United Nations, a disaster is "a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of affected society to cope using only its own resources" (UNDHA 1992). Nowadays, the risk of a major disaster is also termed a *major risk*, (Harding/Romerio/Rossiaud/Wagner/Bertrand/Frischknecht/Laporte 2001).

3.2.1 Conceptual Approaches

The different approaches to risk concepts and evaluation are based, in general, on different disciplinary foundations. One can distinguish between two major approaches, namely the socio-technical approach which may be considered as having been derived from the applied sciences and economics, and the socio-cultural approaches derived from sociology, psychology, anthropology, and culture studies.

The socio-technical approach includes contributions by the natural and engineering sciences and is based on probabilistic estimation of risk. This approach is adopted in toxicology and epidemiology, the actuarial[1] sciences and economics where cost-benefit comparisons are made. All these approaches are based on statistical prediction and on probability analysis. With reference to the socio-cultural vision, diverse social theories of risk may be identified and, as Ortwin Renn (1992) points out, there may be as many perspectives in sociology as there are sociologists. Renn classifies the theories in two categories, namely objectivist and constructivist. Moreover, the socio-cultural vision also covers psychological approaches which include psychometric analysis and the cultural school that bases its work on the analysis of groups and organizations. Unlike the socio-technical methods, socio-cultural approaches do not offer a common denominator for measuring the social and cultural acceptability of risk (Douglas 1985).

3.2.2 Objectivism and Constructivism

Probabilistic estimates of risk attempt to predict failures in the security of complicated technology systems, even where insufficient data are available on the system being analysed. Failure and event trees are used for the analysis, and the probability of failure of each component of the system is evaluated in a systematic fashion linking these to the structure of the system. This approach is useful for detecting deficiencies and for improving security levels in complex systems. The actuarial approach represents a classic example of *objectivist* approaches to the analysis of risk, where the base unit is an expected value that corresponds to the relative frequency of an average event in time.

Undesirable events are understood in terms of physical damage to persons and ecosystems. This may be observed and objectively measured with appropriate scientific methods. An application of this approach can be found in the case of predictions of road accidents for some future year. Results may be extrapolated from data on fatal accidents in previous years. The estimation of risk is reduced to a single dimension and is represented by an average in time, space, and context. Estimations of health and environmental risks basically use the same types of method.

The approach taken by economics transforms physical damage or other undesirable effects into subjective benefits. The base unit of these benefits describes the level of satisfaction associated with a possible action or transaction. An attempt is made to compare risks with benefits (Camerer/Kunreuther 1989). Since risks represent possible and not real costs it is necessary to relate them to the probability of occurrence of an event. Ultimately, what is sought is the use of resources in order to maximize benefits for society. Economic risk comprises a logical and coherent framework for situations where decisions have to be made by individuals and where decisions on loss are confined to the decision-maker's immediate environment. Although the economic perspective permits a uni-dimensional measure of risk that supposes that the benefits and risks are commensurable, there are many factors that impede its use in risk management policies. These include: the problem of aggregating individual gains, the existence of variations between individual preferences, the problem of taking appropriate action to reduce future negative consequences, the impacts on third parties, and the notions of rationality and ethical considerations that the model is based on.

In general, such *technical analysis* provides society with a limited and narrow definition of desirable effects, reducing the possibilities to numeric probabilities based on relative frequencies. Unfortunately, the objectivity that is associated with such calculations, which may be seen as a virtue, can also lead to the serious problem of oversimplifying a complex phenomenon.

On the other hand, the *psychological approach* suggests that individuals respond according to their perception of risk and not according to objective risk levels and scientific evaluations of this. Such estimations are only taken into account by individuals to the extent that they are considered in the light of individual perceptions. This approach assigns importance to the beliefs people have regarding the possibility of the

1 Field of mathematics that is directly related to risk evaluation using probabilistic (analytic) and statistical (data) models. The insurance industry has been based on actuarial studies since many years ago.

occurrence of an undesirable event. In this regard, the question arises as to whether perceptions are based on adequate information or rather, on biases and ignorance, which would make them very inadequate if they are to be used as criteria for decisions on risk reduction. From the point of view of many anthropologists and cultural sociologists, social responses to risk are determined by prototypes and cultural mores i.e. clusters of convictions related to different perceptions of reality. Seen from this perspective, environmental risks are considered to be purely social constructions.

3.2.3 Individualism and Structuralism

Individual and *contextual models* have been proposed by social scientists to explain social responses to risk. The individual model is largely based on psychology, whereas the contextual one is sociologically oriented. In the case of the individualist paradigm an attempt to understand group behaviour is made by studying individuals. An example of such models can be found in the "theory of knowledge and personality" (Wildavsky/Dake 1990). This offers an explanation of the cognitive response to risk, which is based on the knowledge, information, aversion or tolerance of risk that is characteristic of different personality types. Psychometric and risk perception theories are based on this type of paradigm, as are some economic models of risk based on the theory of expected gains to which Camerer and Kunreuther make reference (1989).

Theoretical development of risk perception commenced with the research of Tversky and Kahneman (1973, 1974). These authors were interested in the identification of factors that influence the probability estimations of persons. They concluded that when people face complex problems that involve probability and event frequency, they apply certain rules of judgment and heuristics in order to simplify the problem. These often lead to biases and value judgments. Later contributions by Slovic, Fischhoff, and Lichtenstein (1981) led to the psychometric and cognitive theory of risk perception, based on prediction of individual responses to certain activities, particularly those of a technological nature.

Through the contributions of cultural theory and structuralism an attempt has been made to advance the understanding of the ontological aspects of risk and of the connection between sociological variables and individual attitudes to risk. The ontology of risk refers to its metaphysical status as a property and quality of the physical world. This is a common supposition amongst those who promote the technical evaluation of risk. In the case of contextual approaches, the context is taken as a starting point. These models take into account the social structure, institutional forms, and culture. This approach has many variations, including those proposed by Rayner, Renn, Palmlund, Wynne, and Kasperson, although the latter author avoids providing social factors with an ontological character (Krimsky/Golding 1992).

Structuralists and *contextualists* defend the position that risk is subjective and varies according to the context, criticizing attempts to give it an objective and measurable character. Cultural theorists have even gone as far as to criticize the psychometric paradigm indicating that risk is inevitably the result of a social process, even though it has some roots in nature. That is to say, they defend the position that the most appropriate approach to risk analysis is sociological and not psychological, given that risk is a social product (Thompson/Wildavsky 1982). The debate between individualism and contextualism can only be resolved if we find a reply to the difficult question as to whether personality precedes context or vice versa.

All concepts of risk have a common element: a distinction between reality and possibility. If the future were predetermined or independent of present human activities, the term risk would have no significance. If the distinction between reality and possibility is accepted, then the term risk could be defined as "the possibility that an undesirable state of reality (adverse effects) will occur as a result of natural events or human activities" (Luhmann 1990a). This definition means that humans can and do make causal connections between actions (or events) and effects, and that undesirable effects can be avoided or reduced if the causal events or actions are avoided or modified. According to this definition, risk is a descriptive concept (a representation) and, at the same time, takes a normative dimension. The definition of risk involves three elements: undesirable results, the possibility of occurrence, and a state of reality. All approaches to risk provide different conceptualizations of these three elements. These may be paraphrased in the following three questions: How may we specify and measure uncertainty? What are the undesirable results? What is the concept of reality we hold to? This helps us to distinguish between the different perspectives (Renn 1992).

The distinction between risk evaluation and risk reduction is of interest in this regard, since it has implications regarding the distinctions between science and political decision-making. If risk is seen as being

objectively associated with an activity or a phenomenon and as something measurable in probabilistic terms in order to identify well-defined adverse effects, one can order the risks according to *objective* measures of the probability and magnitude of damage, and resources would be allocated in order to deal with the greatest risks. However, if risk is seen as a social or cultural construction, then intervention would have to be based on different criteria and priorities, and should reflect *social values* and *preferences* for different life styles. These two positions represent the extremes of a spectrum of different positions regarding risk, and both could possibly be biased versions of reality (Renn 1992). Experience shows us that risk is multidimensional, and that differences in culture and social values call for different approaches. Experience shows us that there is no society in which a single criterion has been held to as regards all types of risk. However, the relativist position derived from social constructivism is difficult to justify in terms of its practical consequences when we observe that in many countries similar reduction standards and priorities have been established, despite notable differences in culture and society.

In summary, the conceptual frameworks used to understand and interpret disaster risk and the associated terminologies have not only varied over time, but also differ according to the disciplinary perspective considered. Despite the refinement with which disaster risk is considered in the different fields of knowledge, there is, in reality, no singular concept that unifies the different approaches, or that brings them together in a consistent and coherent manner. Although researchers and professionals working in the disaster areas may believe that they are talking about the same concept, serious differences exist that impede the decision-making effectiveness; i.e. successful, efficient, and effective risk reduction implementation. The conceptual framework proposed herein searches to present a consistent and coherent holistic theory of disaster risk contributing to the effective risk management by policy planners and stakeholders at all levels.

3.3 Conceptual Framework for Decision-making Effectiveness

Risk management is a crucial issue at both the scientific and political contexts, but the concept of risk is a polysemous notion. Psychologists, sociologists, and historians generally consider risk as a social phenomenon. This approach may be termed as *constructivist*. From this perspective, understanding of risk requires knowledge of individual perceptions and social representations, and of the interactions between the different social actors. On the other hand, engineers, geologists, geographers, economists, and epidemiologists generally adopt an approach that may be described as *realist* or *objective*, based on the hypothesis that risk can be quantified or objectively assessed. The same dichotomy of subjective vs. objective features has been inherent to the security concept.

In addition, the enunciation of risk, like security and insecurity, is performative; a situation is described as *safe*, or on the contrary *risky*, to attribute a positive or negative value to it and to begin to act. It is precisely in this respect that risk, security, and insecurity can be considered performative – or normative – notions. Furthermore, with regard to the notion of environmental and human security, to speak of insecurity is also to suggest a *threat* to security – always potentially menaced by crisis or disaster – and the risk one takes in according or refusing trust to the systems that organize the social context. The relationship between environmental and human security and risk involves the idea of threat. A hazard is only considered a risk when there is a threat to exposed elements. Thus the components of security provide a framework for analysis of the vulnerability – and of the resilience – of each element at risk in a hazard prone territory, (Harding/Romerio/Rossiaud/Wagner/Bertrand/Frischknecht/Laporte 2001).

Therefore, the antagonism between the *objectivist* and *constructivist* paradigms must be transcended, and more confidence must be placed in both qualitative and quantitative methods. Action and decision, implicit in the definition of risk, require a compromise between subjective risk perception and the scientific need for objective measurement. While the objective approach lacks the social dimension, which is an important consideration when assessing disasters, subjective definitions are equally unsatisfactory, since they imply that risk is a matter of personal interpretation only. This position is totally inoperable when intervention in risk becomes a must from the public policy angle. That is the reason why there is a need for a common language and a *holistic theory* of risk from an interdisciplinary perspective and based on the approach of the complex dynamic systems (Cardona 2004).

3.3.1 Differences between Risk and Disaster

Risk is not synonymous of catastrophe (Beck 2007, 2008); risk means the possibility of future disaster. The term *disaster risk* suggests that there is a possibility that a dangerous phenomenon or event will occur and that there are exposed elements predisposed or susceptible to being affected. The reduction of risk, therefore, means the reduction of the possibility of future disaster. Hence, *disaster* is a social context or process, triggered by a natural, technological or anthropogenic phenomenon, which in interaction with a susceptible medium causes intense alterations in the normal functioning of the community. These alterations may be expressed, amongst other things, as loss of life, serious health problems, damage or destruction of individual and collective goods, or severe damage to the environment. For this reason, rapid response is required in order to restore the well-being of affected persons or ecosystems and to re-establish adequate levels of normalcy. Disaster implies loss and damage, and consequential impacts that the affected community is unable to absorb or to cushion the effects and recover using its own resources and reserves. This suggests that there are levels and types of loss and damage that do not signify disaster for society. Disaster is a given situation, a product that is tangible and measurable.

Disaster supposes the prior existence of determined risk conditions. That is to say, disaster is the materialization of pre-existing risk. On the other hand, when defined as the probability of future loss, a disaster can be explained by the prior existence of a latent threat and certain intrinsic or constructed characteristics of society that predispose it to suffer determined levels of damage. Disaster risk may be considered a collective or public risk. It is the type of risk which signifies a threat to all members of the prone community. Once this risk is recognized as such by the community something must be done about it. Commitment by public and private institutions and the community itself becomes a must. But, collective risk supposes a series of interdependent, dynamic, and uncertain problems that require collective action in order to solve them. Unfortunately, it is not uncommon for communities that are exposed to and aware of dangerous phenomena to do nothing about it due to resource restrictions, or because perception of the danger is insufficient to stimulate collective action. On occasions, some community members are conscious of the danger and carry out individual actions to reduce it, but the community as a whole still remains vulnerable. The risk level of a society is related to its development level and the ability to modify the risk factors that affect it. In this sense, disasters may be considered unmanaged risks. Risk is constructed socially, even where the physical phenomenon is natural.

Definitions and concepts may hide many different aspects and vary notoriously with scientific discipline, ideology, and ontological viewpoint. As with almost all conceptual processes, the epistemological foundations and context are crucial for understanding the way a topic is dealt with. For example, 'the reduction [or mitigation] of natural disasters' has been a useful slogan for mobilizing support in general, but from a conceptual viewpoint this terminology is imprecise and confusing. What is it precisely we search to reduce or mitigate? Although it may seem to be a subtlety, it is a very different thing to talk of 'disaster risk reduction' as opposed to 'natural disaster reduction or mitigation'. From a decision-making viewpoint or from the point of view of the public in general, different ways of defining the same term will elicit different responses. Moreover, the risk *of* disaster used to refer to a probability is different to risk *from* disaster, which refers to feasible consequences. Concentrating on *risk* clearly allows us to discriminate between activities *ex ante* and *ex post*, and between the needs and activities relevant to one or another of these situations. Here, it is clear that the management approach has been long dominated by consequences (interest in humanitarian response) and not by an interest in the probability that these will occur (interest in prevention-mitigation). Although these approaches have common objectives, they signify different things in terms of funding, methods, functions, interests and expertise. In other words, it is not the same to visualize the problem from a social and economic development perspective, for example, as it is to look at it from the perspective of preparedness for humanitarian emergencies.

3.3.2 Disaster Risk as Potential of Crisis

The formulations of the problem owe a lot to the original ideas of the so-called *human ecology* school of thought first proposed by geographers at the University of Chicago during the second decade of the 20th century and further developed by White (1942, 1964, 1973), Kates (1971, 1978) and Burton (1962), by Burton and Kates (1964), as well as by Burton, Kates and White (1968, 1978) in their studies on hazards and disasters. On the other hand, the convolution of the

frequency of hazard events with the severity of its feasible consequences has been the traditional approach for risk assessment from the techno-hazards point of view.

Prompted by these ideas, the Office of the United Nations Disaster Relief Coordinator (UNDRO) and UNESCO organized an expert meeting in July 1979 with the objective of proposing a unification of disaster related definitions. The report from that meeting, *Natural Disasters and Vulnerability Analysis* (UNDRO 1980), included the definitions of natural *hazard* (H), *vulnerability* (V), *elements* at risk (E), *specific risk* (S), and *risk* (R). From this perspective, risk may be defined as

$$R = E \cdot S = E \cdot H \cdot V \text{(given that } S = H \cdot V \text{)} \quad (1)$$

Whilst essentially maintaining this conceptual framework, during the Institute for Earthquake Engineering and Engineering Seismology meeting, held in 1985 in Skopje (Former Yugoslav Republic of Macedonia), this author proposed the suppression of the variable related to the exposure, because it is implicit in the notion of vulnerability. In other words, one cannot be 'vulnerable' unless one is 'exposed'. Originally, this formulation was presented by Fournier d'Albe (1985), Petrovsky and Milutinoviç (1986) and later by Coburn and Spence (1992). The expression of risk as a function of hazard and vulnerability that is now widely accepted in the technical and scientific fields, and increasingly in the social and environmental sciences, was formulated as follows[2]:

$$R_{ie} \mid_t = f\left(H_i, V_e\right) \mid_t \quad (2)$$

This signifies that once the *hazard* or *threat* (H_i), is known (expressed as the probability that an event with an intensity greater or equal to *i* will appear during a period of *exposition t*), and the *vulnerability* (V_e), is also known (understood as the intrinsic predisposition of an element *e*, to be affected or to be susceptible to damage with the occurrence of an event with an *intensity i*), the *risk* (R_{ie}), is expressed as the probability of loss to the element as a result of the occurrence of an event with an intensity greater or equal to *i*. That is to say, risk in general may be understood as the probability of loss during a given period of *time t* (Cardona 1985, 1986).

Now, if C_p expresses a *crisis potential*, T_a represents the possibility of occurrence of a *trigger agent*, and I_c are the *instability conditions* of a system, from the perspective of the complex systems, it is possible to posit the following meta concept:

$$C_p \mid_t = f\left(T_a, I_c\right) \mid_t \quad (3)$$

This expression is more general and contains the abovementioned equation of risk, which is a particular case of behaviour of a specific non-linear dynamic system, at the border of chaos, in which it is important to consider the triggering agent or perturbation – i.e. the hazard – but also the dynamic conditions of instability – i.e. the vulnerability – (Cardona 1995, 1999, 1999a). The possibility that a crisis can appear must always be considered in a lapse or a 'window' of time, which would mean to express each factor in probability terms.

The evolution of the complex systems cannot be represented in an adequate way by linear functions or soft and continuous curves, except in the case of approximations over short segments of time. Equation (3) is appropriate to describe the potential bifurcations or inherent unpredictable development of the system. In the case of risk, the instability conditions are the weaknesses or the deficiencies that may be of environmental or ecological character; demographic, social or cultural; economic, institutional or political, among others. The concepts of *vulnerability*, or predisposition to be affected, and *resilience*, or capacity of recovery and adaptive behaviour, play an important role due to their important relation with the possible occurrence of discontinuities. One system may pass from an almost constant state to another one if it is altered by a sufficiently impacting perturbation, which does not only depend on the intensity of the event but also on possible instabilities that are not easily perceptible of the system. Lastly, a few words about the potentiality of the trigger event or agent are needed. This potentiality undoubtedly contributes to knowledge of one main component of risk: the *hazard*; the latent danger or probability of occurrence of a damaging event. It is necessary to have in mind that without hazard, without a trigger phenomenon, there would be no risk and no possible future disaster.

2 This equation is a definitional circle as the well-known Newton's *F=ma* – the force equals to the mass plus acceleration – where acceleration can be definable by itself by independent concepts, whereas force and mass are co-defined; i.e. one depends on another. Hazard and vulnerability are also co-defined: one cannot be vulnerable if one is not threatened by hazard, and one can not be threatened if one is not exposed and vulnerable. However, Wittgenstein pointed out that in any level of description the concepts form typically definitional circles.

3.4 Vulnerability as a Key Concept

Vulnerability of human settlements and ecosystems is intrinsically tied to different socio-cultural and environmental processes, but it is also related to the fragility, the susceptibility, or the lack of resilience of the exposed elements, both from society and environment. It is also closely tied to natural and built environmental degradation at the urban and rural levels. Thus, degradation, poverty, and disasters are all expressions of environmental problems and their materialization is a result of the social construction of risk, brought about through the construction of vulnerability or hazard, or both simultaneously. Therefore, when seen from a social viewpoint, vulnerability signifies a lack or deficit of development. In this regard, risk is constructed socially, even though it has a relationship to physical and natural space. In many places, increases in vulnerability are likely to be related to factors such as rapid and uncontrollable urban growth and environmental deterioration. These lead to losses in the quality of life, the destruction of natural resources and landscape, and loss of genetic and cultural diversity. In order to analyse vulnerability as part of wider societal patterns it is necessary to identify the deep rooted and underlying causes of disaster vulnerability and the mechanisms and dynamic processes that transform these into *insecure conditions*. All this leads to the conclusion that the underlying causes of vulnerability are economic, environmental, demographic, and political processes that affect the distribution of resources among different groups, which in turn reflect the distribution of power in society. Some global processes require more attention than others. These include population growth, rapid urban development, international financial pressures, degradation of the earth, global warming, and environmental change and war. To take but a limited number of examples, urbanization processes have been an important factor in damage caused by earthquakes in urban areas; population increase helps to explain increases in the numbers of persons affected by floods and prolonged droughts; and deforestation increases the chances of flooding and landslides (Blaikie/Cannon/Davis/Wisner 1994). Adhering to the hypothesis that the lack of development and vulnerability are correlated and considering that the lack of capacity to cope, recover, and adapt is also a factor of vulnerability, particularly taking into account the climate variability and change, this author has suggested that vulnerability originates in:

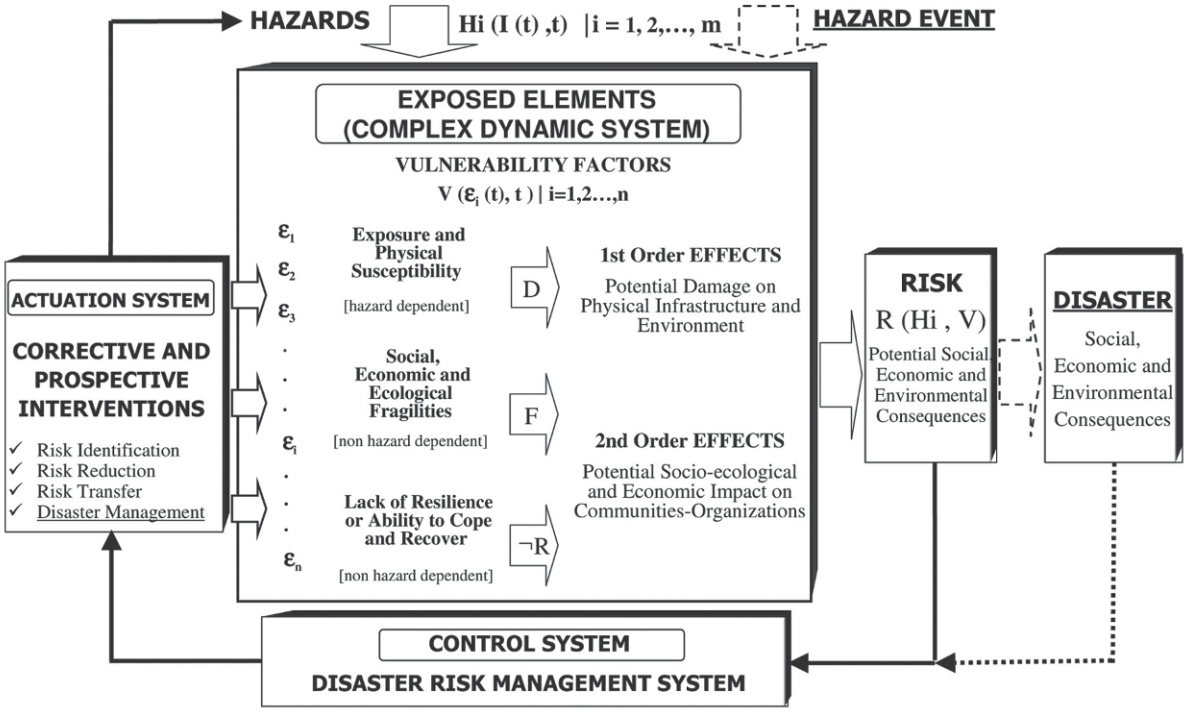
a.) *Physical fragility or exposure* (D): the susceptibility of human settlements and environment to be affected by a dangerous phenomenon due to its location in the area of influence of the phenomenon and to a lack of physical resistance.
b.) *Social, economic, and ecological fragility* (F): predisposition of society and ecosystems to suffer harm resulting from the levels of marginality and social segregation of human settlements and disadvantageous conditions and relative weaknesses related to social, economic, and environmental factors.
c.) *Lack of resilience or ability to cope and recover* (¬R): limitations in access to and mobilization of the resources of the human settlement, and incapacity to adapt and respond in absorbing the socio-ecological and economic impact.

According to this model (figure 3.1), vulnerability conditions in disaster prone areas depend on *exposure* and susceptibility of physical elements (human settlements, infrastructure, and environment), the *socio-economic and ecological fragility* and the *lack of resilience* or *ability to cope* with the context. These factors provide a measure of direct as well as indirect and intangible impacts of hazard events. Vulnerability, and therefore, risk are the result of inadequate economic growth, on the one hand, and of deficiencies that may be corrected by means of adequate development processes, on the other hand.

Indicators or indices could be proposed to measure vulnerability from a comprehensive and multidisciplinary perspective (Birkmann 2006). Their use intend to capture favourable conditions for direct physical impacts (*exposure* and *susceptibility*), as well as indirect and, at times, intangible impacts (*socio-ecological fragility* and *lack of resilience*) of hazard events. Therefore, according to this approach, exposure and susceptibility are necessarily *hard* conditions for the existence of physical risk, or first order effects, and these are hazard dependent. The propensity to suffer negative impacts as a result of the socio-ecological fragilities and not being able to adequately face disasters, are circumstances of the context that can be considered *soft* conditions, related to second order effects that aggravate the impact and usually are non-hazard dependent.

Using the meta concepts of the theory of control and complex system dynamics, to reduce risk it is necessary to intervene in a corrective and prospective way

Figure 3.1: Theoretical Framework and Model for a Holistic Approach to Disaster Risk Assessment and Management. **Source:** Adapted from Cardona (1999: 65), Cardona and Barbat (2000), IDEA (2005a/b) and Carreño, Cardona and Barbat (2007a).



the vulnerability factors and, when it is possible, the hazards directly. Then risk management requires a system of control (institutional structure) and an actuation system (public policies and actions) to implement the changes needed on the exposed elements or complex system where risk is a socio-environmental process.

This kind of thinking attempts to integrate in a holistic way the contributions of the physical and social sciences with the idea of obtaining a more complete vision of the factors that create or exacerbate vulnerability (Cardona/Hurtado 2000a, 2000b, 2000c; Cardona/Barbat 2000; Cardona 2001[3]). The conceptual framework and model for a holistic approach to evaluate disaster risk consider several dimensions or aspects of vulnerability proposed by Wilches-Chaux (1989), which are characterized by the above mentioned three categories or vulnerability factors. These dimensions are correlated to human security components and briefly described as follows:

a.) *Physical (habitat) dimension*: This depicts locations in susceptible areas and deficiencies in the resistance of the exposed elements. The latter affects the capacity to absorb the shocks associated with dangerous phenomena. Examples of the physical dimensions of vulnerability from habitat perspective can be found in the inadequate levels of seismic resistance of buildings located in earthquake prone areas, the location of a community in a landslide or flood prone area, etc.

b.) *Environmental dimension*: There is an increase in vulnerability when the development model is not based on an adequate relationship with the environment and promotes or fosters the exploitation and destruction of natural resources. These circumstances inevitably lead to deterioration in ecosystems and an increase in vulnerability. Self-adjustment in order to compensate the direct and indirect impacts of human activity or of natural events may become very difficult.

c.) *Economic dimension*: More economically depressed sectors are more vulnerable in general. Poverty can increase vulnerability. At the local and individual levels this is expressed in unemployment, lack of income, and difficulties in gaining access to services. At the national level, this is expressed in terms of excessive economic dependency and lack of control over external factors, lack

3 Available at: <http://www.desenredando.org/public/varios/2001/ehrisusd/index.html>.

of diversification of the economic base, restrictions on international commerce, and the imposition of retrograde monetary policies.

d.) *Social dimension*: The higher the levels of social integration of the community, the easier it will be for the community to absorb the consequences of a disaster and react more rapidly. Societies may be less vulnerable when they react as an organized group or according to group interests, and more vulnerable where individual or circumstantial interests prevail.

e.) *Political dimension*: This may be expressed in terms of the level of autonomy of a community in the use of resources and decision-making. The community is more vulnerable under centralist schemes of decision-making and government. Lower levels of regional and local autonomy impede actions that respond to the felt needs of the population at these levels. Participation in decision-making that affects the community will help reduce vulnerability.

f.) *Institutional dimension*: This relates to the difficulties faced in undertaking risk management. The lack of preparedness or of efficient and effective mitigation actions when collective risk is known to exist are sources of vulnerability. Institutional vulnerability is also expressed in the lack of flexibility and in excessive bureaucracy, and in the fact that political decisions and the desire for protagonism prevail over more rational ways of dealing with problems.

g.) *Educational dimension*: The lack of knowledge of causal factors and effects of disasters, the lack of a sense of the community history and the lack of preparation and understanding of individual and group responses to disaster are all aspects that make a community more vulnerable. Deficient education or lack of educational coverage in a susceptible community and the lack of socialization of information also increase vulnerability.

h.) *Cultural dimension*: This relates to the way individuals see or perceive themselves and the groups or collective units they belong to. This may at times negatively influence the behaviour given the existence of pernicious stereotypes that are neither questioned nor changed. The communication media play a crucial role in this, given that they contribute to the slighted use of images and the transmission of imprecise or inconsequent information related to the environment, society, and disaster.

i.) *Ideological dimension*: This relates to the ideas and beliefs that exist as regards the world, its existence and future. It is at times expressed in passive and fatalistic attitudes and religious beliefs that limit action under certain circumstances. Dogmatic perceptions may generate confusion as regards purpose and a lack of reaction or loss of motivation that limits the undertaking of transforming actions.

This deconstructive approach helps us visualize vulnerability from different angles and perspectives that involve also technological, anthropological, and psychological aspects. The proposal facilitates an understanding of vulnerability as a dynamic and changing circumstance or condition. Moreover, we can also see it as an accumulative process of permanent fragilities, deficiencies, and limitations that play a role in the existence of higher or lower levels of vulnerability.

The Holistic Approach is compatible to the 'Pressure and Release' model and to the 'Access' model; both related to the progression of vulnerability – chain of explanation – and to the analysis of the principal factors of human vulnerability (Wisner/Blaikie/Cannon/Davis 1994, 2004). From the perspective of these models vulnerability is related to the situation or the characteristics of a person or group that influence the impact of hazard event or process on them. This situation or characteristics of people depend on their unsafe conditions that are product of a set of dynamic pressures whose explanation is due to another set of root causes. The main subtle conceptual differences between these models and the Holistic Approach are that in the latter human and environmental insecurities are the result of a set of vulnerability dimensions and factors in each level of the chain or hierarchy of the explanation. Vulnerability is not only referring to the people but also to the contexts and to the complex interactions of society and environment; particularly, interactions not only from the global to the local but also from the local to the global. This is important for the exacerbation of socio-natural hazards and disaster risk understanding in the framework of climate change and environmental degradation, and to improve the resilience-building processes where a top-down political decision approach has to be combined with a bottom-up of awareness and social practices of environmental protection and disaster risk reduction.

3.4.1 Quantifying and Applying the Model

The Holistic Approach was used to evaluate disaster risk in countries[4] of Latin America and the Caribbean

in the framework of the *Disaster Risk Management Indicators Program for the Americas*, led by the Institute of Environmental Studies (IDEA), of the National University of Colombia for the Inter-American Development Bank (IDB) (Cardona 2006, IDEA 2005a, 2005b, ERN 2009). In addition, it has been applied in Italy at the regional level in Lombardy (Prevenzione Lombardia 2007).

The methodology applied for the calculation of *Urban Seismic Risk index*, USRi, proposed by Carreño, Cardona, and Barbat (2007a) is useful to illustrate the quantifying and application of the holistic approach described above. The model was developed to guide the risk management decision-making, helping to identify the critical zones of a city and their vulnerability from an interdisciplinary perspective. This approach contributes to the effectiveness of risk management, inviting to the action or intervention by identifying the hard and soft weakness, reflected by distinct type of indicators of the different units of analysis (districts or areas, for example) of an urban centre. The total urban disaster risk is measured not only in terms of the direct impact of expected physical damage but also considers indirect impact factors that account for the socio-economic fragility and coping capabilities of the city's population and its institutions. In this application, the USRi is the total risk R_T obtained from the potential direct impact of earthquakes denoted as physical risk R_F, and on the indirect effects given by and impact factor $(1+F)$ based on the aggravating coefficient, F. Thus, it is expressed as follows:

$$USRi = R_T = R_F(1+F) \tag{4}$$

where

$$R_F = \sum_{i=1}^{p} F_{FRi} \cdot w_{FRi} \tag{5}$$

and

$$F = \sum_{i=1}^{m} F_{SFi} \cdot w_{SFi} + \sum_{j=1}^{m} F_{LRj} \cdot w_{LRj} \tag{6}$$

The factors of the physical risk are based on the gross values of the physical risk descriptors such as the number of potential deaths, injured, or the destroyed area, among others. The factors of the aggravating coefficient are based on socio-economic conditions (social fragilities) and coping capacity descriptors (lack of resilience) such as area of slums, social disparity, population density, awareness level, public space available, hospital beds, physicians, firemen, etc. They are calculated using transformation functions that standardize the gross values of the descriptors, transforming them in commensurable factors which take values between 0 and 1; w are the weights or influences of each factor of physical risk, social fragility and lack of resilience, respectively. They represent the relative importance of each factor and are calculated by means of the Analytic Hierarchy Process (Saaty 1980). Figure 3.2 presents the summary of the USRi results for the all cities of Metro Manila.

Once the results have been obtained for each locality or district, it is easy to identify the most relevant aspects of the total risk index. The results can be verified and the mitigation priorities can be established as regards the prevention and planning actions to modify those conditions (sub-indicators) having a greater influence on risk. In addition, this technique allows comparing risk among different megacities, therefore this methodology allows using a common rule of measurement to compare and benchmark the results. It is a comprehensive technique where the concept underlying is one of controlling risk rather than obtaining a precise evaluation of it. This methodology has been applied at the urban level to Bogotá, Metro Manila, Barcelona, Manizales, and currently to Istanbul (Cardona 2001; Cardona/Hurtado 2000a/b; Carreño/Cardona/Barbat 2007a, Fernandez/Mattingly/Bendimerad/Cardona 2006, Suarez 2007, Khasai 2007; Marulanda/Cardona/Barbat 2009; Carreño/Cardona/Marulanda/Barbat 2009).

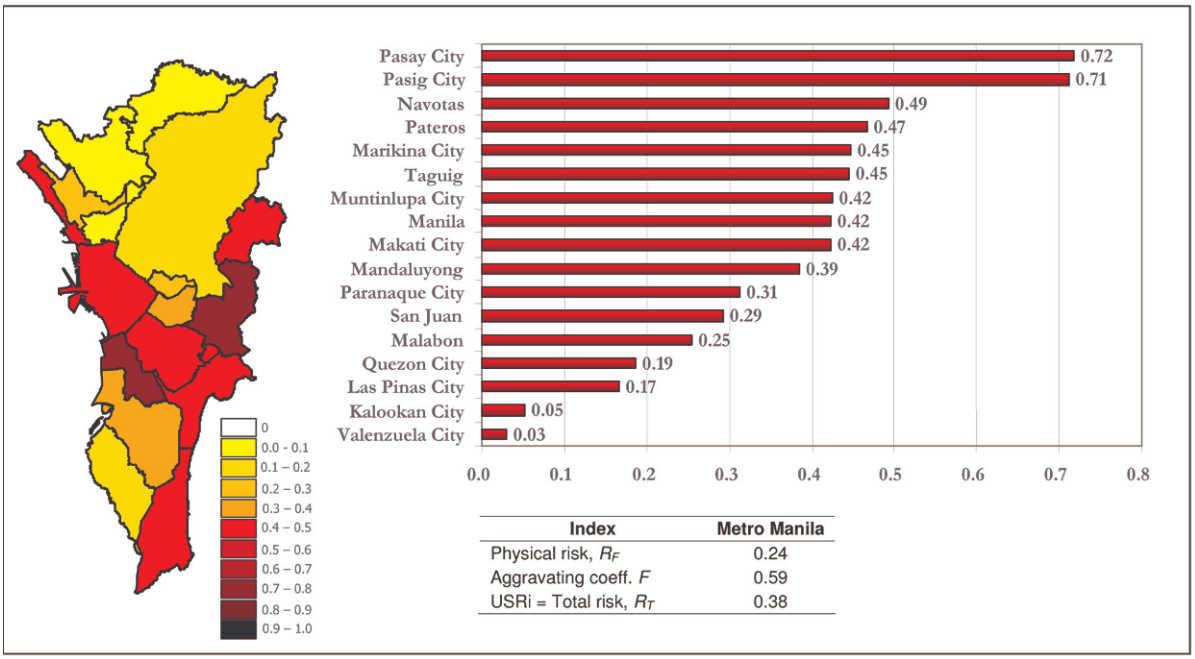
3.5 Territorial Safety as an Object of Risk Management

One of the objectives of *risk management* and of *sustainable human development* is to guarantee to human communities the *territorial safety*[5] that they require in order to develop their lives with quality and dignity. This is, in fact, an attribute that is beneficial for communities and for nature. Territorial safety is the result of the interaction between a set of factors that allow a territory, as space of policymaking and management (Agudelo 2005), to offer *stability* to

4 14 countries in 2005 and 18 countries in 2009.

5 Territory as space of mutual interactions between society and nature is understood as a space of management not only as an area or surface.

Figure 3.2: USRi results for the holistic seismic risk evaluation of Metro Manila. **Source:** (Fernandez/Mattingly/Bendimerad/Cardona (2006) and Marulanda/Cardona/Barbat (2009).



those who inhabit it; that is to say, they provide permanence of the conditions that make life in space and time possible. These conditions or factors – some are natural and others anthropogenic – on which the capacity of the territory depends to offer stability and security for their inhabitants, are mainly *food security*, *ecological security*, *social security*, *economic security*, and *institutional and legal security* (Cardona/Wilches-Chaux 2006). In general, the responsibility of the state is to generate the conditions that permit *territorial safety* in its different dimensions, as much for the people as for the ecosystems that comprise the territory. For that reason the security is an attribute both for the society (human) and for the ecosystems (environment) on which sustainable development depends; understanding sustainable development as that form of development which allows that the dynamics of nature neither become a threat to human communities and their processes of production, nor that the dynamics of human communities become a threat to ecosystems.

Risk management may be understood as a set of elements, measures, and tools directed towards intervention in hazards and vulnerabilities with the objective of reducing *existing* – by corrective interventions – or controlling *future* possible risks – by prospective interventions (Lavell 2000). This concept of prevention and mitigation can be differentiated from another group of tools whose objective has been the improvement of intervention in disasters once these occur: preparedness activities, response, and reconstruction. Risk management aims to articulate different types of actions, assigning a central role for prevention and mitigation, but without abandoning disaster response, in an attempt to develop preventive policies that significantly reduce the need for intervening in disasters once these occur.

This type of management should not be seen as a purely government-led process, but a participatory exercise, involving governmental and non-governmental actors with the idea of dealing with risk and disaster. In this sense, risk management policy must be based on the involvement of the diverse social, institutional, public, and private forces and groups that exist, on a broad and inclusive *territorial* basis; i.e. a national, regional or local system for disaster risk management. A part of the improvement in human living conditions consists in the achievement of greater levels of *security* and survival in relation to the actions and reactions of the environment. This calls for a better understanding of the forms of interaction between our immediate social environment and the natural environment (Duque 1990). It follows, therefore, that risk management is a fundamental strategy for sustainable human development given that it attempts to establish an equilibrium between natural ecosystems and the societies which oc-

cupy and utilize them, guiding human actions and activities that affect the environment and vice versa.

It should be realized that disasters are to a great extent an expression of an inadequate relationship between the development model and the environment within which the model is supposed to operate. Conflicts between economic, social, political, and cultural objectives and mores may lead to inconsistencies in this regard, possibly ending up in a disaster. Because of this, risk management should be an explicit objective and component of development planning where development is understood not only as an improvement in living conditions but also in the quality of life and *well-being*. Independently of ideological discussions, development should guarantee the needs of humans and their environment, and promote quality growth. *Territorial security* is in general a fundamental component of sustainable human development and, for this reason risk reduction is also a fundamental strategy in the search for equilibrium between human settlements and nature.

3.5.1 Risk as a Measure of Human and Environmental Insecurity

It is necessary to make risk *manifest* for decision-making. Risk must be recognized and it thus becomes a preoccupation for somebody. However, risk is a complex and at the same time, curious concept; its existence is consubstantial for human beings. It is an abstraction of a transformation process that denotes simultaneously a possibility and a reality. It represents something unreal, related to uncertainty. It reflects an undesirable state of reality which has not yet materialized. It is imaginary, difficult to grasp, and does not exist in the present but only in the future. According to Ulrich Beck (2000: 213) "risks, then 'are' a type of *virtual reality*, real virtuality." Beck cites Van Loon (2000: 176) who writes: "Only by thinking of risk in terms of reality, or better, *a becoming-real* (a virtuality) its social materialization can be understood. Only by thinking risk in terms of a construction can we understand its indefinitely deferred essence." Risks are necessarily constructed but they are not constructed on the basis of imagination; that is, we are not free to *construct* risk as we please (Adam/Van Loon 2000). In risk analysis, the context – management capacity and related actors – determines the limits, reasons, purpose, and interactions to be considered, which reveals its normative character. Analysis has to be congruent with context and this must be taken into account when analysing the sum of the contributing factors. If not, analysis would be totally irrelevant or useless.

Vulnerability is the state of reality that underlies the concept of risk. It is the causal reality that determines the selective character of the severity of damage when a hazard event appears (Cardona 2001). Vulnerability reflects susceptibility, the intrinsic predisposition to being affected; the conditions that favour or facilitate damage. The measurement of vulnerability is a challenge; many believe it is not feasible. However, it is fundamentally important to understand how vulnerability is generated, how it increases, and how it builds up. The evaluation and follow-up of vulnerability and risk is needed to make sure that all those who might be affected, as well as those responsible for risk management, are made aware of it and can identify its causes. To this end, evaluation and follow-up must be undertaken using methods that facilitate an understanding of the problem and that can help guide the decision-making process.

It is important to mention that research in and the development of the concept of risk in the applied and physical sciences commenced with the modern development of probability theory. In this context, the concept of *probability* had quasi-deterministic overtones, where probability scores were influenced by an epistemic lack of knowledge or, in other words, *uncertainty*. This can, in principle, be overcome by more experimentation and learning exercise. But the need to formulate statistical physics in order to study certain complex phenomenon has introduced a component of irreducible uncertainty, which has been called *randomness*. These two types of uncertainty reflect the duality that underlies the concept of probability, and therefore of risk.[6] At present some other analytical theories are related to the uncertainty: the theory of fuzzy sets, the theory of possibility, and the theory of evidence (Kikuchi/Pursula 1998). According to Max Weber (1991) the sociology of risk is a science of potentialities and of *Möglichkeitsurteile*; i.e. of judgments about possibilities.

There are a wide range of approaches for integrating data and modelling risk and vulnerability. *Inductive* approaches model risk through weighting and combining different hazard, vulnerability, and risk reduction variables. *Deductive* approaches are based on the modelling of historical patterns of materialized risk (i.e. disasters, or damage and loss that have already occurred). Other approaches combine the re-

6 Such as it is defined in a platform for disaster risk modeling like CAPRA (ERN 2009a). See <www.ecapra.org>.

sults of inductive and deductive modelling. An obstacle to inductive modelling is the lack of accepted procedures for assigning values and weights to the different vulnerability and hazard factors that contribute to risk. Deductive modelling will not accurately reflect risk in contexts where disasters occur infrequently or where historical data are not available. In spite of this weakness, deductive modelling offers a short cut to risk indexing in many contexts and can be used to validate the results from inductive models. There are no standard procedures for measuring or weighting the effectiveness of risk reduction, given the large number of stakeholders and the wide variety of activities involved.

Risk *indicators* or *indices* are feasible techniques for risk monitoring and may take into account both the harder aspects of risk as well as its softer aspects (Cardona/Hurtado/Duque/Moreno/Chardon/Velásquez/Prieto 2003; Cardona 2006; IDEA 2005a, 2005b[7]). The usefulness of indicators depends on how they are employed. The way in which indicators are used to produce a diagnosis has various implications. The first relates to the structuring of the theoretical model. The second refers to the way risk management objectives and goals are decided on. This aspect is important given that it is preferable to promote an understanding of reality not in strict terms of the ends to be pursued, but, rather, in terms of the identification of a range of possibilities, information on which is critical to organize and orientate the praxis of effective intervention (Zemelman 1989). An appropriate technique based on indicators can be a rational benchmark or a *common metric* to rule the risk variables from a *control* point of view (Carreño/Cardona/Barbat 2007b). The goal is not to *reveal the truth*, but rather to provide information and analyses that can improve decisions.

It is important to recognize that complex systems[8] involve multiple facets (physical, social, cultural, economic, and environmental) that are not likely to be measured in the same manner. Physical or material reality have a *harder* topology that allows the use of quantitative measurement, whilst collective and historical reality have a *softer* topology where the majority of the qualities are described in qualitative terms (Munda 2000). These aspects indicate that a weighing or measurement of risk involves the integration of diverse disciplinary perspectives and this may usher in problems of comparability. In other words, in order to measure risk and its management we need a holistic focus (Cardona 2001, 2004, 2006). This type of integral and interdisciplinary focus can more consistently take into account the non-linear relations of the parameters, the context, complexity, and dynamics of social and environmental systems, and contribute to more effective risk management by the different stakeholders involved in risk reduction decision-making. It permits the follow-up of the risk situation and the effectiveness of the prevention and mitigation measures can be easily achieved. Results can be verified and the mitigation priorities can be established with regard to the prevention and planning actions to modify those conditions having a greater influence on risk (Carreño/Cardona/Barbat 2007a).

3.5.2 Politics and the Decision-making Process

It is important to stress that the concept of risk is linked to decision-making and, therefore, it has a time dimension relating to the feasibility and convenience of taking action. Risk is directly related to its mediation; be it scientific, political, economic or popular. Once one knows that there is a possible consequence, one faces a responsibility. This responsibility takes the form of a *decision*, although not to decide is by itself a decision. From a risk management perspective, actions that reduce the vulnerabilities and stimulate the strengths and capabilities of exposed communities must be the main objective of risk management planning and actions; i.e. the *decision science* from the perspective of disasters.

Political decisions on risk are taken under conditions of uncertainty and are based on data of variables and, at times, of undetermined quality. This may be complicated by the political manipulation of uncertainty in order to speed up or slow down a decision and action. Quality, understood as the ability of a product to satisfy determined requisites, is the concept that underlies the determination of its attributes and criteria that allows an analysis of the decision-making process (Funtowicz/Ravetz 1990, 1992). Hence, the key question is: what is the role of the information in decision-making? Once the problem of

7 Available at: <http://idea.unalmzl.edu.co>.

8 This representation is based on a constructive rationality that allows the consideration of uncertain, incommensurable, multidimensional, and conflicting aspects and effects. It departs from the recognition that risk is a condition or state of the dynamics of a socio-ecological, non-linear, and dissipative system as a framework for interactions and for making integrated multi-criteria evaluations (macro and micro) and for decision-making in multiple variable environments.

designing criteria has been resolved, the following question arises: who will determine the criteria to be used? (Corral 2000) Uncertainty with regard to risk and the fact that the scientific community can not possibly resolve and characterize these problems totally ('given that no expert can provide certainty for political decisions') has led to a request for the inclusion of more actors, including the community, into the decision-making process. This permits a plurality of perspectives which, whilst not denying the competence of experts, permits the inclusion of a wide range of stakeholders in decision-making. It provides a combination of skills that permit all those involved in the problem to enrich the collective vision. Thus, the determination of criteria must be arrived at by dialogue and cooperation between experts, decision-makers, and other relevant actors, using the notion of *quality* as a baseline.

The models that are applied in the design of public policies such as risk management may influence the quality of the decision process. Opting for one type of modelling over another (for instance, mono- as opposed to multi-criteria models) may lead to different results which then push public policy objectives in a determined direction. Therefore, despite what many believe, the design of a public policy like risk management is very much related to the evaluation technique used to orient that policy. The quality of the evaluation technique, called by some as its scientific pedigree, has unsuspected influence on policy formulation. If the diagnosis invites action it is much more effective than where the results are limited to identifying the simple existence of weaknesses or failures.

The quality attributes of a model are represented by its *applicability*, *transparency*, *presentation*, and *legitimacy*. Respect for these attributes determines the *scientific pedigree* of a particular technique. Applicability refers to the way a model is adjusted to the evaluation problem at hand, to its reach and comprehensiveness, and the accessibility, aptitude, and level of confidence of the information required. Transparency is related to the way the problem is structured, facility of use, flexibility and adaptability, and to the level of intelligibility and comprehensiveness of the algorithm or model. Presentation relates to the transformation of the information, visualization, and understanding of the results. Finally, legitimacy is linked to the role of the analyst, control, comparison, the possibility of verification, and acceptance and consensus on the part of the evaluators and decision-makers.

In conclusion, the development of techniques that permit a permanent monitoring of territorial and social accumulation of vulnerability or the evolution of physical trigger processes is conducive to the application of realistic and dynamic planning techniques. This should be flexible enough to adjust to continuous or abrupt changes in the natural, economic, and social environment. This type of corrective and prospective approach is more appropriate than the uni-dimensional approaches, given the levels of uncertainty and instability that characterize existing processes of change and which render long term plans almost impossible to realize. In many places economic, social, and cultural factors are becoming increasingly relevant for the dynamics of growth and progress. In view of this, we need to develop less rigid planning models that allow us to more adequately incorporate uncertainty, instability and surprise, using diagnostic and follow-up techniques that permit the monitoring of the social and environmental context and possible perturbing agents.

The holistic approach to disaster risk and management herein described, based on a consistent conceptual framework, has been used to develop evaluation methods to measure vulnerability and risk with the purpose to favour decision-making, implementation, and action. They have been developed taking into account the attributes of the scientific pedigree of modelling. Nowadays, there are examples worldwide of how this model has been used by distinct kind of stakeholders in different territorial levels. The methods based on composite indicators and indices developed and adapted using this model have proven useful in identifying relevant issues of vulnerability, in guiding risk reduction from an interdisciplinary perspective, and taking in mind as objective of these metrics a preventive vision of development.

4 Economic Vulnerability and Economic Security

Czeslaw Mesjasz

4.1 Introduction

Over the last two decades 'vulnerability' has become a topical issue in multidisciplinary studies concerning a broad variety of overlapping domains – agriculture, climate, development and poverty studies, disaster and risk management, economic geography, engineering, finance, information technology, military theory and policy, public health, security studies and sociological studies of disasters. Vulnerability is also applied both in a traditional, narrow approach and in a broadened interpretation of security.

Due to its multiple applications, vulnerability must have different meanings depending on the area (narrow interpretation of security, economy, environment) and on the level of socio-economic hierarchy. Similarly as in the case of security, which has also a multitude of meanings, a question must be asked whether a common systemic interpretation of the vulnerability concept is achievable.

In the literature four security 'dangers' and 'concerns' are distinguished: threats, challenges, vulnerabilities and risks (Brauch 2005: 7; chap. 2 above). A closer look at these concepts allows concluding that their meanings are overlapping and that they are logically interdependent. It has important consequences for security theory since it shows that those terms are redundant and it is necessary either to resign from some of them or to study their meaning more precisely. It has a fundamental importance for the proponents and critics of securitization of environmental issues and for advocates and adversaries of the concept of human security.

Similarly as in 'adjective' domains of security in its broadened meaning, several overlapping domains (sectors, areas) of vulnerability can be distinguished – economic, environmental, military, social and political although in most cases a separation of these areas is impossible.

As in other cases of fuzzily defined normative concepts, vulnerability can be seen both as a 'buzzword' in the language of politics and as a term used for more or less precise descriptions and analyses in research and policy-making. It is then necessary to investigate whether structural invariants of vulnerability exist in various contexts or whether it is just another term used in theory as a dead metaphor with different and incongruent meanings. Such a situation exists in security theory where it is sometimes difficult to find a systemic resemblance between broadly defined human security and military security. It is especially visible when a securitization approach is applied.

For more precise considerations, vulnerability needs to be interpreted in a multiple way as "vulnerability of what", "vulnerability to what" at "what scale", to mention only the most important aspects (Bogardi 2006: 5).

In the broadened security concept, vulnerability was treated as the other side of the coin with threats in all security sectors (Buzan/Wæver/de Wilde 1998). In the discussion on vulnerability it is commonly agreed that vulnerability is a two-sided phenomenon. Thus in the security discourse threats and vulnerabilities are two sides of the coupling state of an object with its environment.

A review of writings on the theory of development and environment concludes that vulnerability has become their key descriptive and analytical concept, in some way competing with the use of security in a broadened sense. In consequence, the use of the concept of security in non-traditional sectors, e.g. in environment studies, is decreasing, and subsequently, considerations on securitization in the sense proposed by the Copenhagen School (Buzan/ Wæver/de Wilde 1998) are also given less attention.

This process reflects a specific 'desecuritization' of environmental issues. A question is however arising what are the consequences of a replacement of security with vulnerability in various areas of extended security theory and policy – environmental, economic, development, and last but not least, in human security.

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This is not only a theoretical problem. The process of replacement of security considerations with vulnerability means a shift of attention from the context of an object where threats (dangers, disturbances) and reactions to them are scrutinized in relation to the object, to inherent characteristics of that object considered in relations to its surrounding.[1] As far as the emotional or normative meaning of those two terms is concerned they both have the same appeal of uncertainty and negative emotions on the present status and about the future of the object and its surrounding. The dilemma emerging in the theory of broadened security requires separate considerations, especially for environmental studies, development problems and human security issues.

A similar phenomenon can be also observed in the discussions on economic security. In this case interactions between security and vulnerability seem particularly interesting due to difficulties in defining economic security under market conditions and for market actors – companies and areas – finance (Buzan/Wæver/de Wilde 1998; Mesjasz 2008a).

There are other impulses to broaden and deepen the studies of economic vulnerability and economic security. The ongoing turmoil on financial markets (2007–2010) has shown that studies of economic vulnerability should be extended from the traditional area of poor and small states to more developed indebted countries, e.g. to Greece, Portugal, Spain, some of the new emerging market economies, e.g. Latvia and Lithuania or perhaps, even to most developed countries affected by financial problems, such as the United Kingdom or the United States.

Trouble on financial markets is caused and at the same time is stimulated by inefficient governance and control of financial institutions and of corporate governance. Therefore it is inevitable to expand reflections on economic vulnerability and economic security to market-oriented organizations as well as other institutions.

In continuation of earlier studies on economic security, several questions can be raised. What is economic vulnerability? What are the relations between security and vulnerability in all security sectors? And subsequently, what is the specificity of the links between economic security and economic vulnerability for all economic actors? Can the term economic security be applied to all economic actors?

In systemic terms, security and vulnerability can be regarded as two sides of the same coin since each of them enables defining the other one. The same relationship exists between vulnerability and threat, danger and disturbance. Thus, additional questions may be raised. Are those ideas absolutely symmetrical? If so then in purely logical terms their definitions would be redundant and only one of them should remain. If not, then what makes a difference between them?

This chapter offers partial answers to these questions on the relations between economic security and economic vulnerability. The broadened security concept of the Copenhagen School (Buzan 1991; Buzan/Wæver/de Wilde 1998) and ideas developed in previous volumes of the Hexagon series constitute a conceptual framework. A detailed analysis of the meanings of the above utterances is not possible here but a deeper explanation of economic vulnerability and economic security as well as of their linkages is proposed.

A further objective is to extend the discussion on vulnerability beyond environmental issues and development theory to broader economic issues and to include other market and non-market actors. A survey of definitions of vulnerability is treated as a point for departure for a deepened analysis of the meaning of economic vulnerability. The chapter was prepared between 2008 and May 2010 when new phenomena relating to economic and financial vulnerability were in *statu nascendi*. Thus, any far-reaching conclusions are impossible.

Given the multitude of definitions, interpretations, measures and indices of vulnerability (chap. 2 by Brauch), and economic vulnerability in particular, it is impossible to refer to all of them. The selection is based on the need to answer the research questions. This also applies to the discussion of relations between economic vulnerability and sustainability. The many definitions of vulnerability make it impossible to study the links between the levels of hierarchy of socio-economic systems and economic vulnerability.

Section 4.2 offers a survey of definitions and interpretations of vulnerability, including environmental and social vulnerability, and proposes a systemic interpretation of vulnerability, security and securitization. The next part focuses on economic vulnerability (4.3.) discussing the meaning of the term 'economic' in the discussion on vulnerability (4.3.1) and interpreting economic vulnerability of various social entities, of states (4.3.2), non-state actors (4.3.3), households and individuals (4.3.4). Then the links between economic

1 Due to the variety of definitions of such terms as hazard, risk, threat, etc. the terms 'disturbance' and 'disruption' will be used for describing external or internal influence on the functioning of a system under scrutiny.

vulnerability, economic security and securitization are studied (4.4). Finally, a new approach and an extension of applications of the concept of economic security are proposed (4.5).

4.2 Vulnerability in the Security-related Discourse

4.2.1 Definitions and Interpretations of Vulnerability

The concept of vulnerability is used in many areas,[2] why vulnerability research covers a complex, multidisciplinary field that is of particular importance for organizations trying to reduce vulnerability, especially regarding poverty and other Millennium Development Goals. Researchers are currently working to refine definitions of 'vulnerability', measurement and assessment methods, and effective communication of research to decision-makers.

Given the many applications of vulnerability and its multiple interpretations, in the social sciences it is neither necessary nor possible to strive for a unique definition of vulnerability. Multidimensional interpretations that include only a common 'core meaning' are sufficient for studying various characteristics of objects taken together and labelled as vulnerability. The Vulnerability Network and Observatory[3] collected 30 definitions of vulnerability and are discussed below (Brauch 2005; Perry/Quarantelli 2005; Thywissen 2006; Villagrán de León 2006; Warner 2007; Nathan 2009).

For Brauch (2005: 7; chap. 2 above) 'vulnerability' is one of four security features besides 'threats', 'challenges' and 'risks', but the redundancy of the meaning and of the political use of these terms makes this typology rather superficial (chap. 12 by Brauch). In a universal sense, vulnerability has two basic meanings. First, as a set of characteristics of uncertainty about the future of any object – technical (military equipment, IT systems), biological (human beings, animals, species) and social (from individuals to global society). In this meaning vulnerability is usually associated with danger, disaster, hazard, resilience, risk, stress, threat, etc. Relations between vulnerability of social entities will be discussed below. In a general sense vulnerability refers to expectations towards negative external and internal contingencies of a system.

The second meaning of vulnerability in development theory and policy and in associated areas points to 'vulnerable groups', such as the elderly, orphans, widows or even more general, such as the landless or low-paid workers (Dercon 2006). Vulnerability refers to a more general 'weakness' or a meaning of 'defencelessness' and to a lack of means to cope without damaging loss. The loss can take many forms, becoming or being physically weaker, economically impoverished, socially dependent, humiliated or psychologically harmed.

In one of the first definitions, vulnerability is treated as an opposite to security and described as exposure to contingencies and stress, and difficulty in coping with them. It has two sides: an external side of risks, shocks, and stress to which an individual or household is subject; and an internal side which is defencelessness. Although vulnerable is used simply as a synonym for poor, vulnerability is no synonym for poverty (Chambers 1989: 1). The weak social groups may also face uncertainty-related vulnerability, but their defining characteristic is unrelated to uncertainty or risk, but linked to their general inability to take advantage of profitable opportunities. Without substantial support they may end up in severe and persistent poverty.

The two-sided interpretation of vulnerability proposed by Chambers (1989) has been extended by Bohle (2001). In this structured approach, the external side of vulnerability basically refers to the exposure to stresses and is influenced by these factors (Bohle 2001; Villagrán de León 2006: 12):

- *human-ecological perspectives*, which target population dynamics and capacities to manage the environment;
- *entitlement theory*, which relates vulnerability to the incapacity of people to obtain or manage assets via legitimate economic means;
- *political economy* approaches, which relate vulnerability to the exposure of some groups to social inequalities and to the control of assets by some upper classes, leading to struggles, including struggles between government and some groups of people.

The internal (coping) side of vulnerability is determined by:

- *action theory* approaches, which span the means and ways used by the people to act, either by free

2 Deepened linguistic considerations on vulnerability are presented in Brauch (2005: 31) and chap. 2 above.

3 Vulnerability Network & Observatory: *Definitions of Vulnerability*; at <http://www.vulnerabilitynet.org/> (15 March 2010).

will or as a result of societal, governmental, or economic constraints;
- *models of access to assets*, which allow people to mitigate their vulnerability via access to assets of different nature;
- *crisis and conflict theory*, which focuses on the control of resources and assets, the capacity to manage crisis situations, and the resolution of conflicts.

Definitions quoted herein reflect most important features of vulnerability in a universal sense. In a framework of the *International Strategy on Disaster Reduction* (ISDR 2002: 24, 342) vulnerability has been defined "as a set of conditions and processes resulting from physical, social, economical, and environmental factors, which increase the susceptibility of a community to the impact of hazards". These conditions are shaped "continually by attitudinal, behavioural, cultural, socio-economic and political influences at the individuals, families, communities, and countries". Vulnerability is closely linked to development.

From the perspective of the hazard research community, Blaikie, Cannon, Davis and Wisner (1994, 2000) redefined vulnerability commonly used as "being prone to or susceptible to damage or injury". Their working definition is:

> By 'vulnerability' we mean the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society. ... We use the term to mean those who are more vulnerable. When used in this sense, the implied opposite of vulnerable is sometimes indicated by our use of the term secure. ... Our definition of vulnerability has a time dimension built into it. Since it is damage to livelihood and not just life and property that is at issue, the more vulnerable groups are those that also find it hardest to reconstruct their livelihoods following disasters. ... Our focus on vulnerable people leads to give secondary consideration to natural events as determinants of disasters. Normally, vulnerability is closely correlated with socio-economic position (cited and summarized by Brauch 2005: 36).

According to Villagrán de León (2006: 8), vulnerability is generally perceived as the predisposition of societies to be affected and the incapacity to cope with disasters; and hazard, as the probability or possibility that an external event manifests itself in a certain geographical area within a certain interval of time. Hazards can be classified as natural: earthquakes, volcanic eruptions or hurricanes; technological in the case of explosions, spills, and release of toxic chemicals, and as social or human-induced in the case of civil riots, or terrorist attacks.

The list of hazards can also include a new emerging class, denoted as socio-natural, which are created or enhanced as a result of human action: climate change as a result of agricultural fires, burns and gaseous industrial emissions; landslides due to deforestation of mountains and high-sloped hills, and salinization as a result of poorly designed irrigation of soils are typical examples.

In a general sense, although relating to country's economy, vulnerability may be defined as the risk of being negatively affected by shocks. Shocks can be caused by nature – for example, a cyclone, earthquake, drought or locust invasion. Such shocks can perhaps be anticipated but often cannot be prevented. However, countries can also be adversely affected by economic shocks that are outside their control, such as a rapid decline in the price of their major export, changes in interest rates on international capital markets or reduced access to credit (UN CDP 1999: 10).

The impacts of climate change, adaptation and vulnerability have also been scrutinized by the second IPCC working group (1990, 1996a, 2001a, 2007a; Brauch 2005: 35; chap. 2 above), whose mandate is "to assess the vulnerability of ecological systems, socio-economic sectors, and human health to climate change". The IPCC also distinguishes between sensitivity, adaptive capacity and vulnerability ("the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes").

It is also necessary to underline narrow and broad interpretations of vulnerability. For Oliver-Smith (2004: 10) "vulnerability is fundamentally a political ecological concept", while, according to Brauch (2005: 31), Wilches-Chaux (1989: 20–41) identifies 11 types of vulnerability, "natural, physical, economic, social, political, technical, ideological, cultural, educational, ecological and institutional vulnerability". Villagrán de León (2006) distinguishes three independent categories (dimensions) of description and analysis of vulnerability – sectors, components and scale of consideration. For the purpose of studying economic vulnerability the last dimension should also include another level of companies and social organizations.

According to Wisner (2004: 183–193), vulnerability is used in the hazard community as:

- structural engineering vulnerability;
- lifeline infrastructural vulnerability;
- communications systems vulnerability;

Table 4.1: Dimensions of description and analysis of vulnerability. **Source:** The author's own research based on Villagrán de León (2006: 22).

Sectors	Components of vulnerability	Scale of consideration
Agriculture	Administrative	Global
Basic lifelines	Economic	Regional (Transnational)
Commerce	Environmental	National
Education	Functional	State or Province
Energy	Gender	District or Municipal
Finance	Physical	Local or Community
Health		Company or Social Organization
Housing		Household (Livelihood)
Industry		Human beings
Infrastructure		
Telecommunications		

- macro-economic vulnerability;
- regional economic vulnerability;
- commercial vulnerability;
- social vulnerability.

Cardona (2004: 37–51; chap. 3 above) proposed a holistic approach to vulnerability and risk arguing that in developing countries social, economic cultural and educational aspects are frequently "the cause of the potential physical damage". For Cardona "vulnerability of human settlements is intrinsically tied to different social processes. It is related to fragility, susceptibility or lack of resilience of the exposed elements. On the other hand, vulnerability is closely linked to natural and human environmental degradation at urban and rural levels".

In his process-based interpretation, Cardona (2004: 49) argues that from a social view "vulnerability signifies a lack or a deficiency of development" that often contribute to "disaster vulnerability". He pointed out that population growth, rapid urbanization, environmental degradation, global warming, international financial pressures and war have all increased vulnerability resulting from:

- physical fragility or exposure: the susceptibility of a human settlement to be affected by a dangerous phenomenon due to its location in the area of influence of the phenomenon and a lack of physical resistance;
- socio-economic fragility; the predisposition to suffer harm from the levels of marginality and social segregation of human settlements, and the disadvantageous conditions and relative weakness related to social and economic factors; and
- lack of resilience: an expression of the limitations of access and mobilization of the resources of human settlement, and its incapacity to respond when it comes to absorbing the impact.

To expose the links between vulnerability and social change, Birkmann (2005: 5) proposes that vulnerability must be understood as a process embedded in a larger development process. In this processual interpretation vulnerability does not involve merely active and passive factors, but rather dynamic objects and subjects in continuous motion. It could be described with the indicators which should allow identifying goals more precisely and providing guidance for strategies of vulnerability reduction. Due to the intricate character of vulnerability it is not surprising that it is often associated with ideas derived from complex systems studies (Warner 2007: 16).

These definitions of vulnerability and adaptation have implications for normative assessments. In the first case, vulnerability depends on the adaptation that has taken place; in the other, vulnerability is defined as a capacity to adapt, and the capacity to respond to stress is a starting point for impact analysis.

Nathan (2009: 1126) distinguished two features of vulnerability: exposure and insufficient capacities. a) physical exposure: presence and density of the people, habitat, networks, goods and services in risk zones, defining potential losses or damages, both human and non-human (stakes); and b) socio-ecological: human-induced ecosystemic perturbations aggravating the natural hazard (deforestation, land degradation, street pavement, some engineering practices, climate change, etc.) Insufficient capacities to prevent, prepare for, face and cope with hazards and disasters can be separated in:

- physical weakness: physical incapacity to resist or recover from a hazard's impact;
- legal vulnerability: weak state of the legislative and judiciary regulations to prevent, mitigate, prepare for, face and recover from disasters;
- organizational vulnerability: weak state of the organizational disposals, at all levels, to prevent, mitigate, prepare for, face and recover from disasters;
- technical vulnerability: inadequate knowledge and/or use of risk management techniques;
- political vulnerability: weakness of the political powers, their legitimacy and control. Inadequacy

of the control schemes, policies and planning, or broad political conditions;
- socio-economical vulnerability: socio-spatial segregation, large inequalities of wealth and of access to the security disposals, misery, anomie and social disorganization, poor social position and social isolation of exposed people, existence of higher social risks undergone by people;
- psychological and cultural vulnerability: inadequate security paradigm or risk perceptions;
- cultural anomie or weakness; attachment to risk zones or risky behaviour, non-willingness or incapacity to protect oneself.

Scholars from UNU-EHS have developed two different vulnerability models: the 'BBC-model' by Bogardi and Birkmann (2004) based on the concept of Cardona (2004) and the 'onion model'. The latter model analyses the impacts of a hazard (based on processes of climate change, globalization and innovation) both on a reality (certainty) and an opportunity (probability) axis on a natural events sphere (as a flood event or hazard) that impact on the economic sphere (as flood damage or risk) and on the social (disutility) sphere (as flood disaster or vulnerability) whose intensity or degree will be modified by the coping capacity. Social vulnerability should include the economic dimension but also confidence, trust, fear, apathy as potential consequences of a specific hazard (Brauch 2005: 54).

The 'BBC-model' defines 'vulnerability' and 'risk' as key components in the hazard-vulnerability-risk chain. A hazard impacts on a multidimensional concept of vulnerability that is influenced by the environmental, the social and the economic sphere, where the degree of exposure is reduced by the specific coping capacity in the specific region or country. 'Risk' is the product of these complex determinants and can be measured and observed as environmental, social and economic risk. While the 'onion model' excludes environmental vulnerability, the 'BBC-model' takes social, economic and environmental vulnerabilities into account (Brauch 2005: 54–55).

Villagrán de León (2006: 18) distinguishes two discerning facts regarding views on vulnerabilities with respect to their dependency on the type of hazard. According to one view, vulnerability does not depend on the type of hazard in question and can be related to issues associated with underdevelopment (poverty, power relations, access and control of assets, societal structures, insecurity, etc.), and in the opposite point of view it does.

Models proposed by Chambers (1989), Bohle (2001), Briguglio (1995, 1997) and Pelling (2003) are examples associated with the first perspective. Models by UNDP-BCPR (2004) and Villagrán de León (2006) point to the second. Among the examples associated with the second view are the vulnerability of infrastructure to earthquakes and droughts. The impact of drought on infrastructure is negligible compared to earthquakes. However, the impact of droughts on agriculture is vast and can be minimal in the case of earthquakes.

In addition to the above selective list of definitions and interpretations of vulnerability there are attempts to elaborate more precise definitions of vulnerability. The most advanced model was proposed by Luers (2005) that defined vulnerability as the susceptibility to damage, and is often characterized in terms of one or more of the following: the sensitivity to or exposure of a system (people or place) to shocks, stresses or disturbances, the state of the system relative to a threshold of damage, and the system's ability to adapt to changing conditions (IPCC 2001; Luers/Lobell/Sklar/Addams/Matson 2003). The terms 'shocks', 'disturbances', 'stresses' and 'perturbations' are often used to refer to exogenous forces that have the potential of creating an adverse impact, e.g. (Kelly/Adger 2000; Chambers 1989; Bohle/Downing/Watts 1994). A force is seen to be 'exogenous' if its occurrence is beyond the power of the unit of analysis such as the individual or household (Kelly/Adger 2000). These forces include phenomena such as climate variability and change, floods, hurricanes and market fluctuations.

Research on all kinds of vulnerability often deals with characteristics that are difficult to measure, either because data are unavailable or because the factor of interest is difficult to quantify with features which could be described with objective scales, a ratio scale or at least a cardinal scale. Therefore, as for many other features of social systems, debates evolved on how to measure the 'unmeasurable' in ways that are meaningful to policy-makers and institutions in the realm of sustainable development, environment policy and economy, or in a broader sense, in governance in all those areas (Birkmann 2006, chap. 69 below; Warner 2007, chap. 71 below).

The quantification of vulnerability is accomplished in two ways. The most dominant approach is based on defining various sets of indices which reflect characteristics of vulnerability of social entities and individuals. Less frequent are comprehensive mathemati-

cal models reflecting functional relationships between components of vulnerability.

Among numerous more or less descriptive qualitative or quantitative models of vulnerability, the concept of operationalization proposed by Luers (2005) is among the most rigorous. According to this model, vulnerability is conceptualized as a vector, and relative vulnerability is represented by a position on a three-dimensional surface. Definition of the surface is based on a generic vulnerability function, which is derived by translating a general definition of vulnerability, the susceptibility to damage, into a mathematical expression (Luers/Lobell/Sklar/Addams/Matson 2003). To do this, first a threshold of damage is defined and then susceptibility is represented in terms of its sensitivity and exposure to exogenous disturbing forces and its state relative to a threshold of damage:

$$Vulnerability = f\left[\frac{(Sensitivity, Exposure)}{State/Threshold}\right]$$

Vulnerability expressed in this form can be treated as a surface in a three dimensional space and is proportional to sensitivity and exposure and inversely proportional to the state of the system relative to a threshold of damage. While the specific functional form will vary by context and location, the general relationship between the components of the equation is likely to characterize vulnerability broadly. The goal is not to simply define a quantifiable measure, but rather to represent a relationship in a standard form that can be used as a tool to help sort through the complexity of vulnerability analysis (Luers 2005: 216).

4.2.2 Vulnerability and Related Concepts

Difficulties with defining vulnerability are in some way deriving from the many proposals of its determinants and components. Vulnerability is usually defined with the use of two groups of terms. The first group embodies external factors influencing an object (system, element) under scrutiny – risk, challenge, disaster, hazard, shock, stressor, threat, security challenge. The other one includes characteristics of the object (system, element) – coping, coping capacity, adaptive capacity, exposure, resilience.

A special significance in the discussions on economic vulnerability and economic security is given to sustainability in numerous areas – environmental, social economic and at all levels, beginning from the global one and ending with the level of elementary market units (company) and non-market units – institutions of self-government, households, etc. Due to its complexity and lack of an unequivocal definition it may be only stated that vulnerability is rather a short-term characteristic of any social entity while sustainability reflects a long time tendency. In numerous cases vulnerability is referred to as a factor undermining sustainability. Although the authors of definitions of vulnerability aim at putting in order relations among meanings of those terms, it will most likely not be possible. In consequence, more advanced discussions on vulnerability are hampered by an insufficient clarity of the notions applied.

In order to achieve a sufficient level of conceptual precision for analysing economic vulnerability, economic security and the sense of securitization in the discourse on economic vulnerability, a review of building blocks of definitions of vulnerability is presented below. It does not provide systematic typologies of interpretations but only shows the main discrepancies and similarities in defining vulnerability both in a universal sense as well as in specific domains.

It is somehow puzzling to observe that definitions of vulnerability and of other above terms are often illustrated with specific formulae and expressions, which sometimes are labelled as the 'mathematical' ones. However, they cannot be treated like that, e.g. as algebraic formulae but solely as a kind of conceptual framework in which various fuzzily defined linguistic variables are presented in quasi mathematical (arithmetic) operations applied as a point of departure for further operationalizations. Some of those formulae are described below.

4.2.2.1 Risk

Risk is the first notion that is used in defining vulnerability. It has become especially important since the ideas of 'risk society' (Beck 1986, 1992, 1999, 2007, preface essay above) have become dominant in theoretical discussions as a reaction to the increasing role of human-driven change in a modern society. Beck (1999: 3–4) defines 'risk'

> as the modern approach to foresee and control the future consequences of human action, the various unintended consequences of radicalized modernization. It is an (institutionalized) attempt, a cognitive map, to colonize the future. Every society has ... experienced dangers. But the risk regime is a function of a new order: it is not national, but global. ... Risks presuppose decision. These decisions were previously undertaken with fixed norms of calculability, connecting means and ends or causes and effects. These norms are precisely what 'world risk society' has rendered invalid. ... What has given rise to the prominence of risk? The concept of

risk and risk society combines what once was mutually exclusive – society and nature, social sciences and material sciences, the discursive construction of risk and the materiality of threats.

In more 'technical' considerations risk can be depicted in a threefold way:

- definition from classical decision theory and economics – "risk as a measurable uncertainty" (Knight 1921; Luce/Raiffa 1957).
- risk as missing the goal (in negative and in a positive sense) – definition applied in risk management,
- functional definitions of risk in which it is treated as a function, usually product and/or sum of specific components.

The concept of risk applied in the discourse on vulnerability is usually reduced to the third group of definitions. Bearing in mind a subjective character of risk, such an approach imposes significant limits on a deepened understanding and analysis of vulnerability, not only in economics but also in other areas (Mesjasz 2008b). The basic formula of risk found in numerous writings in risk studies (Villagrán de León 2006: 9) reflects the abovementioned 'mathematical' interpretations:

$$\text{Risk} = \text{Hazard} \,¤\, \text{Vulnerability}$$

where ¤ represents the function that describes the combination between the hazard and the vulnerability. The simplest example of such a function is a product, as proposed by UNISDR (2004: 16)

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability}$$

Alexander (2000: 10) defines risk as "the likelihood, or more formally the probability, that a particular level of loss will be sustained by a given series of elements as a result of a given level of hazard". Total risk would then consist of the sum of predictable casualties, damages and losses, represented via the equation:

$$\text{Total Risk} = (\text{Elements at Risk}) \times \text{Hazard} \times \text{Vulnerability}$$

Relations between vulnerability and other related concepts are not always exposed by product. Other formulae are accommodated as well. Recent publications define risk incorporating such terms as 'coping capacity', 'exposure', and 'deficiencies in preparedness'. For example, one typical relation employed by many agencies is (Villagrán de León 2006: 9):

$$Risk = \frac{\text{Hazard x Vulnerability}}{\text{Coping Capacity}}$$

In this context, coping capacities refer to the means by which people or organizations use available resources and capacities to face adverse consequences related to a disaster. In general, such capacities involve management of resources before, during, and after the disaster.

Another formula of vulnerability has been proposed by the *Disaster Reduction Institute* (DRI) in a report to the *Department for International Development* (DFID) of the UK (Villagrán de León 2006: 9). Vulnerability itself is seen as a combination of exposure, susceptibility, and coping capacity:

$$\text{Vulnerability} = \frac{\text{Exposure x Susceptibility}}{\text{Coping Capacity}}$$

Villagrán de León (2006: 10) proposes another equation:

$$\text{Risk} = \text{Hazard} \times \text{Vulnerability} \times \text{Deficiencies in Preparedness}$$

More similar formulae can be found in the studies by Brauch (2005) and Villagrán de León (2006: 10) that concluded that no commonly accepted definition of risk exists. Despite multiple interpretations, risk remains a relatively clearly defined concept used in describing or defining vulnerability. Other ideas associated with vulnerability are defined in a more fuzzy way and their scope of meaning is often overlapping.

4.2.2.2 Hazard

Hazard is relatively clearly defined in the literature on natural disasters. From a variety of definitions the following ones are representative. According to UNISDR (2004: 16) hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity, frequency and probability.

Other attempts tried to define hazards with 'mathematical' formulae. Mitchell (1990) conceptualizes

hazards as a multiplicative function of risk, exposure, vulnerability, and response:

Hazard = f (risk x exposure x vulnerability x response)

where
risk = the probability of an adverse effect
exposure = the size and characteristics of the at-risk population
vulnerability = the potential for loss
response = the extent to which mitigation measures are in place.

4.2.2.3 Disaster

Disasters are an object of analysis in anthropology, development studies, engineering, geography, geophysical science, sociology, social psychology, and in health sciences. This list is not complete and can be supplemented with other domains, e.g. environment studies or international relations. From many definitions the following can be viewed as representative.[4]

According to the UNISDR (2004: 17), disaster is a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.

Blaikie, Cannon, Davis and Wisner (1994) offered a comprehensive theoretical framework on the challenges of disasters. According to their definition: A disaster occurs when a significant number of vulnerable people experience a hazard and suffer severe damage and/or disruption of their livelihood system in such a way that recovery is unlikely without external aid. By recovery we mean the psychological and physical recovery of the victims, the replacement of physical resources and the social relations required to use them (Blaikie/Cannon/Davis/Wisner 1994: 21).

An attempt to develop a precise mathematical definition of disaster based in political economy of war and foreign aid was made by Cohen and Werker (2007). As a point of departure of the model the following distinction is proposed. 'Shock' refers to the natural act itself – the volcanic eruption, earthquake, drought, etc. – and 'disaster' refers to the net impact of the shock on the population.

4.2.2.4 Stress (Stressor)

While disturbances (perturbations) usually emerge unexpectedly and are major alterations in the system deriving from external surroundings and generating exceeding effects with which the system can cope while stress is a continuous increasing pressure on the system. Stressors are components of the stress, means of exerting a negative influence on that system.

4.2.2.5 Threat

In security theory and policy the term 'threat' is commonly applied usually without any deepened reflections on its meaning. According to the Merriam-Webster Online Dictionary the term threat has the following etymology: Middle English *thret* coercion, threat, from Old English *thrat* coercion; akin to Middle High German *drz* annoyance, Latin *trudere* to push, thrust. It has three meanings: "a) an expression of the intention to inflict evil, injury, or damage; b) one that threatens, and c) an indication of something impending <the sky held a threat of rain>" (chap. 2 by Brauch).

A more thorough analysis concerns the sense of the term 'existential threat', which constitutes the key concept of securitization theory proposed by the Copenhagen School. Assigning a meaning of existential threat to an issue is the foundation of securitization (Buzan/Wæver/de Wilde 1998). Threat without any measures of intensity and such normative interpretations as the above 'existential' characteristic is often used as a concept applied in describing or defining vulnerability in development or environment studies. A closer look at the literature on vulnerability leads to the conclusion that the difference between threat and hazard is of a purely discretionary character and would require a more deepened analysis.

While the above definitions considered the environment as an object under scrutiny, other concepts, such as exposure (Nathan 2009, see above), coping, coping capacity, adaptive capacity and resilience reflect characteristics of the object itself.

4.2.2.6 Coping and Coping Capacity

Following the definition by UNISDR (2004: 16), 'capacity' is a combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster. Capacity may include physical, in-

4 A broad survey of interpretations of vulnerability can be also found in (Perry/Quarantelli 2005).

stitutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

'Coping capacity' refers to the means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards. Sometimes coping capacity is reduced to the ability of adaptation, i.e. an ability of a unit to gradually transform its structure, functioning or organization to survive under hazards threatening its existence (Kelly/Adger 2000; Saldaña-Zorrilla 2006: 16).

4.2.2.7 Resilience

The meaning of resilience is close to the meaning of coping capacity (chap. 1 by Brauch/Oswald Spring). Resilience can be interpreted as an antonym of vulnerability. Similarly as with other vulnerability-related terms, there are numerous attempts to define resilience. According to UNISDR (2004: 16–17), resilience is the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Resilience is becoming a notion with an autonomous meaning applied as sufficient for establishing a new domain of environmental and social research. The Stockholm Resilience Centre, established in 2007, aims to advance transdisciplinary research for governance of social-ecological systems with a special emphasis on resilience – the ability to deal with change and continue to develop. It is a joint initiative among Stockholm University, the Stockholm Environment Institute and the Beijer International Institute of Ecological Economics at The Royal Swedish Academy of Sciences. The centre is funded by the Foundation for Strategic Environmental Research (Mistra). According to this Centre, resilience refers to the capacity of a social-ecological system both to withstand perturbations from, for instance climate or economic shocks, and to rebuild and renew itself afterwards. Loss of resilience can cause loss of valuable ecosystem services, and may even lead to rapid transitions or shifts into qualitatively different situations and configurations, evident in, for instance, people, ecosystems, knowledge systems, or whole cultures.[5]

4.2.2.8 Security Challenge

In the literature on a wider security and human security (Brauch 2009: 74) the concept of 'security challenge' has been widely and increasingly applied. Similarly as in other cases, there are no deepened analyses on the links between the challenge and similar ideas such as risk, threat and vulnerability. The concept 'security challenge' is either treated as synonymous to 'threat' or implies a broader, softer character or new (non-classical) present and potential disturbances of functioning of a social or natural system (Brauch 2005: 29: chap. 2 above). It is also frequently used in the language of politics both at international (interstate) and national levels when precision is not necessary and the appeal is more of emotional character (see below chap. 12 by Brauch on the discussion in US national strategy papers).

As can be seen from the above preliminary survey of definitions and formulae, characteristics depicting the vulnerability possess a very broad spectre of interpretations. Sometimes they are even included in the definitions in a contradicting sense, as for example risk and hazard. In one case risk is used to define hazard and in another hazard is used to define risk. In purely formal terms it seems correct but when verbal definitions are taken into account such symmetry can be rarely achieved. Similarly, disaster research is a separate domain of scientific inquiry and it is not too easy to distinguish it from, say, risk analysis. The above survey shows that definitions of all those terms are fuzzy and overlapping. Thus, the discussions on vulnerability and related terms in various areas are incompatible and communication about their meaning is of a very limited effectiveness.

4.2.3 Vulnerability, Security and Securitization: A Systemic Interpretation

In security theory and policy and in the studies on vulnerability the relations between vulnerability and security are not always clearly delineated and in the literature there are a few studies addressing their direct links. Usually their relations are treated as indirect.

5 See on the Stockholm Resilience Centre; at <http://www.stockholmresilience.org/>.

The studies of direct links between vulnerability and security are focused on these topics:

- security and vulnerability in classic security considerations,
- vulnerability in all sectors of a broadened security concept,
- environmental (ecological) vulnerability and environmental (ecological) security,
- vulnerability and human security (including food security and livelihood security).

The indirect relations between those two concepts are commonly described but it must be underlined that it is not always possible to identify precisely the indirect links between universal or specific definitions of vulnerability and specific sectors of security. It is especially difficult in all areas of security except for military and environmental security. While military threats and vulnerabilities are relatively simple to identify, some environmental threats or hazards are undisputable, e.g. natural disasters, other examples of environmental threats may seem to be more disputable, e.g. long-term consequences of global warming.

In the narrow approach, security of the state or country is viewed as supplementary and in some way mirrors the category of vulnerability (Buzan 1991: 112–116; Crawford 1992: 4). A threat to the security of an object (a social entity or individual) may occur in consequence of existence of its vulnerability and vice versa. This symmetry and coupling constitute the key element in any discussions on the sense of vulnerability and security taken together. It concerns all security sectors and the only distinguishing factor is to what extent threat and vulnerability are objective or subjective and how easily this relationship can be identified.

In a classical definition proposed by Chambers (1989) vulnerability of social actors is also treated as opposite (inverse) to their security and described as exposure to contingencies and stress, and difficulty in coping with them. Villagrán de León (2006) indirectly refers to vulnerability as a concept opposite to security although he makes no direct reference to classical security concepts. Brauch (2005) treats discussions on vulnerability as a part of analysis of broadened security although he focuses primarily on environmental and human security. He also indirectly refers to securitization of environmental issues but does not propose any specific approach for the role of vulnerability in the processes of securitization.

Vulnerability of individuals is usually more often linked to security in a general sense, and to human security. In the World Bank's campaign vulnerability and risk associated with poverty are treated as opposites to security. Enhancing security is equivalent to reducing poor people's vulnerability to ill health, economic shocks, crop failure, policy-induced dislocations, natural disasters, and violence, as well as helping them cope with adverse shocks when they occur. A big part of this is ensuring that effective safety nets are in place to mitigate the impact of personal and national calamities (World Bank 2001: vi).

The links between vulnerability and security can be described with the idea of securitization developed by the Copenhagen School (Buzan/Wæver/de Wilde 1998). In the original approach of the Copenhagen School security is regarded as an act of speech which assigns an extraordinary significance to disruptions called threats, dangers, etc. but no direct reference is made to the role of vulnerability in securitization.

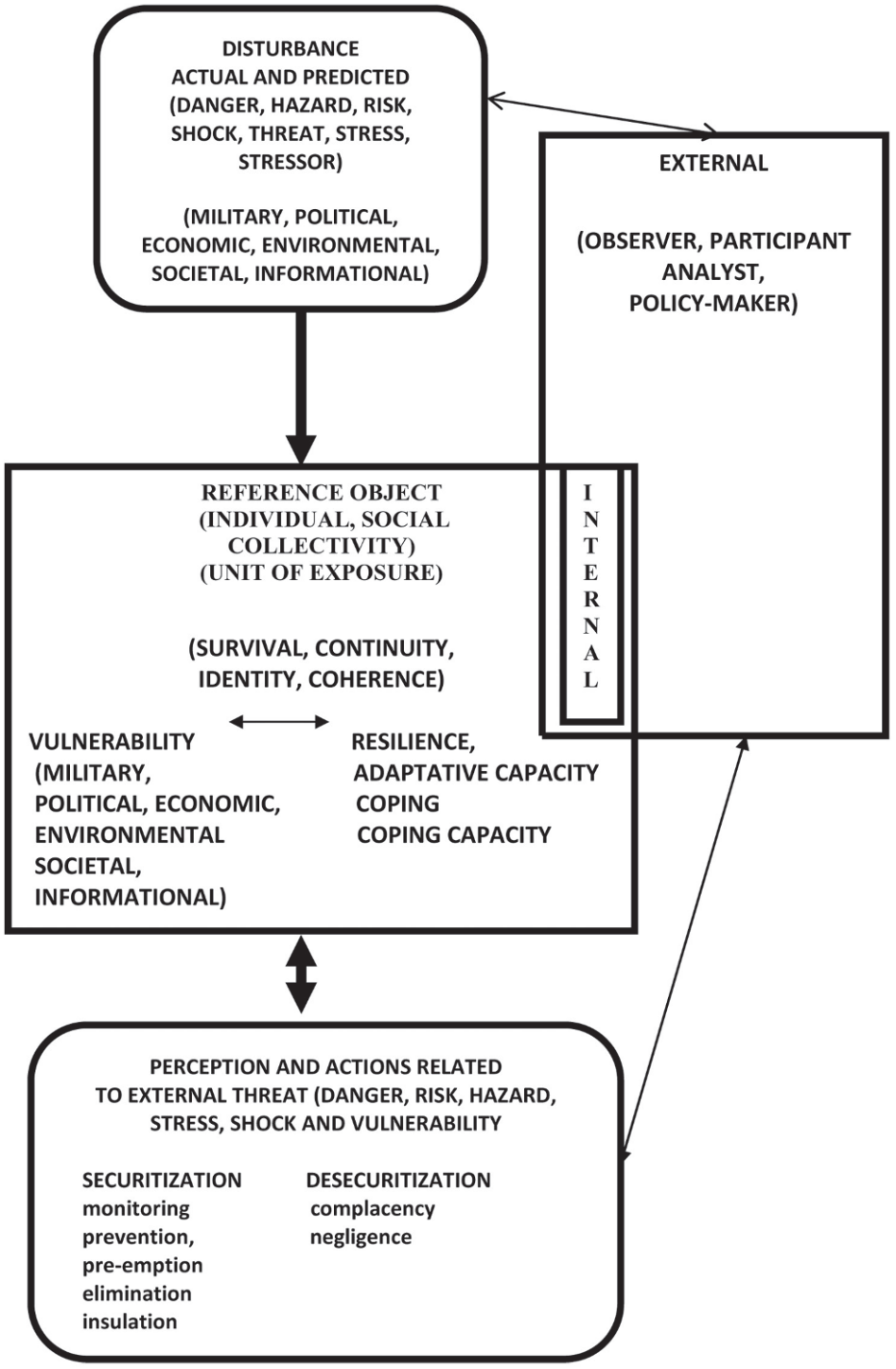
A question is how vulnerability can be included into the securitization process. First and foremost it must be concluded that vulnerability is associated with all kinds of external disturbances. It means that if an object is vulnerable beyond certain limits, or threat is perceived as something extraordinary, then the securitization is taking place. Subsequently, it may be concluded that calling a set of characteristics vulnerability can be perceived as an act of speech. Therefore a deeper reflection is needed whether in securitization the identification of external threats is equivalent to identification of vulnerability.

The following situations are hypothetically possible:

- identification of threats is directly linked to exposing vulnerabilities,
- external threats are exposed without a relevant reference to vulnerabilities,
- vulnerability is exposed to explicit relations to threats in the securitization process,
- vulnerability is exposed without direct relations to securitization,
- vulnerability is treated as dominant and security in a traditional and in a broadened sense is not considered.

The concept of vulnerability has been applied in theory and practice in a broad variety of areas that can be described in universal systemic terms as a feature of relations between an object (unit of exposure) and its environment. When recalling a systemic interpretation of a broadened concept of security, vulnerability is always linked to external disturbance. Taking into account the broadened security concepts and the impact of the Copenhagen School (Buzan/Wæver/de

Figure 4.1: Systemic framework of security, vulnerability and securitization. **Source:** The author's own research.



Wilde 1998; Brauch/Oswald Spring/Mesjasz/Grin/Dunay/Behera Chadha/Chourou/Kameri-Mbote/Liotta 2008), it can be also added that both threats (danger, disturbance, risk) and vulnerability are interconnected in the process of securitization. They can be seen as two sides of the same coin although it seems that they are different and not purely symmetrical. The asymmetry of those two ideas will be discussed below. As was observed in some studies (Luers/Lobell/Sklar/Addams/Matson 2003: 255),

> a new emphasis on vulnerability marks a shift away from traditional scientific assessments, which limit analysis to the stressors (e.g. climate change, hurricanes) and the corresponding impacts, towards an examination of the system being stressed and its ability to respond. By focusing on the mechanisms that facilitate or constrain a system's ability to cope, adapt or recover from various disturbing forces, vulnerability assessments aim to not only identify which systems are most at risk but also to understand why. This information is critical for decision-makers who often must prioritize limited resources in the design of vulnerability-reducing interventions.

In a simplified form interdependence between security and vulnerability can be illustrated with a scheme deriving from a systemic interpretation of security (Mesjasz 2008: 51). It can be treated as an extension and supplementary to the above considerations on relationships between various characteristics of vulnerability, its context, and relations to security and securitization. The above systemic or structural scheme (figure 4.1) allows for identification of characteristics of vulnerability and security that are applied in the process of securitization. It requires some additional explanations of the character of disruptions, their character (external/internal) and their consequences (risk and disaster), their measures and explanation of the links between vulnerability and security.

As to grasp the complexity of the double analysis of vulnerability and security, the initial scheme of a systemic interpretation of security should be extended by a rank of element. While in the discourse on security, the disturbances (disruptions) were predominantly associated with threat, danger, shock, they should be extended to other categories of risk, hazard, stress, stressors. In addition, characteristics of the second side of vulnerability of resilience, coping, coping capacity, adaptive capacity should also be taken into account.

The extension of categories of disturbances brings about two questions. First, in the concept of a broadened security, it is not clearly defined in a universal way whether 'existential threats' may have an external or internal character, in the discourse on vulnerability, threats, risks, hazards, etc. are only external. The internal side of vulnerability is characterized by susceptibility, resilience, coping capacity, adaptive capacity, etc. Second, the concepts of hazard, risk, threat and danger implicitly assume discontinuity, surprise and unpredictability. In the discussions on vulnerability they are supplemented with such ideas as stress and stressors which may be continuous and their impact can be to a large extent predictable.

Measurability of vulnerability is associated with predictability and unpredictability. In most of the attempts of building indices of vulnerability (social, environmental, economic) an implicit assumption of possibility of identification of threats, hazards and risks is embedded (Warner 2007). In the discourse on security dominance of uncertainty of existential threats is emphasized (Buzan/Wæver/de Wilde 1998). The role of uncertainty and limits of predictability is taken into consideration in all cases when a processual understanding of vulnerability is assumed (Cardona 2004).

Relations between vulnerability and security have to be analysed for both objective narrow and broadened security and subjective broadened security. In the case of objective, 'classical' security for which a threat is an objective category, vulnerability characterizes the state of a system exposed to the disturbances – risk or threats, etc. All barriers resulting from limitations of definitions of state (international security) or internal security and vulnerability are relevant, e.g. an unclear meaning of hazard, risk, threat and related terms – resilience, coping capacity, etc. remain valid. Security and vulnerability are interrelated with the latter being equivalent to insecurity.

Although in vulnerability-related studies objectivity is one of the core issues, there are some attempts to introduce subjective elements into the discourse. Alexander (2000: 12) defines vulnerability as "the potential for casualty, destruction, damage, disruption or other forms of loss with respect to a particular element". He also recognizes that vulnerability can be enhanced or reduced depending on the type of action taken with respect to it, and its perception is an important factor to consider. Such an approach relating to the role of the observer in the second-order cybernetics makes an explicit connection between vulnerability and the research conducted to assess it. Deprived vulnerability arises when research results are not disseminated nor used, while wilful vulnerability arises when such knowledge on vulnerability is deliberately ignored. In this respect, he comments that pristine vulnerability arises as a result of the lack of experience regarding hazards. These views would lead to a proposal of vulnerability reflecting the lack of use of research information.

In contrast, he points to the notion of primary vulnerability in relation to the high susceptibility to catastrophic damage, while secondary vulnerability is related to the lack of appropriate capacities and resources which can lead to a poor or deficient response in case of a disaster. In this case vulnerability

relates to susceptibilities or incapacities, rather than the lack of use of knowledge (Villagrán de León 2006: 12).

However, the interdependence between the meaning of vulnerability and a broadened subjective security is much more complex. In the concept of securitization, a disturbance called 'existential threat' emerging outside or inside the reference object (system) exposes its vulnerability and is identified as the first one. Vulnerability is even not mentioned directly in the initial concept of securitization. It means that a specific asymmetry is assumed between disturbances and vulnerability. All kinds of external and internal disturbances are given a subjective priority in securitization although in an objective sense they are connected and equal.

In the case when vulnerability is given priority in the discourse, characteristics of the system (reference object) are considered together solely with external disturbances since internal disturbances are included in resilience (coping ability, coping capacity). In such situations the objective symmetry between disturbances and system vulnerability is reflected in a better way. It may then be concluded that securitization extended to the sectors where disturbances (existential threats) are more difficult to define, e.g. the environment, economy or social life in general, the approach based on the dominance of vulnerability seems to be more relevant. It also means that securitization in those sectors is more difficult both in theoretical and empirical terms. It also proves the increasing role of vulnerability in theoretical and policy discourse which is even reflected in a growing number of publications concerning vulnerability in those sectors.

4.2.4 Vulnerability and Security of the State: The Classical Approach

Origins of discussions on vulnerability in a broadened security theory deriving from classical security ideas can be traced already in the early 1990's. In his first work on broadening the meaning of security, when discussing national security, Buzan (1991: 12) regarded the concepts of threats and vulnerabilities as "a key divide in security policy". The early discussions were predominantly focused on state security and vulnerability understood in a classical military-political-economic sense.

Because in numerous considerations no difference is made between vulnerability of the state understood as an institution and vulnerability of a country (embodying state apparatus, which in many cases can be acting against the population and society), no distinction between both terms is made in this chapter. This lack of distinction is probably caused by the fact that some definitions are proposed by UN agencies, which are determined by the opinions of the member states.

Focusing on state security, it can be observed that the source of vulnerability lies in one's capabilities in relation to the capabilities of others. The source of threats can be found in one's intentions toward others. In order to reduce threats, states attempt to affect the intentions of others; traditional means include the negotiation of treaties, like arms control or trade agreements. As to reduce relative vulnerabilities, states must implement policies that expand their own military and industrial power, reduce the military and industrial power of others, and reduce their dependence on others (Buzan 1991: 112–116; Crawford 1992: 4).

The links between both security and vulnerability of the state were analysed by Crawford with the use of examples taken from the Cold War era and from the post-Cold War period. Focusing on the last years of the Cold War, Crawford (1993) used East-West economic relations as to show how trade relations contributed to the vulnerability of both parties. She examined the impact on the Soviet economy of imports of technology-laden products and joint ventures with Western firms, the vulnerability of Europe arising from imports of Soviet gas, and the impact on both borrowers and lenders of the substantial build-up of hard currency debt, especially in Eastern Europe. The concept of vulnerability allowed for showing to what extent economic and financial relations and vulnerability of parties involved exerted an impact of their security posture.

In addition to conclusions about a limited impact of trade on security of both parts, Crawford showed that vulnerability deriving from economic relations could be applied in the analysis of international security. Crawford analysed also the impact of international economic interdependence on debates over the redefinition and reconstruction of 'national security' after the end of the Cold War. She explored how the forces of interdependence influence those debates by reducing military threats in the view of analysts (called economic 'doves') and increasing military vulnerabilities in the view of others (called economic 'hawks') (Crawford 1995). The arguments by both sides can be simply stated: Interdependence reduces threats because it weakens incentives for military conquest.

But at the same time, interdependence increases vulnerabilities, and threatens to weaken the state, because potential military resources – especially high-technology ones – are increasingly found in global commercial markets over which states have little control. Policy responses are, in some countries, at least, focused on reducing vulnerabilities and strengthening the state through strategies of market control, indicating that 'hawks' have come to dominate the discourse of economic security. In examining these debates and policy strategies, this essay is both an exploration of the interaction between material and cognitive factors that shape the political elite's new definitions of security and an assessment of their policy responses.

The distinction between threats and vulnerabilities in state security allows to distinguish the following approaches (Crawford 1992: 4–5): Structural realists tend to focus on vulnerability and vulnerability reduction as the central security concern. They believe that states will enhance their capabilities to reduce vulnerabilities, and that they are constantly in the process of measuring the capabilities of others. They further argue that states care more about relative than absolute gains of interaction, because the state who gains more will be the more powerful.

Liberals look to a set of processes and institutions that shape intentions to reduce the threat of war, despite a potential lack of clarity about power positions or vast differences in power. Finally, those who study the domestic causes of war and peace also address the sources of threat rather than vulnerability. They argue that the nature of states and societies will determine the intensity of the military threat. These theoretical approaches provide a new framework for studying vulnerability, resulting from economic interdependence and contributing to states insecurity in the post-Cold War era.

According to Crawford (1992), relative gains from interdependent economic relationships matter for national security for two reasons. The first is the increasing importance of industrial strength to military power. A superior economy can be rapidly converted into a stronger war machine. No modern state has been able to maintain a first-rate military capability with a declining industrial base. Economic power, in turn, depends on technological excellence. And technological strength developed in commercial competition can quickly be adapted to bolster military capabilities to counter potential new threats.

Secondly, just as states have come to rely increasingly on industrial strength and commercial technology for military power, the factors of production have become increasingly mobile: corporations can easily move their bases of operation to lower-cost production areas; technology and information diffuse almost instantly across national boundaries; raw materials are rapidly transported from their source to production sites thousands of miles away.

What this means is that military power has increasingly come to rely on goods and services allocated by global commercial markets. Not only will the market increasingly allocate goods necessary for national security but those goods cannot necessarily be confined to home markets which states can control. Market forces create a specialization of production meaning that different firms around the globe occupy niches in the markets which supply the defence industrial base of any particular nation.

In such a way interdependence increases vulnerabilities and threatens to weaken the state, because potential military resources, especially high-technology ones, are increasingly found in global commercial markets over which states have little control (Crawford 1992). The above description exposing a kind of mirror relation expressed by the external character of threats and the internal character of vulnerabilities shows only as an example of the sense of both ideas in state security without specifying how they can be defined and how they are interrelated.

4.2.5 Social Vulnerability

Among a large number of definitions and approaches to vulnerability, a group of broader concepts can be distinguished. They can be placed between specific types of vulnerability to economic and natural disturbances and security and political vulnerability. These concepts and measures of vulnerability can be treated as another category called 'social vulnerability' (chap. 68 by Birkmann; chap. 69 by Marre/Renaud; chap. 70 by Villagrán; chap. 71 by Warner; chap. 72 by Oswald Spring).

It is described with several definitions of the meaning of 'social' (Gall 2007). Similarly as in other cases of vulnerability studies, the term social is also ambiguous. On the one hand it is used in defining social vulnerability as: "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard" (Wisner/Blaikie/Cannon/Davis 2004: 11). On the other hand, the adjective 'social' means that attention is paid to broader categories however always focusing on the weaker groups of society: "...vulnerability to disasters refers to the ina-

bility of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed" (Warner 2007: 9).

In spite of a broad variety of definitions of social vulnerability some common characteristics, or the sources of adjectives, 'social' can be identified. In definitions of social vulnerability its collective character is emphasized since it can be seen as the inability of people, organizations, and societies to withstand adverse impacts from multiple disturbances to which they are exposed. These impacts are stemming from characteristics inherent in social interactions, institutions, and systems of cultural values. In other words, social vulnerability is a structural feature since it can be eliminated or diminished solely and resolved through social (as opposed to individual) means.

Research on social vulnerability can be based upon the 5 W's reflecting the following questions of what, who, where, when and why? (Warner 2007: 14–15):

- What is social vulnerability?
- Who are those most affected by social vulnerability?
- Where is social vulnerability the biggest problem?
- When is social vulnerability most apparent?
- Why does social vulnerability persist?

Answers to these questions are to various extents given in all definitions and studies of social vulnerability. Pizarro (2001: 11) of the *Economic Committee for Latin America and Caribbean* (ECLAC) defines social vulnerability in terms of two components: "the insecurity and defencelessness experimented by communities, families, and individuals in their livelihoods as a consequence of the impact of a socio-economic event of traumatic character; and the second component is the management of resources and strategies which are utilized by these communities, families, and individuals to cope with the effects of this event". In addition to social vulnerability, political and institutional vulnerabilities have also been addressed by ECLAC and the *Inter-American Development Bank* (IADB). In this context, vulnerability is defined in general terms as "the probability of a community, exposed to a natural hazard, given the degree of fragility of its elements (infrastructure, housing, productive activities, degree of organization, warning systems, political and institutional development), to suffer human and material damages" (Villagrán de León 2006: 15).

As an illustration of the idea of social vulnerability and its links with economic vulnerability, the following concepts can be taken: Prevalent Vulnerability Index, Predictive Indicators of Vulnerability, and Index of Social Vulnerability to Climate Change for Africa.

The *Prevalent Vulnerability Index* (PVI) is part of a much broader, comparative analysis of risk management in Latin America developed by the Institute of Environmental Studies of the University of Colombia in Manizales, the Economic Committee for Latin America and the Caribbean, and the Inter-American Development Bank. It focuses on social, economic, institutional, and infrastructural capacity to recover from natural hazards or the lack thereof (Cardona 2007; chap. 3 above). This index depicts predominant vulnerability conditions by measuring exposure and susceptibility in prone areas, socio-economic fragility and lack of social resilience. These items provide a measure of direct as well as indirect and intangible impacts of hazard events. The index is a composite indicator that provides a comparative measure of a country's pattern or situation. Inherent vulnerability conditions underscore the relationship between risk and development. Vulnerability, and therefore risk, are the result of inadequate economic growth, on the one hand, and deficiencies that may be corrected by means of adequate development processes. The PVI recognizes 24 indicators ranging from the percentage of population that lives in poverty to the amount of insured infrastructure and built environment expressed as a percentage of the GDP (Cardona 2007).

The index of *Social Vulnerability to Climate Change for Africa* (SVA) can be treated as an explicit social vulnerability index although its spatial coverage is limited to Africa (Adger/Vincent 2005). The SVA concentrates on social vulnerability to climate change and in particular water availability. This causes the index to be inherently biased towards events such as droughts and does not accomplish an all-hazards representation. The index includes five indicators which are aggregated with weights: institutional capacity, economics, rural population, demographics, and trade balance. In its current version, the SVA describes the social vulnerability of 49 African nations based on eight (Version A) or nine (Version B) indicators. The two index versions differ in their in-/exclusion of a corruption indicator (Gall 2007: 51). Leaving apart assessment of the validity of the SVA, it can be added that it is just another illustration of variety of interpretations of the term 'social' and of the links between that interpretation and economic factors of vulnerability.

Another example of the links between climate and social vulnerability is reflected in the *Predictive Indicators of Vulnerability* (PIV) that is focused on vulnerability to climate variability and climate change and excludes geophysical events in its assessment

(Brooks/Adger/Kelly 2005; Gall 2007). The PIV rests on the conceptual framework that risk (outcome) is a function of biophysical and social vulnerability, which is similar to the DRI's approach (Brooks/Adger/Kelly 2005). The PIV includes the following partial indicators: literacy (15–24 yrs.), sanitation, voice and accountability, literacy (> 15 yrs.), calorie intake, civil liberties, male to female literacy ratio, life expectancy, political rights, maternal mortality and governance. It should be stressed that the SVA represents a framework-driven approach whereas the PIV is outcome-driven. The PIV consults hazard fatalities to conclude on driving vulnerability (Gall 2007: 57–58).

In addition to more or less precisely defined concepts, estimates and measures of social vulnerability, there are some ideas which have been elaborated in the studies of broadened security, outside the traditional areas of vulnerability studies. A proposal that not all security issues involve threats and that the notion vulnerability should be used for 'soft' (non-military) security was put before by Liotta and Miskel (2008: 879–880). Coming out from that assumption they regard threat as identifiable, often immediate, and requiring an understandable response. A threat is clearly visible or commonly acknowledged. Vulnerability is often only an indicator perhaps not completely understood and not always suggestive.

In human and environmental security a condition of extreme vulnerability can arise from living under conditions of severe economic deprivation, to victims of natural hazards and to those who are caught in the midst of war and internal conflicts. Long-term vulnerabilities requiring strategic planning can be called *creeping vulnerabilities*. They may include (Liotta/Miskel 2008: 880–881):

- disproportional population growth and urbanization;[6]
- the outbreak and the rapid spread of diseases such as HIV/AIDS; SARS;[7]
- significant climate change;
- the scarcity of water and other natural resources;
- the decline in food production; access and availability;
- progressing soil erosion and desertification;
- increased urbanization and pollution in 'megacities';
- the lack of warning systems for ecological disasters.

4.2.6 Environmental Vulnerability: Definitions and Measures

In addition to poverty, it was predominantly environmental concerns which led to the development and implementation of the concept of vulnerability. Environment-related concepts of vulnerability have been widely described in the literature on security, development, and in related areas, and are an important factor in policy-making at various levels of socio-political hierarchy. Although environmental (ecological) concerns are taken into account in most concepts of vulnerability, they play the key role in the following areas: global change, climate research, hazard research, environment, development and early warning studies (Brauch 2005, chap. 2 above). Definitions of environmental vulnerability include economic and social attributes, thus in result separation of definitions and measures does not seem achievable. They have been surveyed and presented in a synthetic way by Brauch (2005), Gall (2007), Nathan (2009) and below (chap. 20–28),

In the studies of economic vulnerability attention should be paid to attempts of measuring 'environmental vulnerability' since it usually embodies economic and social attributes. Although it is impossible to measure vulnerability in an objective way and only estimates are feasible, there have been several attempts to define and measure characteristics describing variously defined environmental vulnerability (Luers/Lobella/Sklar/Addams/Matson 2003). They were designed either to grasp all aspects of environmental vulnerability or only specific types of disasters, such as hurricanes, floods or earthquakes.

A comprehensive index allowing for analyses of environmental vulnerability was elaborated by the *South Pacific Applied Geoscience Commission* (SOPAC) in cooperation with the *United Nations Environment Programme* (UNEP) and their partners (Kaly/Pratt/Mitchell 2005). The *Environmental Vulnerability Index* (EVI) was stemming from the efforts of the *Small Island Developing States* (SIDS) of the Pacific to promote sustainable development across the world and cooperation on issues relating to our natural life-support ecosystems.

The logic of the *Environmental Vulnerability Index* (EVI)[8] can be described as follows. Vulnerability

6 It may also include changing demographic structure, which in the future will make developed societies more vulnerable.

7 The list of diseases may be extended with the avian flu and H1N1 influenza (swine flu) which have become a cause of fear and controversy during 2008 and 2009.

can be defined as the potential for attributes of any system, human or natural, to respond adversely to events. Hazardous events are those that can lead to a loss of diversity, extent, quality and function of ecosystems. These changes are often described as damage to the biological integrity or health of ecosystems, and therefore their ability to keep supporting humans. These may include natural hazards as well as human pressures.

Vulnerability to damage arises from a combination of the inherent characteristics of a country, the forces of nature and human use, including the special case of climate change. The EVI simultaneously examines levels of present risk and conditions, predicting how the environment is likely to cope with future events.

For example, environments that have been damaged in the past, particularly more recently, are likely to be more at risk of damage from events in the future. The EVI focuses on feedback and interactions, being more proactive than measures of the state of the environment, though it includes them. A result indicating high vulnerability speaks of a high risk of damage from future conditions, some of which may be related to damage in the past, and may therefore be a more appropriate measure for adaptive management, particularly at the scale of countries.

The EVI does not address the vulnerability of the social, cultural or economic environment, nor the environment that has become dominated by those same human systems (such as cities and farms) because these are included in the economic and social vulnerability indices which are needed separately to identify trade-offs. Therefore, the natural environment includes those biophysical systems that can be sustained without direct and/or continuing human support. The environment at risk includes ecosystems, habitats, populations and communities of organisms, physical and biological processes (such as beach building and reproduction), productivity and energy flows, diversity at all levels, and interactions among them all.

A rank of other indices aiming at capturing vulnerability and environmental issues was surveyed by Simpson and Katirai (2006: 19):

- *Urban Earthquake Disaster Risk Index* (EDRI);
- *Environmental Vulnerability Index* (EVI);
- *Disaster Risk Index* (DRI) - United Nations;
- *Hurricane Disaster Risk Index* (HDRI);
- Indicators of Disaster Risk and Risk Management;
- Measuring Improvements in the Disaster Resilience of Communities;
- Social Flood Vulnerability Index;
- *Social Vulnerability to Environmental Hazards* (SoVI);
- Natural Hazard Index for Megacities.

4.3 Survey of Definitions and Measures of Economic Vulnerability

4.3.1 What Is 'Economic' in Economic Vulnerability?

Although a semantic reflection on the adjective 'economic' was offered earlier (Mesjasz 2008a), it is necessary to extend them to economic vulnerability and in consequence, to add new elements to theoretical considerations on economic security. The notion 'economic' refers to a) a type of activity (economic); b) a conceptual approach (associated with economics as part of scientific reasoning); and c) an economic component of any kind of social activity.

In the first, general sense 'economic' refers to the human activities related to the production, distribution, exchange, and consumption of goods and services. All those activities are accomplished at different levels constituting a hierarchy of aggregation: global, regional (supra-national), international, state (4.3.2), non-state actors, e.g. of the market (companies) and non-market (4.3.3), and individuals (4.3.4).

Subsequently, economic may mean any aspect of those activities accomplished by those actors at those levels. In such a case external threatening circumstances refer to threats or risks, etc. and subsequently, to economic security, while susceptibility to potential harm caused by those external and internal factors to activities in all those areas and coping capacities (resilience) can be referred to as economic vulnerability (table 4.2).

As it is stressed in studies of economic security, all the above 'economic' processes, perhaps with the exception of consumption, depend on different external threats. Therefore economic vulnerability must have different interpretations for production, exchange, distribution and for consumption. It also has another sense in finance where risk and vulnerabilities associated with it are viewed as an indispensable component.

8 See: *Environmental Vulnerability Index. The Official Global EVI Website*; at: <http://www.vulnerability-index.net/index.htm> (26 November 2009).

Table 4.2: Framework of analysis of economic security and vulnerability. **Source:** The author's own research.

	Production	Distribution	Exchange	Consumption
Global	ECONOMIC SECURITY (Threat (disturbance, hazard, risk), securitization)			
Regional (supra-national)				
International				
State	ECONOMIC VULNERABILITY (Threat (disturbance, hazard, risk), susceptibility, resilience) (Securitization?)			
Non-state actors				
Individual				

The second meaning of the adjective 'economic' is deriving from the sciences of economy and economics. In a historic perspective it was initially Political Economy and later International Political Economy which linked security issues with economic activities at the state and international levels.

The term 'economics' was proposed to reflect a more scientific understanding of the discipline. In such an approach economics is commonly understood as the scientific study of the choices made by individuals and societies in regard to the alternative uses of scarce resources which are employed to satisfy wants. From the point of view of normative security-related considerations the divide into positive economics ('what is?') and normative economics ('what ought to be?') is of a special importance.

If economics as science is involved in the discourse on security and vulnerability, two situations should be borne in mind. The first, when general normative economic considerations are taken into account with such categories as utility, rationality, efficiency, optimization, etc. In this case, security threats and subsequent vulnerabilities may emerge when some of those criteria are not fulfilled. In the second situation, economic mathematical models are applied in solving specific problems which can be associated directly with security, conflicts, threats, etc. (Hirshleifer 1997, 2001). Indirectly, they can also relate to vulnerability, not necessarily only in the economic sphere.

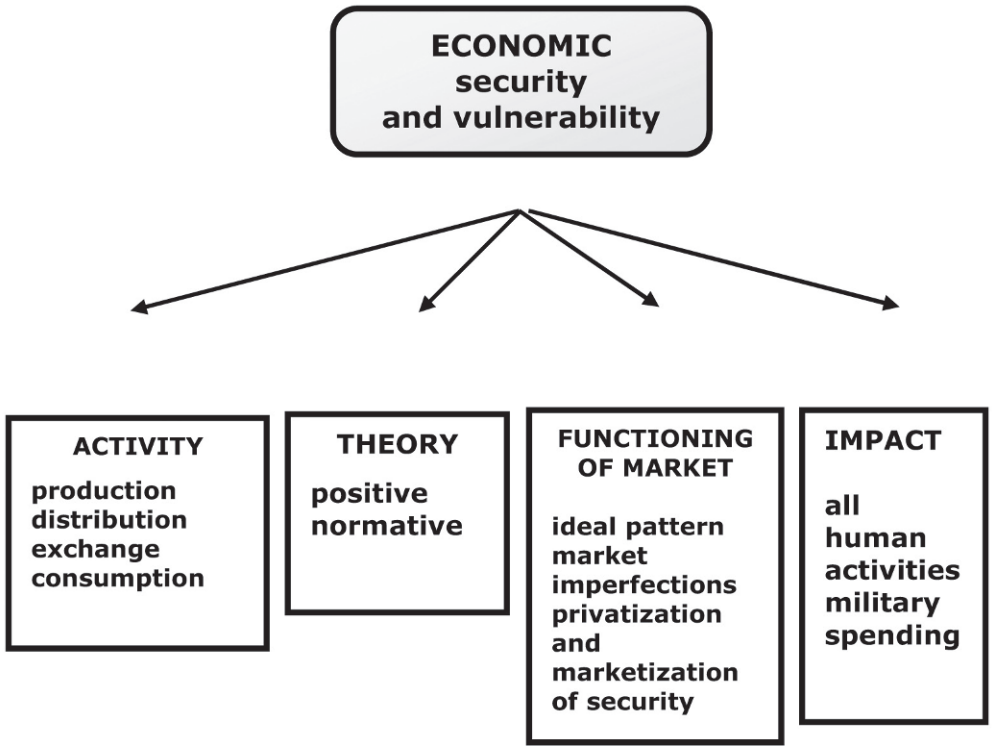
The third meaning of economic in reflections on security and vulnerability is associated with the normative approach and with the functioning of the market. In such a case, two options can be considered. Firstly, assuming that the market is an ideal pattern for all economic activities – 'ideal market', any deviation from market rules can be viewed as a source of vulnerability, and subsequently, insecurity. Secondly, all theoretical and real market imperfections – externalities, non-competitive markets and public goods can also be seen as causes of vulnerability and insecurity. This assumption is likely too far-reaching but it is resulting from a purely formal reasoning in which a normative system is treated as an 'ideal pattern'. In economics treated as a normative science the 'ideal market' is an absolute reference point. In this case the scope and form of the external intervention by the state or other institutions can be viewed either as a source of additional vulnerability or, on the contrary, as a method of strengthening resilience, diminishing vulnerability and increasing economic security.

In a present era of enlarging the scope of influence of market mechanisms, security traditionally treated as a public good is more often economized and marketized. It concerns both the individual levels – private security guards and ends with state security – 'outsourcing' of some military operations as in the case of Blackwater (a private US military company in Iraq). This phenomenon can be included into the third meaning of economic in security and vulnerability analysis.

Fourth, similarly as economic security, economic vulnerability is strongly interlinked with all human activities, and subsequently, with vulnerability and security in other sectors. Disruption of economic activities of any state and non-state actor may contribute to increased vulnerability of those sectors. Opposite relations also seem plausible, although not necessary. In this case a special significance is given to economic foundations of military strength and the impact of military spending on economics.

Obstacles in defining economic vulnerability are to some extent similar to the barriers in defining vulnerability in a universal sense in other areas. The term 'economic' in the definitions is associated with various characteristics and activities, and no systematic attempt to study links between economic theory and policy, and differently interpreted economic vulnerability have been made.

Figure 4.2: Interpretations of the meaning of 'economic' in the discourses on security and vulnerability. **Source:** The author's own research.



The typology proposed by Villagrán de León (2006: 22), including the following levels (subjects) – global, regional (transnational), national, state or province, district or municipal local or community, company/social organization, household (livelihood), human being along with various interpretations of the term 'economic', can be used as a point of departure for a preliminary ordering of ideas how to define, assess and measure economic vulnerability. In addition, it must also be taken into account that economic aspects of vulnerability are included in numerous attempts to define vulnerability in other areas.

The hierarchy of economic vulnerabilities leads to many questions on disturbances influencing economic activities at all those levels. The origins of those disturbances, shocks and threats, etc. can be natural or man-made. The first group of disturbances influencing economic activities is associated with environmental disturbances, irrespective of their character. The second includes all categories resulting from purposive human economic, social, political, military activities. In the case of economic and social disturbances influencing economic vulnerability two categories can be distinguished – policy-induced and market-induced. Thus, two kinds of economic vulnerability can be distinguished.

The hierarchy of economic vulnerabilities is associated with a hierarchy of economic disturbances. It may be observed that in the case of economic vulnerability the hierarchy of disturbances is isomorphic with the hierarchy of disturbances although their interdependence is very complex. While in the case of an individual or a household it is difficult to distinguish ecological disturbance affecting only their level, in the case of economic vulnerability each actor or object is exposed to disturbances emerging at all levels and at its specific level, e.g. sources of poverty of an individual or household may refer only to their specific level.

4.3.2 Economic Vulnerability of the Country or State

4.3.2.1 General Definitions of Economic Vulnerability

Analysis of the meaning of 'economic' in the studies of vulnerability allows to conclude that in the simplest sense this term may be associated with a disturbance (natural and/or man-made, including an economic one) affecting any form of economic activity (production, distribution, exchange, consumption) and resil-

ience in any of those forms of activity. In defining economic vulnerability it is necessary to include structural factors allowing for linking processes and phenomena at all levels of social entities or units, beginning from the global one and ending with the individuals.[9] These interdependences are not yet clearly explained due to their inherent systemic complexity.

It is worth mentioning that studies of vulnerability are not a new research area in economic theory. As one leading specialist in the theory and practice of vulnerability stated: "Vulnerability is not really a new concept in economics, but it has recently become a fashioned one, noticeably because of the concern of several political bodies and the 'turmoil' of international economy" (Guillaumont 1999: 2). In a universal sense economic vulnerability is determined by the following factors (Benson/Clay 2004): natural hazards, economic structure, stage of development, prevailing socio-economic conditions, macroeconomic conditions.

An attempt to define economic vulnerability as an instrument of studies of a developing country (Mexico) was suggested by Saldaña-Zorrilla (2006) who proposes a comprehensive interpretation of economic vulnerability, which in addition to external factors – disturbances and shocks, includes the following components:

- coping capacity achieved thanks to entitlements and assets;
- adaptive capacity achieved thanks to structural changes and embodying risk management and protection.

Saldaña-Zorrilla (2006: 20) defines economic vulnerability as the susceptibility of an economic agent to absorb external shocks (hazards) negatively, given its possession of assets and entitlements system (coping capacity), as well as its implemented risk management and protection measures (adaptive capacity). Following this definition, reducing economic vulnerability consists basically of implementing necessary changes in time to minimize negative effects from exogenous shocks upon economic agents' assets by strengthening contractual elements in the society (entitlements and assets) and/or improving the risk management and protection strategies.

Despite all definitional efforts, similarly as in other areas, there are not any universal definitions of economic vulnerability reflecting specific invariant structural properties. Considerations of economic vulnerability are to a large extent focused on specific groups of states – less developed ones and poor regions, and individuals living in those states or regions.

Two groups of countries have been subject to special interest with respect to vulnerability: the *Small Island Developing States* (SIDS) and the *Least Developed Countries* (LDCs).

4.3.2.2 Economic Vulnerability and Resilience of Small States

Poverty and vulnerability of states or countries are predominantly a topic of concern in human security. However, most ideas on the vulnerability of a state or country originated in theory and policy-making for a very specific group of the *Small Island Developing States* (SIDS), and more generally of small states. The first group comprises fifty-one small island developing states and territories that are listed by the United Nations Department of Economic and Social Affairs in monitoring their sustainable development. These countries are often categorized by their three regions of Africa, Indian Ocean, Mediterranean and South China Sea (AIMS) as well as the Caribbean and the Pacific.

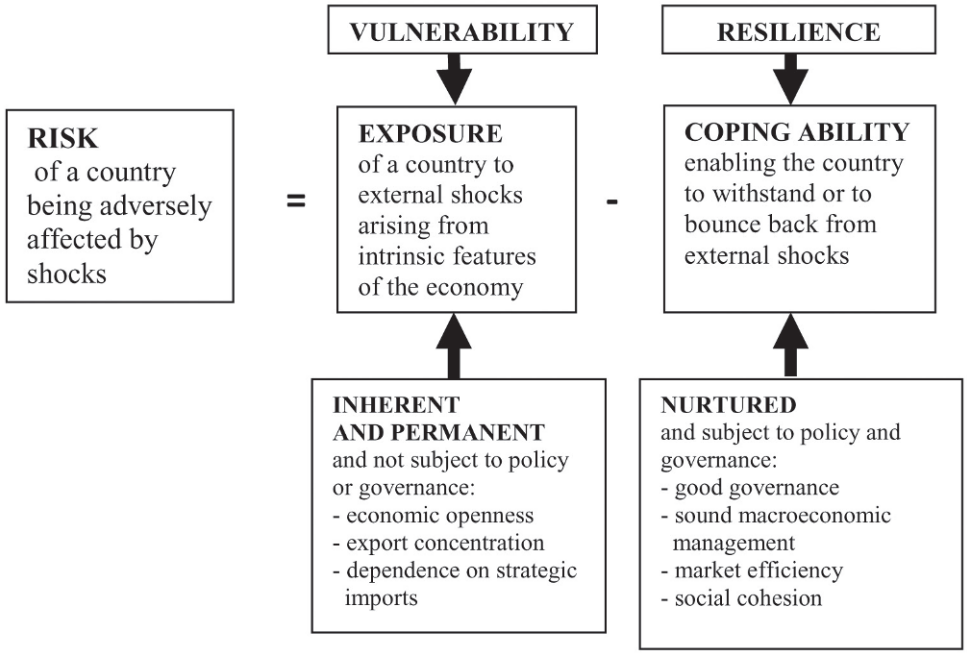
The second is more difficult to describe since there is no generally agreed definition as to which variable should be used to measure the size of countries and as to what should be the cut-off point between a small country and other countries. Generally speaking, population is used as an indicator of size (Briguglio/Cordina/Farrugia/Vella 2008).

SIDS and LDCs constitute two different, although overlapping, groups of countries. In mid-2007, among the 50 LDCs, twelve are SIDS that represent more than 35 per cent of the 37 independent SIDS. Most SIDS countries do not qualify as low income and some have very high income. Among the LDCs, the majority or 58 per cent (39 countries) are fairly small countries (with population sizes smaller than those of the larger SIDS; e.g. Cuba has a population of 11 million people). In brief, the two categories refer to countries that differ significantly in other characteristics but which face, to a large extent, problems associated with small size and in particular high economic vulnerability (Guillamont 2009).

Despite the generalization of the idea of an economic vulnerability index for small states, it is more focused on the small island ones, which tend to be

9 As was declared in the beginning of the chapter, no difference is made between vulnerability of the state understood as an institution and vulnerability of a country (embodying state apparatus).

Figure 4.3: Risk associated with being adversely affected by external shocks. **Source:** Briguglio, Cordina, Farrugia and Vella (2008: 3).



characterized by high degrees of economic openness and export concentration. It leads to exposure to exogenous shocks, that is, economic vulnerability, which could constitute a disadvantage for economic development by magnifying the element of risk in the growth process, without necessarily compromising the overall viability.

Although they are vulnerable in an economic sense, many small states manage to generate a relatively high GDP per capita, when compared with other developing countries. This has been called the 'Singapore Paradox'. There are a number of SIDS – Singapore, Cyprus and Malta are prime examples – that are very economically vulnerable, but have managed to generate high income per capita in spite of this condition. The reason for this is that it is possible for SIDS to build up their own resilience to improve their ability to cope with vulnerability (Briguglio 1995, 2004; Briguglio/Cordina/Farrugia/Vella 2008).

The definition and measurement of economic vulnerability and resilience of small states were among the first focuses of studies in that field. According to researchers specializing in SIDS, economic vulnerability is defined as "the exposure of an economy to exogenous shocks, arising out of economic openness, while economic resilience is defined as the policy-induced ability of an economy to withstand or recover from the effects of such shocks" (Briguglio/Cordina/Farrugia/Vella 2008). In this approach, economic vulnerability is assigned to inherent conditions affecting a country's exposure to exogenous shocks, while economic resilience is associated with actions undertaken by policy-makers and private economic agents which enable a country to withstand or recover from the negative effects of shocks. Actions which enable a country to better benefit from positive shocks are also considered to be conducive to economic resilience.

Using a simplified formula of risk, it is shown that the risk of a country has two elements. The first one is associated with the inherent conditions of the country that is exposed to external shocks and the second is associated with conditions developed to absorb, cope with or bounce back from adverse shocks. The risk of being adversely affected by external shocks is therefore the combination of the two elements (figure 4.3).

The above scheme was used for developing economic vulnerability and resilience indices of the SIDS (Briguglio 1995, 2004; Briguglio/Cordina/Farrugia/Vella 2008).

An *economic vulnerability index* is often based on the premise that a country's proneness to exogenous shocks stems from a number of inherent economic features, including high degrees of economic openness, export concentration and dependence on strategic imports. According to the scheme, economic resil-

ience refers to the policy-induced ability of an economy to recover from or adjust to the negative impacts of adverse exogenous shocks and to benefit from positive shocks. The term is used here in a double meaning referring to the ability to recover quickly from a shock, and to withstand the effect of a shock.

The *resilience index* is intended to measure the effect of shock absorption or shock counteraction policies across countries. It can be assumed that the variables capturing these effects are the following: macroeconomic stability, microeconomic market efficiency; good governance and social development. According to its authors, the resilience index developed by Briguglio and his co-authors can be applied to support decision-making, especially for setting directions and justifying choice of priorities for resilience building (Briguglio/Cordina/Farrugia/Vella 2008):

- disseminate information on and draw attention to the issue of resilience building;
- focus the discussion on essential resilience-building issues;
- promote the idea of integrated action.

Since their onset perception of both indices has been evolved. While the economic vulnerability index is more relevant for small island states and is distinguished from a similar index for poor countries, the resilience index is applied to a wider group of countries.

4.3.2.3 Economic Vulnerability of Least Developed Countries (LDC) – Economic Vulnerability Index

In one of the first studies on economic development, Todaro (1982) considers vulnerability as a situation in which *least developed countries* (LDC) find themselves in a dominance and dependence relationship vis-à-vis developed countries. The same view was expressed by the UN General Assembly (2001: 43). LDCs are structurally more exposed to external economic shocks than most other developing countries, and they also suffer the consequences of major global and regional economic and financial disturbances and increases in the prices of critical imports such as energy products. The typical export dominance of a single commodity or service sector makes their economies particularly vulnerable to adverse physical or economic shocks. Therefore it is not incidental that measures and indices of economic vulnerability were developed as an instrument of analysis of the situations of those countries.

The vulnerability index that was developed for SIDS was not the only attempt to define and measure economic vulnerability. The economic vulnerability of a country can also be defined by the risk of a (poor) country seeing its development hampered by the natural or external shocks it faces. Two main kinds of exogenous shocks or sources of vulnerability can be considered:

- *environmental or 'natural' shocks*, namely natural disasters such as earthquakes or volcanic eruptions, and the more frequent climatic shocks such as typhoons and hurricanes, droughts, floods, etc.;
- *external (trade- and exchange-related) shocks*, such as slumps in external demand, instability of world commodity prices (and correlated instability of terms of trade), international fluctuations of interest rates, etc. Other domestic shocks may also be generated by political instability or, more generally, by unforeseen political changes.

Vulnerability can be perceived as the result of three components (Guillaumont 2008: 2–3)

- the size and frequency of the exogenous shocks, either observed (ex-post vulnerability) or anticipated (ex-ante vulnerability);
- exposure to shocks;
- the capacity to react to shocks, or resilience.

Resilience depends more on current policy, is more easily reversed, and is less structural. But there may also be a structural element in the resilience component of vulnerability. Therefore in considering economic vulnerability, an important distinction should be made between structural vulnerability, which results from factors that are relatively impervious to national policies, and the vulnerability deriving from economic policy, which results from choices made in the recent past, and is therefore conjunctural. For example, export instability (as a result of heavy dependence on a limited number of exports) is a structural factor of vulnerability. However, the capacity to manage instability of the revenue received from such exports depends on the economic policies pursued (UNCDP 1999: 29; Guillaumont 2008, 2009).

Structural economic vulnerability should be distinguished from state fragility. Fragile states are defined as the *Low-Income Countries under Stress* (LICUS) according to policy indicators, essentially the World Bank's *Country Policy and Institutional Assessment* (CPIA) (IEG 2006). Many countries may meet both criteria of structural vulnerability as well as state fragility due to the likely influence of the former on the lat-

ter, but the two concepts are founded on opposite grounds, structural versus policy factors.

Another distinction should be made between economic vulnerability and ecological fragility. The UN's initial concern over vulnerability included both economic vulnerability and ecological fragility, but The Committee for Development Planning at its 32nd session agreed that two concepts should be analysed separately. For instance, losses in biodiversity reflect ecological fragility and are not necessarily major elements of economic vulnerability. Therefore, environmentally-induced economic vulnerability can be considered either as economic vulnerability or ecological vulnerability (UNCDP 1999: 29; Guillaumont 2008: 3).

With resolution 1998/39 of 30 July 1998, the Economic and Social Council requested the *Committee for Development Planning* (CDP) to report on the usefulness of a vulnerability index as a criterion to designate least developed countries. It suggested as the best way of addressing economic vulnerability of least developed countries the replacement of the current *Economic Diversification Index* (EDI) with a composite *Economic Vulnerability Index* (EVI).

In the proposed EVI five indicators of export concentration, the instability of export earnings and of agricultural production, the share of manufacturing and modern services in *Gross Domestic Product* (GDP), and population size were given equal weight. The Committee considered that, since the EVI could give only a partial and approximate measure of the relative level of vulnerability of a country, a country vulnerability profile should be prepared, for some countries to provide a more detailed assessment of the impact of external economic and natural shocks on their economic performance and structure (UNCDP 1999: 5–6). At its triennial review of the LDCs list in 2000 CDP implemented the EVI index as an identification criterion and with some revisions also in 2003 and 2006 (Guillaumont 2008: 2).

The present version of the EVI composite index includes two groups of indicators of exposure to shocks and shocks. They are supported with methodological explanations relating to measures, determinants and weights (Guillaumont 2008). As in all cases of a quantification of qualitative criteria on phenomena in a macro scale they can be criticized for simplifications and arbitrariness. However, they provide at least more or less objective arguments regarding the theory of development and poverty alleviation as well as in policy-making that are targeted at decreasing vulnerability and increasing resilience. In the case of the latter, the EVI allows for a more reliable assistance policy/decision-making. The EVI index can be treated as a universal measure applied also for the SIDS although the division of areas of applications can be seen in the studies of their proponents (Briguglio 1995, 2004; Briguglio/Cordina/Farrugia/Vella 2008; Guillaumont 2008, 2009).

In the studies on poverty not only the country level has become a topic of interest but also the regions within countries where the aim was to develop a concept and measure of the 'vulnerability of place'. It was designed as being due to vulnerability in various areas, such as economic and environmental vulnerability, of governance, demographic and health fragilities. The studies at the subnational level allow for constructing a *Local Vulnerability Index* (LVI) for various districts (Naudé/McGillivray/Rossouw 2008).

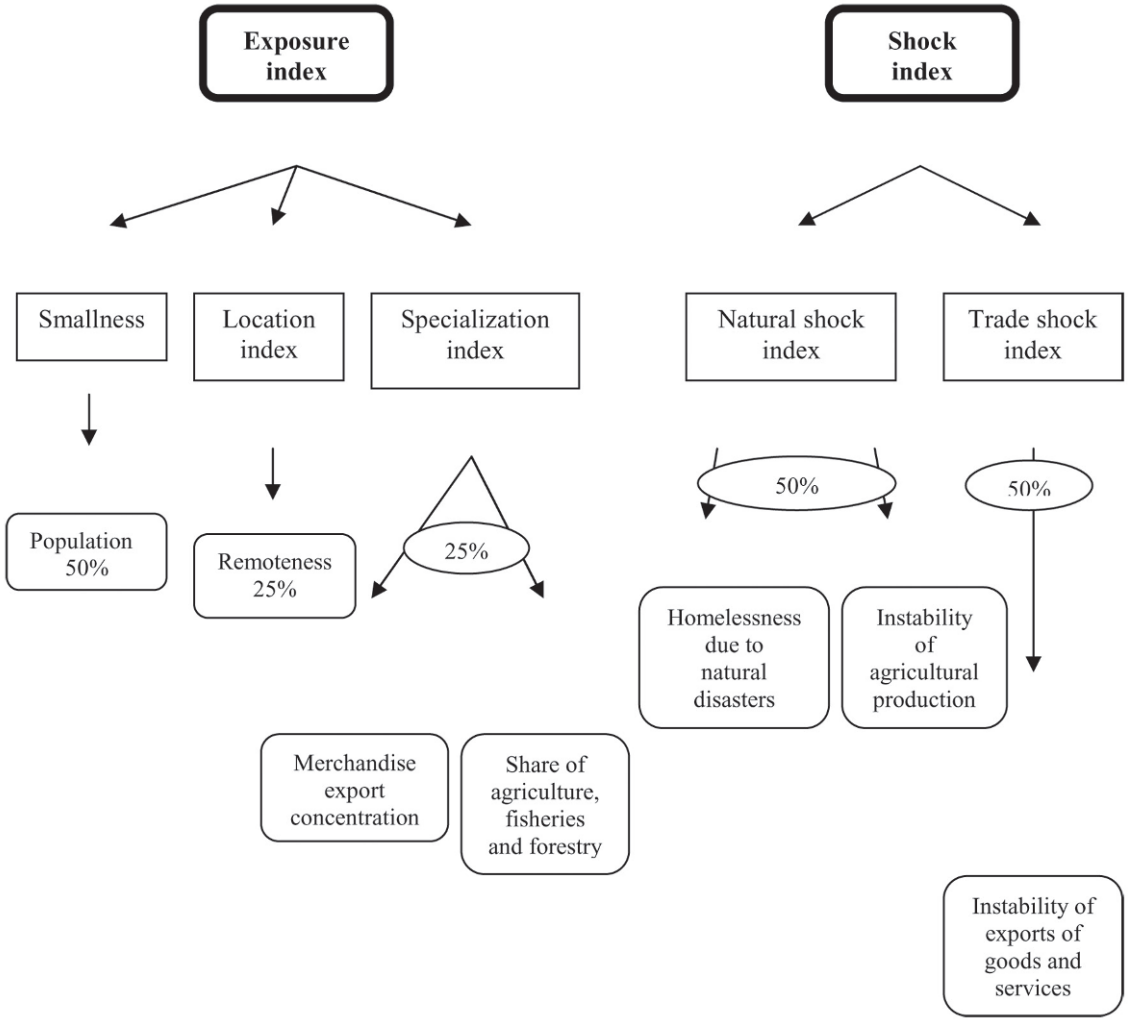
4.3.2.4 Financial Vulnerability

Financial vulnerability constitutes an important component of economic vulnerability. Similarly as in the case of various interpretations of the adjective 'economic', the term 'financial' in the context of vulnerability studies also requires further elucidation. Financial in such a case can refer to vulnerability of broadly defined financial activities under the impact of various natural and man-made disturbances or vulnerability in other sectors caused by financial disturbances. This twofold meaning of financial vulnerability should be kept in mind in the discussion on all kinds of vulnerability. It is visible in different approaches to finance in the discussions on disasters in which either financial vulnerability is viewed in the context of consequences of disasters (Benson/Clay 2004) or financial vulnerability is viewed as a consequence of the overall economic stance of a country as in the studies of poverty.

Finance at the global, international and national level is undoubtedly an area where various forms of vulnerability can also emerge and can expand to other domains. Natural disturbances and financial disturbances, such as shocks, crises and hazards influence the value at risk of assets and if their value is decreasing, the shocks and vulnerability are influencing all areas of socio-economic life in complex ways.

The very character of the international system implies that the basic unit of analysis of financial vulnerability is a state or country. Due to globalization, definitions of vulnerability may also include transnational regions and the global scale. It does not exclude the necessity to consider the financial vulnerability of other units, e.g. banks, companies, households but all of them to a large extent are deriving from the financial vulnerability of the state. As economic vulnerabil-

Figure 4.4: Structure of Economic Vulnerability Index (EVI). **Source**: Based on Guillaumont (2008: 13)



ity, financial vulnerability can also be caused by external and internal shocks and disturbances. It may be a result of structural and policy causes and of a combination of both. Since it is impossible to elaborate a unique definition of financial vulnerability, several types of financial vulnerability can be distinguished:

- vulnerability of the countries with limited access to private financing;
- vulnerability of the countries with access to market-related financing; and
- vulnerability of developed countries.

While the first two categories of vulnerability have been analysed in development studies, the third category should be included in the discussion, especially since the beginning of the turmoil on financial markets affecting the United States and the European Union since 2007. Financial vulnerability is a result of external shocks and domestic policy errors and it may occur in several forms as a component of economic vulnerability of less developed and economically vulnerable countries but if they may also fall in the category of the 'Singapore Paradox' that has more in common with the financial vulnerability of developed states.

Financial activities are also included in the definitions of vulnerability in all areas as a part of the preparedness for hazards and the elimination of the consequences of disasters. The framework of financial mechanisms refers to identification, measuring, and comparing vulnerability to natural hazards (using case studies in different countries) outlining initiated schemes of the federal and local governments, NGOs and micro finance initiated schemes. Those schemes include the expected rise in disaster losses related to

climate change, the public and private insurance system, and an international reinsurance pool.

- natural hazard and financial vulnerability affect how natural disasters interact with the economy;
- financial vulnerability of a government is defined by ex-ante and ex-post decisions where the benefits depend on policy objectives of a maximization of returns, instability and variability;
- tools available to identify, measure, and compare financial vulnerability and to plan.

From the standpoint of macroeconomic policy, the key question is how much and how rapidly can the government afford to borrow to finance the reconstruction costs, while keeping fiscal policy on a sustainable path (Hossini 2008: 22–23). Financial vulnerability caused by financial activities may stem from an unpredictability or a limited predictability of financial disturbances, which are usually identified with the absence of an early warning system. According to some authors such an early warning system should be developed to prevent various crisis situations on financial markets, which may affect entire economic systems at the national and international levels through contagion. Several attempts were made to develop such early warning systems (Goldstein/Kaminski/Reinhart 2000). The aim of that model is to identify key empirical regularities prior to the banking and currency crises that would enable officials and private market participants to recognize the vulnerability to financial crises at an earlier stage. This should facilitate corrective policy actions to prevent such crises from occurring.

Financial vulnerability is sometimes viewed as a mirror concept of financial stability and financial sustainability referring to states, transnational regions and the global financial system. Since no unequivocal definitions of financial stability and sustainability exist, and the definitions are very diverse, then financial stability can be viewed as just another example of a normative term in the discourse on finance (Mesjasz/Rogowski 2005; Schinasi 2006).

4.3.3 Economic Vulnerability of Non-state Actors

The attention focused on economic vulnerability at the household and individual levels that has emerged in connection with environment studies and poverty-related research has also reinforced an interest in other areas and reference objects. Economic vulnerability of households and individuals results to a large extent from disturbances in the entire socio-economic system. It seems that the vulnerability of other market and non-market economic actors, and not only individuals and households, should be treated in a more universal way, not necessarily always in the context of poverty and/or environmental disasters. Thus, considerations of economic vulnerability should be extended to all countries and institutions and the following issues should be taken into account when discussing vulnerability of non-state actors, such as a) market organizations, b) non-market institutions, c) globalization and vulnerability in a universal sense, and d) globalization and economic vulnerability.

4.3.3.1 Market Organizations

In the discussion on economic vulnerability attention is focused on less developed countries and economic causes and consequences of disasters (Benson/Clay 2004). Disturbances on the world market observed since 2007 and earlier events, e.g. the Asian Crisis of the late 1990's or various market 'bubbles' stir the necessity to extend the studies of economic vulnerability beyond traditional areas of poor and developing and/or fragile countries and individuals to organizations operating on the markets in any country at any level of economic development.

Defining economic vulnerability of organizations functioning under market rules, such as non financial (manufacturing and service enterprises), financial (banks, insurance companies, etc.) and others is no easy task since risk and hazards are indispensable factors of their activities.[10] They are exposed to external disturbances which are not depending on their decisions but a large part of those disturbances must be included in their strategic and current planning.

What may external and internal factors contribute to the vulnerability of such organizations? Their external risks and hazards derive from 'natural' risks due to the functioning of an 'ideal' market without market imperfections, what is rather hypothetical if not irrelevant. If deviations from the 'ideal market' are treated as sources of economic vulnerability and threats to economic security, then it is necessary to ask what kind of deviations from that ideal are to be regarded as sources of risks, hazards and limited defensive capacities, such as resilience, coping capacities, etc. In this case the dilemma of an ideally self-regulating market vs. any form of intervention comes to the fore as

10 Due to different interpretations of companies and enterprises in various legal systems, only the divide non-financial and financial market organizations is used herein.

in previous discussions on economic security (Mesjasz 2008a). Answering this question is not simple since when a company (corporation) is taken as a reference object, it is not possible to state whether the absence of any external intervention is unconditionally positive or whether such an intervention is essential for the survival of market-oriented organizations in the competitive environment.

The third source of economic vulnerability of market organizations is the same as for other types of vulnerability, such as environmental, economic (including financial), social and military. In this case a market organization is exposed to the same disturbances as the rest of the society. Resilience to such threats, hazards, etc. is not necessarily connected to its ability to cope with market adversities but with those threats which equally affect other actors during natural disasters, deep economic shocks, etc. Obviously the overall standing of a market organization and its location, be it a developed or developing country, has also a significant impact on its vulnerability.

The economic vulnerability of market organizations should be studied in all areas of modern economic science, beginning from political economy and macroeconomics and ending with the microeconomic level, including analyses of market mechanisms and theories of the firm. From numerous issues which should be analysed, the following ones seem most urgent at the macroeconomic level:

- increasing vulnerability of the world economic system in a global scale (Beck 1999, 2007);
- increasing complexity of economic mechanisms and especially finance;
- governance dilemma: free market vs. external intervention and its impact on economic vulnerability of the market at the global (international) level;
- the impact of environmental factors on economic activities worldwide;
- identification of the limits to growth and a deeper understanding of sustainable development, which too often remains but a void utterance;
- positive and negative impacts of economic globalization on vulnerability in a general sense and on economic vulnerability of all social actors.

At the microeconomic level, the following factors should be taken into account in extending the scope of the concept of economic vulnerability onto market-oriented organizations:

- better understanding of market uncertainty and risk;
- studies of the role of information and knowledge in changing the role of risk management in the environment with increased uncertainty;
- better understanding of the consequences of imperfections of market mechanisms, especially information asymmetry and its consequences (adverse selection, moral hazard) for market organizations and at the global scale (Stiglitz 2002, 2006);
- emphasis of ethical aspects of modern economic activities;
- the impact of environmental factors on the functioning of market organizations under the conditions of disasters.

The list of potential areas of investigation is obviously not complete. For example, a growing role of the impact of the vulnerability of IT systems on the functioning of all organizations should also be noticed (Sutton/Nagle 2006, chap. 12 by Brauch).

4.3.3.2 Non-market Institutions

The term non-market institutions relates to those areas of social life where fundamental economic characteristics are not directly associated with market mechanisms. Non-market patterns of functioning, including political interventions into economic processes are also taken into account. The divide may seem to some extent artificial and fuzzy but it allows defining the vulnerability of non-state actors. The collection of reference objects may include – broadly defined public institutions, public administration, self-government institutions, intra- and inter-state regions, non-market services, e.g. health care and infrastructure.

The economic vulnerability of non-market institutions may have several interpretations resulting from disturbances of all economic activities of those institutions during natural disasters and human-made political, economic or financial disruptions. Such institutions are usually created for providing public goods both under the normal conditions and especially in the time of a disaster, thus any disruptions in delivering those goods may cause a specific threat to those who rely on those goods.

Considerations on vulnerability of non-state institutions cannot focus solely on developing countries. Vulnerability as a new idea is transferred to other areas of economic life only partly relying on market mechanisms. The examples given below do not exhaust all possibilities but may be treated as representative for many entities.

Economic vulnerability may affect regions as in the case of a *Local Vulnerability Index* (LVI) for various districts (Naudé/McGillivray/Rossouw 2008). Economic vulnerability plays an important role in *Critical Infrastructure* (CI) for a wide variety of areas and institutions, including public institutions, health care, civil protection, etc. It is also affected by the disturbances where infrastructure and economic vulnerability of the market organizations and non-state institutions may undermine the functioning of infrastructure.

Another example shows how the idea of vulnerability is extended to areas where market mechanisms coincide with non-market institutions. The Centre of Full Employment and Equity in conjunction with the Urban Research Programme (Griffith University, Brisbane) have developed the *Employment Vulnerability Index* (EVI) for suburbs across Australia, which is an indicator that identifies those suburbs that have higher proportions of the types of jobs considered as being most at risk in the current economic climate (Baum/Mitchell 2009). Similar theoretical and policy efforts are undertaken on the macro level by the UN, where economic vulnerability is linked to unemployment (UNCDP 2006).

It is not possible here to discuss globalization as a factor contributing to economic vulnerability at all levels of the social hierarchy and where simultaneously macro-scale economic and financial vulnerability may occur. While in some cases broadly defined globalization contributes to limiting different types of vulnerability in other cases of social and economic vulnerability it does not.

4.3.3.3 Economic Vulnerability of Individuals, Households, Livelihoods and Human Security

Economic vulnerability of individuals is interrelated with various types of vulnerability at all levels of societal hierarchy. It is also a composition of the following overlapping and interrelated domains of vulnerability of livelihood and households and food security (FAO 2009a). In recent years gender vulnerability is also taken into account (UNCTAD 2004; Warner 2007: 17; Oswald Spring 2008). In a natural way, vulnerability of individuals is thus directly or indirectly included in the discourse on human security, although due to the vagueness of both concepts it is usually done in a descriptive way.

The vagueness of the human security concept is due to the fact that although it has become an indispensable part of security theory and practice, its applications as an analytical and political instrument are still unclear (Burgess/Owen 2004). Summarizing the discussion on human security Bogardi and Brauch (2005) as well as Brauch (2005) argue that it should rely on three conceptual pillars:

- 'freedom from want' by reducing societal vulnerability through poverty eradication programmes (UNDP 1994; CHS 2003);
- 'freedom from hazard impact' by reducing vulnerability and enhancing coping capabilities of societies confronted with natural and human-induced hazards (UNU-EHS 2004);
- 'freedom from fear' by reducing the probability that hazards may pose a 'survival dilemma' for the people most affected by extreme weather events (UNESCO, HSN).

The links between all three 'freedoms' and economic vulnerability of individuals, households and livelihoods cannot be identified due to the multiple meanings and fuzziness of both terms. Therefore, it is only possible to show some basic relationships between those two categories. Economic vulnerability at the level of individuals, households and livelihoods is always analysed with reference to poverty. Vulnerability can be interpreted in such a case as the existence and the extent of a threat of poverty and destitution; the danger that a socially unacceptable level of well-being may materialize (Dercon 2006).

In this approach, vulnerability may be defined as the magnitude of the threat of poverty, measured *ex ante*, before the veil of uncertainty has been lifted. This may be compared to poverty, which points to the magnitude of low welfare outcomes, as observed without uncertainty and whereby low welfare is defined as the outcome levels below some accepted poverty line. The focus is on exposure to the threat or the danger of low welfare outcomes, i.e. downside risk, not just risk in general. Following this definition, vulnerability may be defined or measured by the formula:

$$Vi^*=V(z,y,p)$$

where z is the poverty line, y is a vector of outcomes across n states of the world, and a vector p of corresponding probabilities. It may be easiest to take these outcomes as consumption levels, but it is more suitable to take other well-being dimensions into account. Vulnerability is then a function of outcomes, a norm and the probabilities linked to each outcome. Many functions could be imagined. To narrow this down for a measure, it is possible to define a number of desirable properties of a vulnerability measure. Subse-

quently methods of measurement and forecasting can be elaborated (Dercon 2006: 21).

In discussions of the vulnerability of individuals, livelihood, households and social groups, additional explanations of the entitlements approach developed by Sen (1981) as a concept of famine analysis are needed. Entitlements have been defined by Sen (1984: 497) as "the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces". Devereux (2005: 246) notes that entitlements are a descriptive rather than a normative concept and that they derive from legal rights rather than the morality or human rights.

One of the most valuable contributions of the entitlement approach to famine theorizing is the shift of the analytical focus away from concentrating on food supplies – the Malthusian logic of "too many people, too little food" – and onto the inability of groups of people to acquire food. Food insecurity affects people who cannot access adequate food (e.g. because of poverty) irrespective of food availability – a famine can occur even if food supplies are adequate and markets are functioning well. This is a crucial insight. As Sen emphasized, there is no technical reason for markets to meet subsistence needs – and no moral or legal reason why they should. An equally important insight – and one that has generated much confusion and controversy in the literature – is that famine can be caused by an "exchange entitlement decline" (adverse shifts in the exchange value of endowments for food, e.g. falling wages or livestock prices, rising food prices) as well as by "direct entitlement decline", for instance loss of food crops due to drought. The entitlement approach does not exclude the latter possibility.

In his elaboration of the entitlement approach, Sen (1981) chooses the individual, the household, or an "economic class" of people (sharecroppers, pastoralists) as his unit of analysis, and he shifts seamlessly between these levels of aggregation as if they are interchangeable. A person's "entitlement set" is the full range of goods and services that he or she can acquire by converting his or her "endowments" (assets and resources, including labour power) through "exchange entitlement mappings". In the context of poverty and famine, the entitlement approach aims comprehensively to describe all legal sources of food, which Sen (1981: 2) reduces to four categories: "production-based entitlement" (growing food), "trade-based entitlement" (buying food), "own-labour entitlement" (working for food) and "inheritance and transfer entitlement" (being given food by others).

Entitlements can be treated as essentially the system of legal and customary rights defining the access to the society's resources. Individuals face starvation if their full entitlement set does not provide them with adequate food for subsistence. The entitlement approach focuses on starvation, which has to be distinguished from famine mortality, since many of the famine deaths – in some cases most of them – are caused by epidemics, which have patterns of their own. The epidemics are, of course, partly induced by starvation but also by other famine characteristics, e.g. population movement, breakdown of sanitary facilities (Sen 1981: 50). The entitlements approach allows for linking theoretical economic considerations with vulnerability and food insecurity or security although it also has limitations already recognized by Sen (1981: 48–50) and is criticized for several weaknesses, e.g. failure to recognize individuals as socially embedded members of households, communities and states, and second, a failure to recognize that famines are political crises as much as they are economic shocks or natural disasters (Devereux 2001: 259).

In a generalized sense entitlements can be applied as an instrument of deepened understanding of various areas of vulnerability. Adger and Kelly (1999) have proposed to use the entitlements approach in analyses of vulnerability of individuals, households and social groups. As Ribot (1995) argues, this approach introduces a household perspective on vulnerability, one that replaces 'ecocentric' approaches to environmental change. The main contribution of this approach lies in its focus on the vulnerability of individuals and social groups. Within this framework, vulnerability is understood as being determined by access to resources – specifically by individuals' "entitlement" to call on these resources (Adger/Kelly 1999).

Continuing this line of reasoning, it may be stated that vulnerability does not involve merely active and passive factors, but rather dynamic objects and subjects in continuous motion. As pointed out in Turner et al (2003), systems have different sensitivities to perturbations and stressors strongly linked to entitlements in the case of social units. Entitlements are essentially the system of legal and customary rights defining the access to the society's resources (Saldaña-Zorrilla 2006: 16).

Vulnerability of countries and individuals is linked with security in the FAO approach to food security in the Report prepared by the Interdepartmental Programme on *Food Insecurity and Vulnerability Information and Mapping Systems* (FIVIMS) (FAO 2009). In addition to individuals' food vulnerability or secu-

rity vulnerability of household, livelihood and gender are usually linked with human security.

As far as household vulnerability to poverty is concerned, alternative definitions exist. They were surveyed by Zhang and Wan (2008). In addition to 'typical' interpretations of vulnerability to poverty as the propensity of a household to suffer a significant shock that brings its welfare below a socially accepted level. Some of the definitions include references to the probability that a household would experience at least one episode of poverty in the near future or over a given number of time periods or that vulnerability to poverty at time t as the probability that a household becomes or remains poor at time $t+1$. It is worth noting the key difference between poverty and vulnerability to poverty. The latter involves future risks, is a forward-looking concept, and cannot be observed. One can, however, estimate the probability that a household may remain or become poor in the future due to various risks (Zhang/Wan 2008: 1).

Corresponding to different definitions of vulnerability, alternative measurement methods exist. They include using various differences and proportions between expected consumption and the poverty line and the probability to fall into poverty. Other measures are based on the use of average income and its standard deviation to measure vulnerability or as the difference between the expected value of poverty in the future and its current value. However, as demonstrated in Zhang and Wan (2008), most researchers prefer to define vulnerability to poverty as the probability of a household or individual falling into poverty in the future.

There are also other measures of household vulnerability. Dercon (2006) simply takes the degree of risks faced by individuals or households as a measure of vulnerability. Leaving apart other definitions of vulnerability to poverty, it may be concluded that as the household is a major economic actor studied with a more advanced economic apparatus, the studies of household vulnerability to poverty are deeply rooted in economic considerations.

Links between human security and vulnerability, both in a universal sense and narrowed to economic factors are also exposed in gender vulnerability. Traditional division of labour, more limited access to education and health care, lack of empowerment and entitlement, all put women at the forefront of socially vulnerable groups. They care for children and the elderly. The home-bound status of many women often makes them the first victims of a variety of stressors (Warner 2007: 18). Economic vulnerability is also directly related to more comprehensive ideas associated with human security can be quoted (see the *Human, Gender and Environmental Security* (HUGE) concept by Oswald Spring 2009). An integrated approach of HUGE focuses on overcoming the consolidated gender discrimination by reorienting human security. Economic vulnerability of women is explicitly and implicitly embedded into that concept (Oswald Spring 2008, 2009). This survey shows that vulnerability in a universal sense and economic vulnerability are closely linked to human security at a declaratory level.

4.4 A New Approach to Economic Vulnerability

4.4.1 Conceptual Limitations of Economic Vulnerability and Economic Security

In any attempts to deepen the understanding of economic vulnerability and economic security, the multitude of definitions of both terms, which sometimes do not correspond to each other, should be viewed as a fundamental obstacle. What is even more pessimistic, those linguistic barriers are insurmountable and it is in vain to try to overcome them. Of course, a total conceptual chaos is unacceptable and putting some order into the discourse is necessary.

In the search for better understanding of economic vulnerability, economic security and their relations the following barriers must be considered. A deeper explanation of the meaning of the term 'economic' is lacking in security-related considerations. Usually this adjective is applied without any attempt to explain its specificity although even the basic question whether vulnerability results from economic factors or whether vulnerability concerns economic activities usually remains unanswered.

Second, there are even different structural interpretations of vulnerability in a general sense. Chambers (1989) and other authors distinguish two sides of vulnerability: an external side of risks, shocks, and stress, and an internal side which is defencelessness. Briguglio, Cordina, Farrugia and Vella (2008) and other authors distinguish between vulnerability solely as an exposure to external threats, risks and hazards, and resilience (coping capacity) as an internal feature of the entity (system/individual). In this case relations between defencelessness and resilience would require additional explanations.

Third, it is impossible to separate various types of vulnerability. In attempts to define social, environmen-

tal and economic vulnerability the same characteristics are given mutually excluding significance in various types of vulnerability. For example, in the definition and measures of social vulnerability and economic vulnerability, economic factors are in different places of typological hierarchy like in the definition of *Prevalent Vulnerability Index* (Cardona 2007) and the vulnerability and resilience indices of the *Small Island Developing States* (SIDS) (Briguglio/Cordina/Farrugia/Vella 2008). Numerous similarities and dissimi-larities as well as subjective approaches of that kind can be easily found in deepened studies of other measures and indices of vulnerability (Gall 2007).

Fourth, only with a few exceptions, in most ideas discussed above economic vulnerability was used in a descriptive way. The indices were predominantly designed as descriptive parameters reflecting threats and resilience in a static manner. No attempts could be found to give them a predictive character. Therefore it is necessary to develop the concepts of economic vulnerability and economic security with a broader reference to economic theory – macroeconomics – development theory and microeconomics – risk, decision-making, rational choice, limitations of rationality, public choice, information asymmetry and its consequences, etc. A comment is necessary whether risk, hazard, etc. can be treated as dynamic and uncertain and vulnerability as static. A deeper reflection on vulnerability concludes that it also has a dynamic character. Any external disturbance which can be named as risk or hazard is always coupled with properties of the entity under study. It is prediction of disturbances – risks, hazards, threats, etc. which is contributing to the emergence of vulnerability.

Fifth, as shown above where general definitions of vulnerability and of related terms were surveyed, there exists a significant lack of logical coherence in defining relations between risk, hazards, vulnerabilities that are illustrated with various mathematical formulae, which are sometimes contradictory.

Sixth, since 2007 economic vulnerability of entities at all levels of socio-political hierarchy has increased due to the disturbances on the financial markets worldwide. Thus, it is necessary to include financial dimensions in the discussion on economic vulnerability and economic security. A special role in the discourse on economic vulnerability and economic security must be assigned to limitations of prediction of social phenomena (Mesjasz 2008b). Although most are already well-known in econometrics, yet in economics and in finance special attention is given recently to various 'rare events' labelled with such metaphors as the famous "Black Swan" (Taleb 2007) or less famous but equally rare mysterious "Dragon-Kings" running away from the Zipf's Law (Power Law) ruling (Sornette 2009). Barriers of prediction are part of the limitations of economic vulnerability. Despite many interpretations, economic security is still lacking a deepened theoretical background drawn from economic theory.

4.4.2 Economic Vulnerability, Economic Security and Securitization

While many definitions and interpretations of vulnerability, economic vulnerability and economic security exist, an elaboration of their new preliminary framework interpretations may help to facilitate the discourse. It will never be possible to develop universal definitions of those terms so only a more detailed specification of their meaning is possible. The proposed framework interpretations are stemming from the following assumptions and ideas:

- fuzziness of definitions of economic vulnerability and economic security,
- unclear interpretations of the term 'economic' in the discussions on economic vulnerability and economic security,
- systemic interpretations of the concepts of security, vulnerability and securitization (Mesjasz 2008) having their roots in cybernetics and systems thinking,
- economic vulnerability embodies also all financial activities,
- existence of a typical 'disordered' discourse in which the absence of definitions leads to a strive for political dominance of concepts caused by individual or institutional authority and power.

Two fundamental interpretations of economic vulnerability can help in solidifying the conceptual background of studies on economic vulnerability.

1. Economic vulnerability is a dynamic relationship between a socio-economic entity (system, individual) and its broadly defined environment where any external sudden (predicted, predictable or unpredictable) disturbance and/or any constant external negative stressors undermine accomplishment of its basic economic functions (production, distribution, exchange and consumption) of the system or unit due to its limited capabilities to respond to that external impact, i.e. its capacity to

compensate the impact, eliminate the impact or protect itself from that impact.

2. Economic vulnerability is a dynamic relationship between a system (individual) and its broadly defined environment where external economic (emerging anywhere in production, distribution, exchange and consumption), sudden (predicted, predictable or unpredictable) disturbance and/or any constant economic external negative stressors undermine the accomplishment of any basic function of the system or unit due to its limited capabilities to respond to that external impact due to its capacity to compensate the impact, eliminate the impact or protect itself from that impact.

Based on these two interpretations of economic vulnerability, two mirror interpretations of economic security may be proposed. First, economic security is understood as absence of any kind of threats influencing fundamental economic processes of a socio-economic entity (system or individual). Second, economic security is understood as the absence of economic threats to all areas of the functioning of any area of a socio-economic entity (system or individual).

The above interpretations require additional comments. While the interpretations of 'economic vulnerability' represent all possible situations, the interpretations of 'economic security' do not include all possible contingencies. This especially concerns those cases when economic aspects of defence are considered – defence spending, links between the economic potential of a country and its military potential.

The interpretations proposed above may also be criticized for their universality, which is an absolute purposive feature. It is not the aim of this chapter to propose any comprehensive definitions of economic vulnerability and economic security. The framework interpretations can be used solely as a point of departure for more rigorous studies of economic vulnerability and economic security allowing to put the discourse on those topics in order and preventing applications of those terms in a superficial manner. It is not the only attempt to treat economic vulnerability in a more cautious and logical way instead of just labelling various phenomena with such terms as risk, hazard, challenge, etc. without reflecting on their meaning and without any reference to their earlier interpretations. Therefore in the framework interpretation of economic vulnerability, no discussion on risks and hazards is proposed. Economic risk and hazards are defined in a more precise way and the framework concepts of economic vulnerability and economic security can be treated solely as points of departure for better specified definitions of risk, threats, hazards, challenges, etc. These framework interpretations can be treated as a point of departure for an interpretation of securitization in the economic sector. Two questions should be asked: What is the sense of securitization in the economic sector? What are the links between securitization and vulnerability?

Securitization in the economic domain is very intricate and cannot be achieved in an unequivocal way. Given the multiple meaning of 'economic' in the security-related discourse, securitization may also have a dual meaning: 1) Securitization concerns the threats affecting economic activities; and 2) securitization addresses economic threats affecting all security domains, including also the economic domain. This line of reasoning proves that security and securitization are in some way cyclical and self-referential processes.

The next explanation concerns the relationship between securitization in the economic domain and economic vulnerability. Securitization allows us to identify existential threats and due to the fact that both types of economic security are interrelated with both types of economic vulnerability it may be concluded that securitization allows us to identify vulnerability only indirectly. This pattern of relationships between economic security and economic vulnerability is common for all domains of security and vulnerability. It is only becoming more intricate for the economic security sector (domain).

The literature on economic vulnerability and economic security, similarly as in the environment and social domains of security, shows that since several years the former concept has been applied more frequently than the latter one. It is especially surprising after the period of popularity and frequent applications of securitization in security theory in the 1990's and in the first decade of the 21st century.

The best explanation for that phenomenon arises from a deeper understanding of vulnerability and security and from the specificity of economic vulnerability and economic security, where double asymmetry can be observed. Firstly, economic vulnerability is easier to identify and analyse due to the difficulties with identifying existential threats and a relative simpler identification of characteristics describing a social entity or individual. Secondly, specific barriers of identification of risks, hazards and existential threats in all kinds of economic and financial activities only add to the easiness of shifting from securitizing moves in that domain to identification of characteristics of vulnerability. As was mentioned in the systemic interpretation of the links between vulnerability and security, al-

though they are both closely interlinked in all domains, in search for characteristics of vulnerability, existential threats are identified indirectly. This has a significant theoretical impact – it is easier to study directly the features of the system or individual and indirectly predicting external threats than trying to predict them in a direct way. Once again it refers to finance where an unclearly defined stability concept dominates the discourse in theory and policy, and the use of concepts of the global systemic financial risk is rare (Mesjasz/Rogowski 2005).

4.5 Conclusions

The above considerations on definitions and interpretations of vulnerability used both in a universal sense as well as in various social, environmental and economic contexts are by their very nature limited. They may be treated as to some extent representative, and as such, they allow to conclude on the general interpretations and applications of that term in reference to economic processes. They also identify the links between vulnerability and security both in a universal sense and in the economic domain. Relations between vulnerability, security and securitization can also be studied thanks to a more comprehensive understanding of all terms.

The main conclusion concerning universal and specific definitions of vulnerability is that terminological disorder in that field has become almost uncontrollable and in many instances the basic terms are used in a completely uncoordinated manner. A deepened study of applications of various concepts of vulnerability, including the economic one, leaves the reader with an impression of an 'overflow' of definitions and interpretations, scores of institutions and people dealing with that utterance in various circumstances. Inevitably reflections on the role of fashion in science come to mind. Except for a few works cited above, the definitions and interpretations are sometimes contradictory in a logical sense, e.g. confusions of *definiendum* and *definiens* in describing risk and hazard, and many similar examples. Such a terminological disorder has several theoretical and practical consequences.

In many cases the links between vulnerability and security and the economy in environmental and development studies may not be identified. A systemic framework interpretation of vulnerability and security can thus be treated as a point of departure of identifying the relations between vulnerability and security in a universal sense and in specific domains. Although vulnerability and security are logically symmetrical, in the recent discourse on environment, development and economy the dominance of a vulnerability-based over a security-based approach may be observed. Such a shift is caused by a relative simpler, and in consequence, less costly study of properties of a system or individual than studies of the necessary surrounding in the security discourse in which, especially in securitization, external and internal existential disturbances have to be predicted and securitized as threats.

The survey of definitions and interpretations of vulnerability leads also to a conclusion on a specific conceptual and institutional consequence of the definitional disorder. The lack of unequivocally dominating ideas, except for very general ones, creates a situation where a specific game of words is emerging in the discourse. It is not always necessary to provide a coherent set of ideas but just naming some concepts and then using them for institutional purposes. What could be a difference between 'resilience studies' and 'vulnerability studies' if such names are assigned to research teams and institutions? The situation is similar with the use of the term 'risk' in the names of more or less institutionalized research. Fuzziness of terms used in the 'game of words' allows an uncontrollable 'power game' on the knowledge wherever vulnerability and associated terms are applied in development and environmental studies and in economics.

Similar conclusions are also relevant for definitions and interpretations of economic vulnerability and economic security. Here the conceptual disorder can be somehow structured if a deepened interpretation of the meanings of the term 'economic' in considerations on vulnerability and security is borne in mind. The links between economic vulnerability and economic security also remain asymmetric with a dominance of the former. In addition, economic vulnerability better corresponds with theory and policy in those areas where the term human security is applied (food, gender, household and livelihood). For the following reasons, it is proposed to extend the use of the term economic vulnerability:

- simpler defining economic vulnerability,
- difficulties of securitization in the economic sector,
- autonomization of economic vulnerability from other forms of vulnerability where it was treated only as a component,
- increasing economic threats to developed and developing countries arising from the economic and financial turmoil on modern markets and also

from natural disasters. Many disturbances may create a kind of negative synergy unbearable even for the rich countries at the state level and for market and non-market institutions.

An extension of the applications of the concept of economic vulnerability should then include:

- recognition of the role of economic vulnerability outside the studies of environmental considerations and studies of poor countries,
- inclusion of developed countries into the research area of the studies of vulnerability, and of economic vulnerability in particular,
- studies of vulnerability of market institutions – manufacturing and service companies including the financial ones as well as broadly defined non-market institutions.

On the basis of the conclusions, further studies on the links between economic vulnerability and economic security should be focused on the following issues.

- First and foremost it is necessary to elaborate a more coherent terminology of theory and policy-making concerning economic vulnerability, even in a minimal degree. Perhaps, similarly as is done in management, some standards could be helpful, e.g. (ISO 31000 2009) or similar concepts proposed in risk management in market organizations and non-market institutions. Obviously, it will not be possible to elaborate a unique standard but the present chaos leads to confusion and a waste of resources.
- Second, ordering of terminology should be accompanied by the studies on the links between hierarchy of economic systems or actors and systemic aspects of economic vulnerability. It should include all levels of hierarchy – beginning at the global one and ending with the individual.
- Third, more attention should be given to sound theoretical economic foundations of the studies of economic vulnerability. Rigorous economic thinking is often used in the studies of economic vulnerability but still in too many instances the terms vulnerability and economic vulnerability are used as void labels ('Leerformel').

5 Debt Relief, Economic Growth and Poverty Reduction in Low-Income Countries

Lidia Mesjasz

5.1 Introduction

The debt problem of poor countries has attracted considerable public attention in the 1990's through the Jubillee 2000 campaign for debt cancellation. The United Nations' Millennium Declaration and the associated *Millennium Development Goals* (MDGs) have played an important role in the recognition of debt as a global issue by focusing the world's attention on the plight of the poorest, and making debt relief one of the development goals. In Monterrey in March 2002 the international community agreed that external debt relief could play an important role in financing development and accelerating progress toward the MDGs.

Unlike the earlier debt crisis of the 1980's that broke out suddenly in middle-income countries in Latin America and was largely resolved by the early 1990's, the *low-income countries* (LICs) debt crisis has developed gradually, and arguably worsened to this day. It primarily involves the poorest of the poor nations, especially those of sub-Saharan Africa.[1] LICs' debt crisis can perhaps be best described as a chronic syndrome. Much of the debt of poor countries is owed to official lenders, including individual governments, and multilateral institutions, such as the World Bank and the *International Monetary Fund* (IMF). Low-income countries – unlike the middle-income countries – had to rely on official loans, since their access to private capital markets was very limited. By the early 1990's, debt service was taking a large and rising share of the public budget in poor countries, and donors came under mounting pressure to resolve the issue. The Paris Club[2] creditors provided repeated debt reschedulings on increasingly more concessional terms that involved debt reduction. But this only postponed the resolution of the growing problem of unsustainable debt burdens that could not have been serviced without seriously compromising the poor countries economic growth. Gradually it became clear that a more far reaching programme of debt relief was needed. In 1996, the *Heavily Indebted Poor Countries* (HIPC) Initiative was launched with the aim of cutting debt to sustainable levels, and thereby releasing resources for development spending, including poverty reduction. After further public pressure, this was followed by the *Enhanced HIPC Initiative* of late 1999 which raised the amount of debt relief, accelerated the process and tightened the link between debt relief and the objective of poverty reduction.

The analysis of the HIPC Initiative presented in this chapter addresses directly and indirectly the links between broadly defined security and debt relief of the poor countries. Often a high level of indebtedness of developing countries is either a consequence or a cause of main security threats emerging in all sectors in those countries that undermine international security at the regional, and even at the global level.

The HIPC Initiative has been the most sweeping debt relief programme so far developed by official creditors for low-income countries. However, the HIPC Initiative raises many issues:

1. Can the debt relief Initiative reduce debt burdens of HIPCs to sustainable levels?
2. Will debt relief stimulate economic growth and development spending, including pro-poor spending, contributing to poverty reduction in HIPCs?

1 Low-income countries according to the World Bank classification are those whose gross national income (GNI) per capita in 2008 was 935 US dollars or less. This group consisted of 43 countries in 2008.

2 An informal group of official creditors from currently 19 of the world's richest countries, which provide financial services such as: debt restructuring, debt relief, and debt cancellation to indebted countries and their official creditors.

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3. Is debt relief a viable solution to broader economic development problems?
4. What could be a potential impact of debt relief on economic and human security in low-income countries?
5. What will be the likely impact of the current global financial and economic crisis on achieving the goals of the HIPC Initiative?

These are crucial questions this chapter seeks to answer. There has been little rigorous analysis on the development effects of debt in low-income countries (as opposed to the work done on middle-income countries), and the likely impact of debt relief under the HIPC Initiative. Accordingly, this chapter aims to improve our understanding of the economics of debt relief, including its potential for accelerating growth and reducing poverty in low-income countries. This is especially important for an assessment of how much the HIPC Initiative did contribute to achieving the Millennium Development Goals. The current global economic crisis seriously challenges these goals.

With its initial overview of history, methods and results of debt relief policy of the poor countries by the creditor governments and international financial institutions, the chapter offers a point of departure for further, more advanced considerations on the links between debt of the poor countries and its impact on their broadly defined security. Economic considerations can also be applied as an instrument or methodology for studying the impact of poverty and debt reduction on security, with special attention on human security.

After a preliminary assessment of the links between debt relief and economic and human security in poor countries (5.2), theoretical arguments for debt relief are presented (5.3), and a brief history of the debt crisis and of debt relief initiatives for low-income countries are described (5.4). This is followed by a survey of empirical evidence on the debt and growth relationship (5.5), an analysis whether the HIPC Initiative has met its objectives (5.6), a preliminary evaluation of the likely impact of the current economic crisis on achieving these objectives (5.7), and by concluding remarks (5.8).

5.2 An Economic and Financial Security Context for the Analysis of Debt Relief

There is little doubt that the debt burden of a majority of the least developed countries constitutes a significant factor of broadly defined security of those countries as well as of their neighbours. It also affects directly and indirectly security at regional and even at global levels. Similarly as in most examples of the discussion on economic security a specific dichotomy can be observed. On the one hand self-evident links between official sovereign debt and security in all sectors are easy to identify. At the same time, however, direct links between indebtedness and the broadened concept of security have not yet been studied thoroughly.

Economic security remains probably the most difficult idea of the discourse on broadened security. Referring to various ideas of economic security developed in the literature (Cable 1995; Buzan/Wæver/de Wilde 1998; Kahler 2003; Nesadurai 2005; Mesjasz 2008a), it must be stated that the studies on the links between indebtedness of the poor countries and broadly defined security should be focused on the following issues:

- theoretical considerations on the role of external indebtedness as an element of economic security,
- direct and indirect impact of indebtedness as a determinant of security in all sectors,
- official debt as a determinant of a country's development, and of economic and human security in particular,
- securitization of threats stemming from official and commercial debts of poor countries,[3]
- debt relief as an element of security policy of the rich countries in relation with poor countries.

When studying the role of sovereign debt as an element of broadly defined economic security, it should firstly be answered whether a special role of financial security should be exposed. It is especially an important question which is becoming more urgent under the impact of the turmoil on the financial markets. With regard to economic and financial security, the latter may be seen as a part of the former and the specification of financial security, especially at the state level, should be left for further theoretical considerations.

Financial security is usually well-defined at the micro level as protection against poverty and safety of income of individuals and households and prospects of the future financial guarantees of welfare in case of sickness and retirement. Financial security of interme-

3 Securitization is understood herein in the sense proposed by Copenhagen School (Buzan/Wæver/de Wilde 1998) and not as in financial risk management.

diate actors, e.g. companies is most difficult to define. At the national or international level financial security can be associated either with vaguely defined financial stability (Schinasi 2006; Mesjasz 2008a) or with the impact of the overall financial stance on other security sectors.

Sovereign debt plays a decisive role in all sectors of security in the poor countries. Several examples show that unpaid debt of the state can be both the cause and effect of the situation in the failed states and their consequences, e.g. terrorism and piracy, a cause of local conflicts and of an internationalization of local conflicts, and due to vulnerability to natural disasters. Frequently all those factors occur in parallel as in the case of Somalia or Sudan. Therefore debt relief offered by the creditor country governments and international financial institutions can be viewed as a significant element of the security policy of the affected countries.

Although debt relief is addressed by states and governments, it should also be considered that individuals are the main indirect addressees of that relief. Therefore it should be emphasized that an improvement of human security, and not only of poverty alleviation and eradication, can be also seen as an ultimate goal of this assistance for poor countries.

If debt relief works, it can be argued that it could reduce security risks by making a population more satisfied. But the majority of debt relief efforts have failed; in fact, in many cases relief itself has created worse conditions. Without an effective use of funds that may be made available through a reduced debt service there will be no improvement. Improving conditions in the least developed and usually highly indebted countries could lead to a limitation of security threats but the question is arising whether this form of assistance is effective.

Securitization of indebtedness of developing countries, not in terms of financial risk management, but as understood by the Copenhagen School appears as another important element of the security discourse. Although securitization of economic threats is still a major obstacle, in the case of debts of developing countries the situation seems easier to analyse. A high level of indebtedness is always a threat influencing other security sectors and threatens human security. However, such securitizing moves, due to their complexity, must be preceded by deepened financial and economic analyses of indebtedness and debt relief programmes.

Finally, debt relief is obviously an important instrument of direct policy-making of rich towards poor countries.[4] It can also be used (and abused) as a narrowly defined instrument of foreign policy and influence. In another framework, as exposed by the United Nations, debt relief can also be perceived as an important instrument of security policy of rich countries –viewed in social, economic, political and ethical terms – due to its impact on development of poor countries, on the elimination of poverty and on other threats to human security.

The above survey of potential links between debt relief of poor countries and broadly defined security shows that any deepened security considerations relating to this form of assistance should be accomplished based on thorough economic, financial, institutional and political analyses. A discussion on debt relief can be viewed as a first step into that direction.

5.3 Theoretical Arguments for Debt Relief

In economic discussions four basic arguments for providing debt relief to low-income countries are noted: a) the moral, b) the 'overlending', c) the 'additional financing', and d) the 'debt overhang' argument (Varma 2006).

- The *moral argument* is that it is unjust for rich countries to try to collect the debts owed to them by countries that are desperately poor. This line of argument that was strongly promoted by civil society organizations, religious groups, and some other advocates is exemplified by Jeffrey Sachs' statement: "No civilized country should try to collect the debts of people that are dying of hunger and disease and poverty."[5] The second rationale within the same moral line of reasoning is that some debts were 'llegitimate' in the first place as they were contracted by dictators supported by foreign governments (such as Mobutu Sese Seko in Zaire, now the Congo), and used for their personal and nefarious purposes. Thus, the country should not be responsible for paying such debts; they are solely the liability of the creditor who has made improper loans (Adams 1991; Hanlon 2006). Although the moral argument resonates

4 Commercial debt can be managed by the states only indirectly and therefore should be a topic for separate studies.

5 The statement made at the UN conference on hunger in Africa in July 2004 is quoted by Andrew England, in: *Financial Times Syndication Service*, 7 October 2004 (England 2004).

strongly with anyone who feels compassion for the plight of the world's poor, it would essentially mean no further lending to poor countries, which would then be limited to accessing grant resources to finance their development. This would imply a shrinking of the total resources available to help poor countries invest and grow.

- In the second argument of 'overlending' debt relief is an efficient way of cleaning up the balance sheet in the event that lenders have overlent, partly in an effort to ensure positive net flows to poor countries. If provided in this context, however, debt relief might create a moral hazard: if the 'overlending' argument was valid last time, why should it not be valid again next time? Such reasoning might lead developing countries – possibly the same ones as before – to borrow heavily and recklessly in the future, in the expectation that they will once again receive debt relief should the perception again arise that creditors have overlent.
- The third, and perhaps the most reasonable argument for debt relief in low-income countries, is that of 'additional financing'. It states that debt relief can be an important alternative source of financial flows to the poorest countries that desperately need financing to meet their basic needs. Debt relief offers a vehicle for the international community to provide the additional resources needed to meet the MDGs in a predictable and easily accessible form. But this argument also has its shortcomings. *First*, the additionality of debt relief cannot be taken for granted. Debt relief can only generate a limited amount of resources, especially for HIPCs, much of whose debt has already been forgiven, and most of whose remaining debt is at very low interest rates. *Second*, there may be better ways to provide MDG financing, as debt relief is allocated based on past lending decisions and is small relative to new development assistance.
- The fourth, most popular, argument in support of debt relief initiatives refers to 'debt overhang' (Krugman 1988; Sachs 1989). It has been stated that highly indebted countries benefit very little, if ever, from the returns on any additional investment because of the debt service obligation. Large debt obligations can be seen as a high tax on investment, policy reforms and development, because a significant part of the gains from economic adjustment would go to foreign creditors and not to the country itself. Creditors should therefore offer debt relief to countries with large stocks of external debt in order to reduce future debt obligations. This would increase the share of any marginal gains from economic adjustments that goes to the debtor country and create incentives to make these adjustments. This strategy could end up in a win-win-situation by not only easing the debt burden of debtors but also increasing future repayments to the creditors (Dijkstra/Hermes 2001).

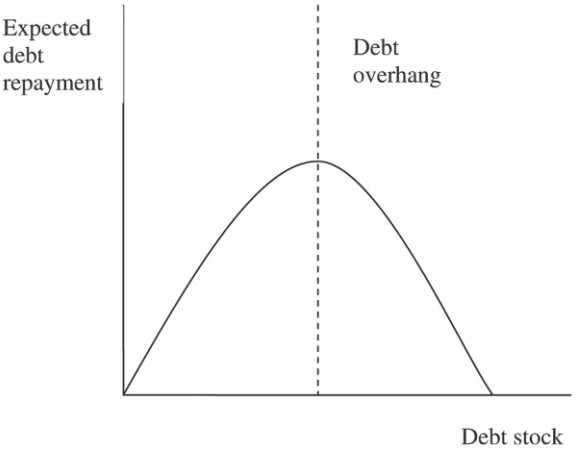
The disincentives for the government to carry out economic reforms caused by excessive external debt are of special concern in low-income countries, where an acceleration of structural reforms is needed to sustain higher growth to meet the Millennium Development Goals. Similarly important is private investment that is discouraged by increasing uncertainty stemming from high indebtedness. As the size of the public debt increases, there is growing uncertainty about actions and policies that the government will resort to in order to meet its debt servicing obligations. In particular, private investors may expect that the government may resort to inflationary finance or future tax increases that could be required to service public debt (Agénor/Montiel 1996). The extensive literature on uncertainty and investment suggests that in highly uncertain and unstable environments, even if the fundamentals are improving, potential private investors wait and see before taking new investment decisions (Serven 1997). Moreover, investment may be misallocated to activities with quick returns, rather than long-term, higher-risk irreversible projects which would be more conducive to long-run productivity growth. Misallocated resources and less efficient investment projects could thus contribute to slower productivity growth.

Since debt acts as a tax on debtors' resources that deters profitable investment opportunities, the debt overhang argument is usually illustrated in a 'debt Laffer curve' (figure 5.1). The concave curve traces the value of expected repayment as a function of outstanding debt: as outstanding debt increases beyond the threshold level, the expected repayment begins to fall as a consequence of the adverse effects mentioned above (Cohen 1993). On the upward-sloping or 'good' section of the curve, increases in the face value of debt are associated with increases in expected debt repayment, while on the downward-sloping or 'bad' section of the curve increases in the face value of debt reducing expected payments. Thus, debt relief becomes a rational choice for both creditors and debtors, when a debtor is said to be on the 'wrong side' of the Laffer curve. Although the debt overhang theories have not

explicitly traced the effect on growth, it may be possible to extend and translate the 'debt Laffer curve' posited by these models into a Laffer curve for the effect of debt on growth. Since the peak of the debt Laffer curve shows the point at which rising debt stocks begin acting as a tax on investment and policy reforms (that is where debt overhang begins), the peak may relate to the point at which debt begins to have a negative marginal impact on growth (Pattillo/Poirson/Ricci 2002).

Not only high debt stocks but also excessive burden of *debt service* actually paid can negatively affect growth. Its adverse effect on growth is by crowding out private investment (Cohen 1993) or altering the composition of public spending. Higher external interest payments can increase a country's budget deficit, thereby reducing public savings. This, in turn, may either raise interest rates or crowd out the credit available for private investment, depressing economic growth. Larger debt-service payments can also inhibit growth by squeezing the public resources available for investment in infrastructure and human capital. Even if HIPCs borrow at high concessional terms, so that the debt service is lower than in middle-income countries, their revenues are much lower because of weak tax systems and scarce enforcements. As a consequence, even if external debt service is not always large as a share of GDP, it is nonetheless a relevant fraction of revenues, so that it could really be a constraint to the government budget. On the other hand, as HIPCs are usually net recipients of resource transfers from external creditors and donors, the adverse effects of debt service on real economic activity are mitigated.

Figure 5.1: Debt Laffer Curve. **Source:** Pattillo, Poirson and Ricci (2002).



In addition, the *uncertainty* about the future debt service burdens may also have negative effects on economic growth because it may hamper much needed government policies, which in turn reduce the incentives to private investors (Dijkstra/Hermes 2001). High instability of annual debt service payments increases the uncertainty with respect to the implementation of government policies. If governments do not have a clear picture of the annual debt service payments, they do not know either how much money will be available for carrying out economic reforms, investments in infrastructure and spending on social programmes. The uncertainty reduces the effectiveness of government policies. This in turn will adversely affect private investment and may even stimulate capital flight. Both the erratic government policies and lower private investments will contribute to lower (and perhaps even negative) rates of economic growth.

Heavily indebted poor countries are particularly confronted with unstable payment patterns. This instability may come from several sources. Firstly, most HIPCs are regularly negotiating with bilateral and multilateral donors about the terms of debt service repayments. The outcomes of these negotiations are difficult to predict, contributing to the uncertainty about the annual debt service payments due. Secondly, the uncertainty about debt payments can be partly explained by the way the debt servicing system is organized. In most cases, these countries only pay part of the debt service due; the rest is postponed. A substantial part of the debt service payments actually made is paid for by new concessional loans and grants. Yet, for governments of HIPCs it remains highly uncertain how much is exactly available to pay debt service from own and external sources. Moreover, a part of the grants are earmarked for special purposes, since the donors do not want their aid money to be used for payment of debt service. These characteristics of the debt servicing system in turn contribute to erratic patterns of debt service payments actually made.

The HIPC Initiative can lower the uncertainty of debt service payments by cutting the number and/or frequency of negotiations on the terms of debt payments as well as on new loans and grants. In addition, the irrevocable nature of the HIPC debt relief upon reaching the completion point may reduce the uncertainty faced by recipient countries about their ability to use grants to service debt, by providing a credible multiyear commitment. This may help the governments of debtor countries to plan more carefully revenues and expenditures, making them more predicta-

ble, which in turn may stimulate private investment and economic growth.

When seen from a broader perspective the above arguments to a large extent coincide with security reasons, which particularly concern economic and human security. Economic analysis extended to ethics can thus be treated as an initial step in studying the impact of debt relief on all security sectors in poor countries.

5.4 Brief History of the Debt Crisis and Debt Relief Initiatives of Low-income Countries

The low-income countries' debt crisis – unlike the middle-income Latin American countries' debt crisis that broke out suddenly in 1982 and was largely resolved by the early 1990's – has gradually developed, largely invisibly, and worsened to this day. It originated from an inadequate use of large volumes of borrowed funds that were not put in growth-enhancing projects and policies that would enable to attain higher growth and poverty alleviation. Several factors were responsible for the poor link between borrowing and growth in most crisis countries. Perhaps the foremost of these were severe shocks such as droughts or prolonged declines in prices of primary commodities – the predominant export category for many low-income countries. Commodity prices fell sharply in the early 1980's and remained low for many years. Other factors included, depending on the country, waste of resources due to policy deficiencies, poor governance, or weak institutions, inadequate debt management, lack of adjustment to an evolving economic environment, as well as political and security factors such as civil wars and social unrest, which often had devastating economic consequences (Brooks/Cortes/Fornasari/Ketchekmen/Metzgen 1998). Some borrowed resources were simply embezzled by corrupt governments and never used for the purposes for which they were intended (Adams 1991).

During the 1970's and 1980's external borrowing to low-income countries increased significantly when creditor governments provided official export credits in order to stimulate their own exports, and export credit guarantees as a complement to direct grants and concessional *Official Development Assistance* (ODA) loans in their overall development cooperation policy (Daseking/Powell 1999).[6] The debt burden of low-income countries rose steadily. By the early 1980's many low-income countries were brought to the point of economic collapse by the years of economic mismanagement. It led to severe security consequences in all traditional sectors but undoubtedly it was human security which was affected the most. Therefore any debt relief for those countries had become an important instrument of improvement of economic security of individuals and, in a broader sense, as an instrument of amelioration of human security.

The international financial community's reaction to the unfolding debt crisis in the 1980's differed for middle-income and low-income countries. In the early 1980's, the prevalent paradigm was that the debt crisis was a problem of illiquidity, and that countries could 'grow out of debt', given temporary debt servicing relief. The Baker Plan launched in 1985 was mainly directed at middle-income Latin American countries whose commercial debt was so high that if they defaulted this could have created a threat to the international banking system's stability.[7] Under the Baker Plan it was assumed that a 'flow rescheduling' of debt without any reduction in its *net present value* (NPV),[8] together with provisions of new lending by commercial banks and creditor governments, conditional on the implementation of an IMF-approved structural adjustment programme, would bring about a solution.[9] New lending would lead to increased investment, which would eventually lead to greater economic growth.

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6 ODA comprises loans or grants to developing countries and territories provided by donor governments and their agencies for the purpose of promoting economic development and welfare. If it is a loan it must be extended on concessional financial terms that are, with a grant element of 25 per cent or more, calculated as the *net present value* (NPV) of the future payment stream discounted at 10 per cent.

7 The plan was named after the then U.S. Secretary of the Treasury, James Baker.

8 The NPV of debt is defined as the sum of all future debt-service obligations (interest and principal) on existing debt, discounted at market interest rates. Whenever the interest rate on a loan is lower than the market rate the resulting NPV of debt is smaller than its face value, with the difference reflecting the grant element (expressed as a fraction of the debt stock). Given the concessionality in loans extended to LICs, the NPV of debt is a more relevant metric for evaluation than the face value of debt as it takes into account the degree of concessionality present in the stock of debt.

9 A 'flow rescheduling' of debt means that interest and principal payments are postponed for some period in the hope that economic growth in the meantime will make it easier for the debtor to repay the debt.

Unfortunately, net new lending was too modest to spur economic growth and adjustment programmes generally failed to boost borrowers' ability to repay loans. The typical austerity programmes included spending cuts, tighter monetary policy to control inflation and liberalization of foreign-exchange regulation in order to make imports more expensive and exports more competitive. In countries that practiced austerity programmes, private and public investment usually fell, unemployment climbed, poverty spread, and the improvement in the balance of payments was at most modest (Killick 1998). Between 1980 and 1990, the *gross domestic product* (GDP) per capita fell 7 per cent in both Latin America and Africa (Maddison 1995: 21–22). But external debt continued to grow both in nominal and in relative terms.

In the meantime, commercial banks started setting aside loan-loss reserves, that eventually allowed them to accept losses in face value of debt by writing down outstanding obligations in the late 1980's. Debt was traded on secondary markets at a substantial discount to face value, confirming the market's scepticism that debt would ever be repaid in full. In the late 1980's the paradigm shifted from one of a liquidity problem to a 'debt overhang problem'. This shift led to the Brady Plan in 1989, which used market-oriented debt reduction schemes, such as debt buybacks and equity swaps, to solve the debt crisis.[10] Again, mainly Latin American countries were involved. Commercial banks used this opportunity to leave the market by making use of their previously accumulated loan-loss reserves. From 1989 to 1995, 13 countries with US$191 billion in commercial bank debt completed debt and debt service reduction operations, which provided for the reduction of nearly 20 per cent in the nominal value of commercial bank debt (World Bank 2003: 60). The overall debt situation of those countries improved, which allowed them to regain access to international capital markets till the mid 1990's. By that time Latin America's debt crisis was over.

But the low-income countries debt problem remained unresolved. Official creditors, which dominated lending to LICs were slower to compromise and more willing to take risks than commercial creditors. While commercial creditors typically reduced their exposure and cut their losses in response to LICs liquidity crisis, official creditors continued to provide comprehensive non-concessional 'flow rescheduling' in the Paris Club, new lending from several multilateral agencies, as well as some additional export credits from creditor governments. By doing so official lenders were able to put pressure on borrowers' governments to implement harsh economic reforms advised by the IMF as well as conceal their imprudent past lending. One reason why the process was able to continue for so long was that in practice the rescheduling approach worked for both creditors and debtors, at least in the short run. Flow rescheduling reduced pressure on official donors to find other – potentially more costly – approaches to ensuring fully financed adjustment programmes in LICs. The industrial country governments had no desire to provide additional direct finance to low-income countries. All in all, the approach allowed for substantial cash flow financing continuing to be made available to LICs during the 1980's. Unfortunately, much of the money provided was not used effectively, and the debt stocks continued to grow. Consequently, a severe debt overhang had arrived by the late 1980's. The nominal stock of HIPCs debt increased from US$55 billion in 1980 to US$183 billion in 1990 (World Bank 1997: 42). On average the net present value of debt as a ratio to exports for HIPCs rose from below 150 per cent in the early 1980s to some 800 per cent by the mid-1990s (Varma 2006).

A 'flow rescheduling' in the Paris Club involved simply a delay in repayments during the IMF-supported economic programme. As the 1980's progressed, the LICs rescheduling increasingly involved all or most principal and interest payments that were rescheduled over a longer period of time. From 1976 to 1988 the Paris Club approved 81 non-concessional flows rescheduling with 27 of the countries now identified as HIPCs. They allowed for payments equivalent to about US$23 billion to be delayed into the future. Nevertheless, the debt service paid by HIPCs increased from about 17 per cent of exports on average in 1980 to a peak of about 30 per cent of exports on average in 1986, although this was less than the scheduled debt service ratios (Daseking/Powell 1999: 5–7).

In the late 1980's the notion of debt overhang gained prominence among policy makers dealing with debt of low-income countries. Krugman (1988) and Sachs (1989) argued that highly indebted poor countries were on the 'wrong side' of a 'debt Laffer curve', and suggested that writing down a debt overhang would raise countries' incentives to invest domestically and therefore increase the available surplus used for debt repayment. Official creditors were forced to accept rescheduling on concessional terms that in-

10 The plan was named after then US treasury secretary Nicolas Brady.

volved reduction in the present value of the debt outstanding. The first initiative by the Paris Club creditors that included an element of forgiveness in non-concessional debt rescheduling, was taken at the Toronto G-7 summit in 1988. G-7 leaders agreed that non-concessional debt of African countries that are eligible to borrow only from the *International Development Association* (IDA), could be reduced by up to 33 per cent in net present value terms. In 1990, these terms were extended to non-African countries. From 1988 to 1991, 20 LICs received rescheduling on Toronto terms, with about $6 billion of declining payments due to either being partially cancelled or rescheduled on a concessional basis (Daseking/Powell 1999: 9).

Although the Toronto terms had some beneficial effect, the international community realized before long that a deeper reduction in the stock of debt was needed to achieve sustained improvement in the debt situation of LICs. The Paris Club creditors accordingly increased the reduction to 50 per cent in 1991 (London or Enhanced Toronto terms) and to 67 per cent in 1994 (Naples terms). In the period since 1991, 26 rescheduling agreements were signed under the London terms, and a further 34 under the Naples terms – seven of which covered the full stock of eligible debt – with a total of about US$25 billion of payments being either partially forgiven or rescheduled at low interest rates over the medium or long term (Daseking/Powell 1999: 10).

Among other fundamental changes of the Paris Club creditors' approach three are worth mentioning. *First*, the Paris Club creditors adopted a flexible two-step approach to debt restructuring combining the restructuring of the debt service during a limited consolidation period[11] with the possibility of a later reduction in debt stock. *Second*, they allowed the possibility of rescheduling, under the Naples terms, of debts previously rescheduled under the Toronto or London terms. *Third*, some Paris Club creditors took important complementary measures, namely the forgiveness of the ODA loans by members of the *Development Assistance Committee* (DAC) of the *Organization for Economic Cooperation and Development* (OECD), and debt conversion arrangements under the Paris Club auspices and through special initiatives such as the U.S. Enterprise for the Americas Initiative and the Swiss Debt Reduction Facility.

The LICs have also benefited from debt relief from commercial creditors. The bulk of it was provided through debt buybacks supported by the *Debt Reduction Facility* (DRF) for IDA-countries only.[12] The DRF-supported operations typically involve a government buying back its public and publicly-guaranteed debts from external commercial creditors for cash at a deep discount, thereby extinguishing such debts from the books of the public sector. Since its creation in 1989, the DRF has supported 24 completed buy-back operations in 21 low-income countries, resulting in the extinguishing of some US$9 billion of debt. In 2008, its policies and practices were modified to enhance the speed and effectiveness of its support for commercial debt reduction operations. The DRF's current mandate expires on 31 July 2012 (IDA/IMF 2008: 24–25; World Bank 2008a).

Since 1990 the stock of HIPCs debt has grown more slowly, though by the end of 1995 it had reached US$215 billion. The slowdown reflected concessional rescheduling of loans, a shift towards greater provision of grants, commercial bank debt reduction, and widespread forgiveness of official development assistance loans (World Bank 1997: 42). The increasingly concessional rescheduling allowed bringing debt service payments of HIPCs down from 30 per cent of exports in 1986 to about 17 per cent in 1997, and below the aggregate level for LICs more generally. Moreover, the debt service paid by HIPCs has typically remained in the range of about 25–35 per cent of total gross external financing (including official grants) for most of the period since 1980. Rescheduling, therefore, has helped to ensure that after other official support was taken into account, overall official transfer (grants and loans minus debt service paid) to LICs remained highly positive throughout the period, averaging 13 per cent of GDP for the average borrowing country over 1984–1996 (Varma 2006). The present value of debt-to-exports ratios started to fall after 1992, reflecting increasingly concessional rescheduling terms, stock-of-debt operations, and more concessional new finance (Daseking/Powell 1999: 11–12).

Nevertheless, several LICs continued to be affected by unsustainable debt burdens, the situation in which they were no longer able to fully service their

11 Consolidation period in a debt restructuring agreement is the period of time during which debt service payments are to be consolidated and rescheduled or deferred.

12 IDA-only countries are those which only receive loans from International Development Association (the concessional lending arm of the World Bank) and usually have no access to international capital markets.

future debt obligations without seriously compromising economic growth. Debt workouts initiated by the Paris Club creditors since the late 1980's were far from effective in offering a permanent solution. The rescheduling and forgiven debt stock was only marginal compared to the accumulated debt stocks. By the mid 1990's, with an increasing share of debt owed to multilateral creditors, a new debt relief initiative was called for at the June 1996 G-7 summit in Lyon. The Paris Club creditors agreed to increase the level of debt reduction up to 80 per cent on net present value basis (Lyon terms). In response, the World Bank and the International Monetary Fund launched the *Heavily Indebted Poor Countries* (HIPC) Initiative in September 1996 to promote growth in the poorest, most heavily indebted countries by removing the debt overhang, provided that they adopted and carried out programmes of macroeconomic adjustment and structural reform. In contrast with earlier proposals for debt relief (also called 'traditional debt relief mechanisms'[13]), the HIPC Initiative also includes the relief of debt to multilateral institutions like the IMF, World Bank and the regional development banks.

After much criticism that the Initiative was too limited and too slow, the Enhanced HIPC Initiative was launched in September 1999 in line with the suggestions endorsed in the June 1999 G-7 summit in Cologne, where the Paris Club creditors agreed to provide up to 90 per cent reduction in debt on net present value basis. The Initiative's framework was enhanced to provide deeper, broader, and faster debt relief, and to strengthen the links between debt relief and poverty reduction. The external debt thresholds for eligibility were lowered, which enabled a broader group of countries to qualify for larger volumes of debt relief. A country becomes classified as a HIPC once the net present value of debt-to-exports ratio exceeds 150 per cent (previously 200–250 per cent on a case-by-case basis[14]) or the NPV debt-to-revenue ratio exceeds 250 per cent (previously 280 per cent). Other low-income countries that have smaller debt burden are not included in a heavily indebted poor countries' group. For example, in 2004 other LICs comprised of 18 countries whose NPV of debt relative to exports was on average 99.5 per cent (the ratio very similar to that of middle-income countries: 98 per cent; World Bank 2006a: 94).

The link between debt relief and poverty reduction was strengthened by requiring that resources released by debt relief were to be used to support poverty reduction strategies through *Poverty Reduction Strategy Papers* (PRSPs), which are developed by national governments in consultation with civil society. The new framework permitted countries to reach decision and completion points faster. A country reaches a decision point and receives interim debt relief just after implementing key reforms (a 3-year track record of good performance is no longer required). If it maintains macroeconomic stability, carries out key structural, and social reforms, and implements satisfactorily a Poverty Reduction Strategy for one year, enhancing human security, it then reaches the completion point, at which time the full amount of debt relief committed at the decision point is irrevocably provided by its creditors.[15]

In 2006, following the 2005 Gleneagles summit of the G-8, the HIPC Initiative was supplemented by the *Multilateral Debt Relief Initiative* (MDRI) providing additional support to HIPCs to help them reach the United Nations *Millennium Development Goals* (MDGs). The MDRI allows for 100 per cent relief on eligible debts by the IDA, the IMF, and the African Development Fund, for countries completing the HIPC process. In 2007, the Inter-American Development Bank also decided to provide similar debt relief to the five HIPCs in the Western Hemisphere.

The debt relief provided to LICs during 1988–2008 has significantly lowered their debt burden. By July 2008, the overall debt relief provided under the HIPC Initiative and MDRI as well as traditional mechanisms, and additional relief from some other creditors to the 33 post-decision-point HIPCs, amounted to US$76 in end-2007 net present value terms. As a result, the debt stocks of these countries have been reduced by about 90 per cent. Most of this reduction (76 per cent) has been delivered in the context of the HIPC Initiative and the MDRI. (IDA/IMF 2008: 29). The debt relief received by countries currently considered as HIPC from the Paris Club creditors through agreements signed between 1988 and 1998 is estimated at US$30 billion in end-1997 NPV terms. Over

13 The term 'traditional debt relief mechanisms' refers to debt relief initiatives by the Paris Club previous to the HIPC Initiative. Traditional debt relief generally allowed for debt reduction of up to 67 per cent in net present value terms.

14 These thresholds were based on early work, by Cohen (1996), among others, who found that the likelihood of debt default climbed rapidly after a country's NPV of debt-to-export ratio climbed above the 200–250 per cent range.

15 See Boorman and Ahmed (1999) for a discussion of the contents of the HIPC Initiative.

the same period, most OECD countries cancelled their ODA loans and LICs were able to extinguish about US$5 billion of commercial external debt through DRF-supported operations (Gamarra/Pollock/Primo Braga 2008).

5.5 Empirical Evidence of the Debt/Growth Relationship

The empirical literature analysing the debt/growth relationship has focused on testing the 'debt overhang' hypothesis. Despite extensive studies on this issue, we still have only a partial understanding of fundamental questions, such as:

- Beyond what level does external debt impair economic performance?
- What is the quantitative effect of debt on economic growth for the typical developing country?
- Is the effect of debt on growth nonlinear – in other words, does the effect on growth of additional debt vary, depending on the level of the debt stock?
- What are the channels through which debt affects growth?
- What effect on growth can we expect from the debt reduction associated with the HIPC Initiative?

The vast majority of the literature on debt overhang was developed in response to the Latin American debt crisis of the 1980's, and thus must be interpreted with caution in assessing the debt/growth relationship in a low-income country context. The channels through which debt affects growth varies between low and middle-income countries, due to the differences in their access to international capital markets, the development of the private sector, the presence of basic infrastructure and their macroeconomic environment. In addition, the aid that donors provide to low-income countries could mitigate any negative effects debt service obligations might have on their economic activity.

The empirical evidence on the existence of the debt overhang hypothesis has been rather mixed. For example, Cohen (1993) using data for a sample of 81 less developed countries finds no evidence for the general existence of a debt overhang. Yet, for the Latin American countries he shows that high debt had a negative impact on their growth performance. In a similar vein, Greene and Villanueva (1991), Serven and Solimano (1993), Elbadawi, Ndulu, and Ndung'u (1997), Deshpande (1997) and Chowdhury (2001) find evidence in support of the debt overhang hypothesis in middle-income countries. In contrast, Warner (1992) concludes that the debt crisis in middle-income countries did not depress investment.

Similar inconclusiveness can be found in the empirical studies on low-income countries. Cohen (1997) explicitly states that for African countries high debt was not a major cause for the low levels of economic growth in the 1980's and 1990's. In a similar vein, Birdsall, Claessens and Diwan (2004) argue that debt overhang argument is not relevant to HIPCs as net transfers to most HIPCs are positive (averaging 12 per cent of gross domestic product in Africa) and consequently there is no fear of a 'debt tax' – unlike in Latin America in the 1980's when net transfers turned sharply negative. Consequently, in their view the HIPC Initiative does not provide positive incentives for better policies. Also Arslanalp and Blair Henry (2004) reject the debt overhang hypothesis in LICs on the ground of positive net resource transfers they face. The authors find that debt relief provided under the HIPC Initiative had little impact on either investment or growth, contrary to countries benefiting from debt relief under the Brady Plan. They argue that the key constraint to investment in HIPCs is not tax uncertainty but an absence of functional economic institutions that provide the foundation for a profitable private sector. Hepp (2005) has found no significant effect of debt relief on growth rates in HIPCs, but argues that non-HIPCs have benefited significantly from debt service relief in the 1990's (a one per cent increase in debt service relief leads to a 0.2 per cent increase in the GDP growth rates). Depetris Chauvin and Kraay (2005) found practically no evidence that debt relief has raised economic growth, investment rates or public spending in low-income countries.

In contrast, Fosu (1999), Cohen (2000), and Clements, Bhattacharya, and Quoc Nguyen (2005) find evidence for the debt overhang effect in HIPCs. Clements and his co-authors conclude that debt appears to affect growth via its effect on the efficiency of resource use, rather than through its depressing effect on private investment. Presbitero (2005) finds the negative relation between external debt and growth in LICs, but her findings suggest that external debt does not reduce the level of investment in physical capital (because the continuous mechanism of new concessional borrowing, debt relief and rescheduling reduces the implicit tax perceived by the investor), but works in terms of misallocation of capital, lack of structural

reforms, and subsequent lower efficiency. Cassimon and Van Compenhout (2007) found a positive effect of debt relief on overall investment spending in African HIPCs, using vector autoregressive techniques. Clements, Bhattacharya, and Quoc Nguyen (2005) suggest that debt relief has significant indirect effect on growth in LICs through higher public investment. Berthélemy (2004) argues that the HIPC Initiative does increase incentives to policy reform (i.e. the debt overhang effect exists) in countries with good economic governance but not in HIPCs with bad economic governance. In the latter group, debt relief will at best act as a multi-year programme of aid flows targeted to poverty reduction.

Few studies have been able to determine how large the stock of external debt has to be for the debt overhang to have an effect. Clements Bhattacharya, and Quoc Nguyen (2005), using data for 1970–1999 for 55 low income countries, found that external debt slows growth only after its net present value reaches a threshold level of 20–25 per cent of GDP or 100–105 per cent of exports. These findings imply that the projected decline in external debt for the countries participating in the HIPC Initiative would directly add 0.8–1.1 per cent to their per capita GDP growth rates. Pattillo, Poirson, and Ricci (2002), in their study of 93 developing countries between 1969 and 1998, found that external debt began to have a negative impact on growth when its net present value exceeded 160–170 per cent of exports and 35–40 per cent of GDP. High debt appears to reduce growth mainly by lowering the efficiency of investment rather than its volume. It should be noted that the target debt level in the HIPC Initiative (150 per cent of exports in NPV terms) remains close to the estimated threshold above which the impact of debt on growth is likely to be negative. In other words, the HIPC Initiative might reduce the level of indebtedness just to a level where a new increase in debt would have a negative impact on growth.

In a follow up study Pattillo, Poirson and Ricci (2004) estimated that halving the 2000 level of debt in the HIPCs is likely to increase the annual average growth rate by 0.5 to 1 per centage point. In the next study (Pattillo/Poirson/Ricci 2004a) the same authors applied a growth-accounting framework to a group of 61 developing countries over 1969–1998 and found that doubling their average external debt level reduces growth of both per capita physical capital and total factor productivity by almost 1 per centage point. In other words, large debt stocks negatively affect growth by dampening both physical capital accumulation and total factor productivity growth.

Relatively few empirical studies have tested the hypothesis of debt service effects on economic growth, and the available evidence is mixed. Elbadawi, Ndulu, and Ndung'u (1997), for example, find a statistically significant relationship between debt service (as a share of exports) and growth in Sub-Saharan Africa, while Fosu (1999) finds no such relationship for countries of that region. Using a broader set of countries, Pattillo, Poirson, and Ricci (2002) also find no statistically significant relationship between debt service and growth. However, Greene and Villanueva (1991) find that external debt service dampens private investment, while Serieux and Samy (2001) find a similar link between debt service and total investment. Hansen (2004) finds that debt service relief in HIPCs can boost economic growth provided that it is additional to other resource transfers. He estimated that 1.3 per centage points decline in the annual debt-service to GDP during 2001–2005, would increase the average annual growth rate of about 0.2 per centage points, if this reduction was additional. For a large sample of developing countries, including some HIPCs, Savvides (1992) finds that debt service crowds out public investment spending. The same effect was observed in low-income countries by Clements, Bhattacharya, and Quoc Nguyen (2005), who found that the crowing-out effect intensifies as the ratio of debt service to GDP rises. On average, every per centage point increase in debt service as a share of GDP reduces public investment by about 0.2 per centage point, implying that reducing debt service by about 6 per centage points of GDP would raise public investment by 0.75–1.0 per centage point of GDP, which in turn result in an increase of about 0.2 per centage points in growth. These findings suggest that one way for country authorities to raise growth and combat poverty would be to allocate a substantial share of debt relief to public investment.

Also Presbitero (2005) finds a very strong crowding out effect of total investment in low-income countries, while there is no evidence of liquidity constraints in middle-income countries. On average, a one per cent increase in the debt service to GDP ratio reduces the total investment rate by almost 0.4 per centage point in low income countries. Presbitero also notices a very high sensitivity on investment to economic policies, but only in LICs, where a one point upward shift in the *Country Policy and Institutional Assessment* (CPIA)[16] add about 2 per centage points to the investment rate. In middle-income coun-

tries, the institutional indicator is not significant, suggesting that, probably, over a certain threshold, institutions and policies are no more likely to boost investment. This result underlines the relevance that should be given to economic and structural reforms in the poorest countries, in order to grant a minimum level of economic management to trigger investment and economic growth.

Very few studies have empirically analysed the relationship between the uncertainty of debt service payments and economic growth. Oks and Van Wijnbergen (1995) find that instability of debt service payments did matter for Mexico in 1988–1990. In particular, they show that the Brady initiative led to a smoothening of external resource transfers, which reduced the uncertainty about future exchange rate crises. This, they argue, stimulated private investment, which contributed to regaining growth in Mexico in the early 1990's. Dijkstra and Hermes (2001) find supportive evidence for the relationship between the uncertainty of debt service payments and economic performance for HIPCs. They conclude that debt relief may contribute to regaining growth by reducing uncertainty with respect to the debt service payments, which in turn may increase the effectiveness of government policies and consequently provide the private sector with positive signals about the future profitability of their investment.

In sum, the existing empirical literature provides diverging conclusions on the debt/growth relationship. The reasons for that might be different samples in terms of countries and time span, as well as different operationalizations of variables. There is limited evidence on how the stock of external debt and debt service affect growth, particularly in low-income countries. There is scope for additional work to clarify the size of these effects, especially for low-income countries that are benefiting from debt relief. Furthermore, more work is needed to explore the channels through which debt affects growth.

5.6 Growth and Poverty Effects of the HIPC Initiative

This section seeks to answer the question whether debt relief granted to low-income countries under the HIPC Initiative has positive effects on their growth performance and poverty reduction. The Enhanced HIPC Initiative has three objectives:

- to help countries achieve debt sustainability by reducing the excessive debt burden and providing a permanent exit from debt rescheduling;
- to promote growth by removing the debt overhang;
- to reduce poverty by freeing up resources for higher social spending.

By end of July 2008, 33 out of 41 HIPCs had passed the decision point and qualified for the HIPC Initiative assistance. Of those, 23 countries reached the completion point and qualified for irrevocable debt relief under the HIPC Initiative and the MDRI. The debt relief committed to the 33 post-decision-point HIPCs amounts to US$76.5 billion (in end-2007 net present value terms), including US$25.4 billion under the MDRI (table 5.1). On average this debt relief represents about 50 per cent of these countries' 2007 GDP. The debt relief accorded to 10 decision-point countries will not become irrevocable until they pass the completion point. A further 8 countries, referred to as pre-decision-point countries, are potentially eligible for the HIPC Initiative debt relief (having met the income and indebtedness criteria), pending the agreement of macroeconomic reforms, poverty reduction strategies, and/or arrears clearance plans[17]. The main obstacles to the other eight countries' progress under the Initiative are of a political or security nature. Many of them have been beset by civil wars and cross-border armed conflicts. Thus a kind of vicious circle emerges. Security cannot be improved without debt reduction, which, in turn, cannot be implemented without ameliorating security conditions. Looking from that point of view it may be worthwhile to reconsider the debt relief programmes as to make them less prone to the impact of that bootstrap effects.

16 CPIA, developed by the World Bank, assesses the quality of a country's policy and institutions in the sense of creating a good environment for sustainable growth and poverty reduction (World Bank 2007).

17 Completion-point countries include: Benin, Bolivia, Burkina Faso, Cameroon, Ethiopia, the Gambia, Ghana, Guyana, Honduras, Madagascar, Malawi, Mali, Mauritania, Mozambique, Nicaragua, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Tanzania, Uganda, and Zambia. Decision-point countries include: Afghanistan, Burundi, Central African Republic, Chad, the Democratic Republic of the Congo, Liberia, the Republic of Congo, Guinea, Guinea-Bissau, and Haiti. Pre-decision-point countries include: Comoros, Côte d'Ivoire, Eritrea, the Kyrgyz Republic, Nepal, Somalia, Sudan, and Togo.

Table 5.1: HIPC and MDRI: Estimates of Debt Relief (end of 2007 NPV terms, in billions of US$). **Source:** World Bank: *HIPC-At-A-Glance-Guide* (Fall 2008); at: <http://siteresources.worldbank.org/INTDEBTDEPT/Resources/Debt_PocketBroch_Fall08.pdf> (3 of 6).

	HIPC	MDRI	HIPC and MDRI
All HIPCs	71.2	28.1	99.3
23 Post-Completion-Point HIPCs	34.9	22.6	57.5
10 Interim HIPCs	16.1	2.8	19.0
8 Pre-Decision-Point HIPCs	20.1	2.7	22.8

Table 5.2: Debt Indicators of 33 Post-Decision-Point-HIPCs in 1999 and 2007 (in per cent). **Source**: World Bank 2008: *HIPC-At-A-Glance-Guide* (Fall 2008); at: <http://siteresources.world-bank.org/INTDEBTDEPT/Resources/Debt_Pocket Broch_Fall08.pdf>: (4 of 6).

	1999	2007
NPV of debt-to-exports	440	128
NPV of debt-to-GDP	102	31
Debt service-to-exports	19	7
NPV of debt-to-revenue	556	171
Debt service-to-revenue	22	8

As a result of debt reduction, the debt burden of the 33 HIPCs is expected to be reduced on average by about 90 per cent in end of 2007 NPV terms compared to their pre-decision-point debt stock. Debt stocks in the 10 interim HIPCs are expected to decline by a similar factor (World Bank 2008; IDA/IMF 2008: 29). Also in relative terms the debt burdens of the 33 HIPCs have substantially declined (table 5.2). At the end of 2007, the NPV of the debt-to-export-ratio averaged 128 per cent (below the Initiative's target: 150 per cent) in contrast to 440 per cent in 1999. During the same period the NPV of debt-to-GDP ratio declined from 102 per cent to 31 per cent on average. Both ratios reached the levels that are broadly consistent with the estimated thresholds at which debt overhang should be eliminated (Clements/Bhattacharya/Quoc Nguyen 2005; Patillo/Poirson/Ricci 2002).[18] Other debt indicators also improved. The NPV of the debt-to-revenue-ratio declined from 556 per cent to 171 per cent on average (well below the Initiative's target of 250 per cent of revenues). Debt service-to-exports and debt service-to-revenue dropped almost three times at that time.

Despite the significant decline of debt burdens due to this debt relief, long-term debt sustainability of many HIPCs remains a concern even for the 23 post-completion-point countries according to the most recent *debt sustainability analyses* (DSAs) performed jointly by the World Bank and the IMF (World Bank/IMF 2008). As of end of June 2008 post-completion-point HIPCs are in a better debt situation than other HIPCs (at end of 2007, the NPV of the debt-to-export ratio for post-completion-point HIPCs averaged 63 per cent whilst for pre-completion-point HIPCs 200 per cent), and also other low-income non-HIPCs. But only about 40 per cent of them (nine countries) have been assessed as having a low risk of debt distress. More importantly, reflecting structural weaknesses in their economies or weak macroeconomic management, four of these countries have been assessed as having a high risk of debt distress. In addition, the analyses show that the debt outlook in post-completion-point countries is very sensitive to export shocks and the terms of new financing.

These results highlight the need for implementing sound borrowing policies and strengthening the countries' capacity in public debt management. Meeting the MDGs by the target date of 2015 will require substantial financial flows to developing countries. These resources need to be provided on sufficiently concessional terms to avoid a renewed risk of debt distress. Finally, a country's debt sustainability depends also on implementing growth-enhancing policies that would boost its repayment capacity. This is particularly relevant for post-completion-point HIPCs given their increased attractiveness for private and non-traditional official creditors. Thus, it is critical for LICs to reflect upon the middle income countries' experience regarding the links between debt sustainability and growth (IDA/IMF 2008: 30–34).

A second objective of the HIPC Initiative it to stimulate economic growth by removing the debt overhang. This is important for two reasons. First, the growth rates of HIPCs have been extremely low, and as a result, the tax base has stagnated or declined in many cases, and low or declining public revenues have contributed to the under-funding of development spending, including pro-poor spending. Second, growth can reduce income poverty by enhancing the living standard of the poor, although its effectiveness in doing so depends on complementary action to enhance the human capital and productive assets of the

18 For details see above.

poor which are key determinants of their participation in growth.

Removing the debt overhang is a necessary but not a sufficient condition for achieving sustainable growth, reduce poverty, and as a consequence, to improve human security conditions. To encourage countries to implement significant economic and social reforms, the HIPC Initiative provides debt relief only after a country has developed a track record of a satisfactory reform programme. Then the benefits from debt relief may be felt in longer term institutional development and growth. The World Bank's *Country Policy and Institutional Assessment* (CPIA) is used to assess a country's policy and institutional performance. Post-completion point countries have the best policies as compared to both interim and non-HIPC countries, and have seen significant improvements in their policy performance over the past few years as measured by their aggregate CPIA score (IEG 2006a: 25–27). That progress is consistent with the requirement that they implement a satisfactory programme of reform.

Answering the question of whether debt relief boosts growth is very difficult by the fact that growth is effected by many factors. Looking at growth over time of those countries receiving debt relief does not give an accurate portrayal. Table 5.3 shows average real growth rates from a sample of decision-point HIPCs, pre-decision point HIPCs, other low-income countries and middle-income countries. Growth in all groups of countries has risen recently. Real GDP growth in decision-point HIPCs averaged 4.6 per cent over the period 2000–2005, up considerably from an average rate of 2.6 per cent in the 1990's and just 1.8 per cent in the 1980's. Moreover, the average increase in real GDP growth in decision-point countries over the periods 1990–1999 versus 2000–2005 (1.9 percentage points) was the same as in 'other low-income countries' (countries that currently are not eligible for the HIPC Initiative) and in middle-income countries. Furthermore, the increase in growth also reflects the fact that HIPCs are required to establish a track record of macroeconomic stability in order to reach the decision point. In the pre-decision HIPCs real GDP growth increased by only half of a percentage point during this period. It is still too early to tell whether and to what extent higher growth is a result of the debt-stock reduction.

A third goal of the HIPC Initiative is to reduce poverty, by freeing up resources for *poverty-reducing expenditures* (PRE). In general, debt relief could contribute to higher PRE in two ways. First, debt relief

Table 5.3: Average Real GDP Growth Rates in Low Income Countries, 1980–2005 (in per cent). **Source:** World Bank (2006a: 97).

	1980-1989	1990-1999	2000-2005
27 Decision-point HIPCs	1.8	2.6	4.6
11 Pre-decision point HIPCs	2.6	1.7	2.2
19 Other low income countries	4.7	2.7	4.6
77 Middle income countries	3.5	2.8	4.8

creates fiscal space that may be used for PRE. The Initiative has encouraged countries to increase their social expenditures by requiring to develop and implement a country-owned poverty-reduction strategy that specifies exactly how resources that are released by the Initiative are to be used, and by tracking public expenditures deemed to be 'poverty reducing'. Largely as a result of the Initiative, an increasing number of HIPCs are now reporting poverty-reducing spending: in 2005, 19 countries reported such spending, compared with only four in 2002 (IEG 2006: 30). Debt service relief should positively affect the growth rate: directly by increasing public investment activity, and indirectly by increasing human capital (at least in the long term). Second, a reduction in the debt stock eases the government's intertemporal budget constraints, and may facilitates borrowing to raise PRE. The first effect would be limited if debt relief is provided in the form of arrears clearance, which would not reduce debt service due. The second channel may not work in countries which are still credit constrained, like HIPCs in the interim period.

If debt relief is to increase fiscal space for poverty-reducing expenditures it must be additional to other resource transfers. The goal of additionality was explicitly incorporated in the Enhanced HIPC Initiative in 1999. *Additionality* means that debt relief should supplement, not replace, the flow of development aid to the poorest countries. Hansen (2004) stresses that additionality of debt relief resources is necessary for debt relief to have positive impact on economic growth. By joint analysis of aid flows and debt service payments, Hansen concludes that non-additional debt relief will in all likelihood not lead to increased growth rates in the HIPCs. He also finds that if decreases in debt service payments are accompanied by falling grant levels, there may even be a negative impact on growth.

Assessing additionality of HIPC debt relief is extremely difficult. One way to do that is to look at changes in net development aid to eligible countries

Table 5.4: Debt Service and Poverty Reducing Expenditure in 33 Post-Decision-Point HIPCs, 1999-2007 (in millions of U.S. dollars, unless otherwise indicated). **Source** IDA/IMF (2008: 65).

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Debt service paid	3,179	3,795	3,167	3,263	3,380	3,859	3,835	3,718	2,598
PRE[a)]	5,952	5,819	6,314	7,364	8,578	10,672	14,107	16,880	21,202
Debt Service/GDP (per cent)	3.9	4.6	3.1	2.9	2.6	2.7	2.5	2.1	1.5
PRE/GDP[a)] (per cent)	7.0	6.8	6.7	7.0	7.3	7.5	8.4	8.7	8.8
PRE/Government Revenue[1] (per cent)	34.7	37.8	44.7	46,2	44.5	42.6	50.0	49.0	47.2

a) Excludes CAR, Haiti, and Liberia for which data are not available.

in response to debt relief. Debt relief is *additional* if it leads to additional resources made available to the *individual* debtor receiving debt relief. The empirical studies on debt relief additionality have brought about mixed results. For instance, Birdsall and Williamson (2002) show that from 1990 to 1999, as debt relief programmes intensified, total ODA declined. Birdsall, Claessens, and Diwan (2004) find that debt reduction in the 1990's crowded out other forms of disbursements. However, Powell (2003), looking at data for 60 'IDA-only' countries from 1996 to 2000, finds that neither the level of official development assistance nor official net transfers received is affected by debt relief provided by official and multilateral creditors. Hence, there seems to be additionality (in the sense the term is used here). Also Hepp (2005a), focusing on 66 low income countries (fourty of them are classified as HIPC) over the period 1989 to 2002, finds that debt relief did not affect aid inflows significantly for low-income countries, neither positively nor negatively. Hence, debt relief provides additional resources since donors did not cut aid flows by the amount of debt relief provided.

The additionality of the HIPC Initiative was also found by the *Independent Evaluation Group* (IEG) of the World Bank (IEG 2006: 9–10). In its 2006 evaluation report, the IEG stated that debt relief has been significantly additional to other net resource transfers since 2000. Net annual transfers to the 28 decision-point HIPCs have doubled from $7.3 billion in 2000 to $15.8 billion in 2004, while transfers to other developing countries grew by only one third. As a result HIPCs' share of net transfers to all developing countries has increased substantially. On average, the 28 decision-point HIPCs received 47 per cent of transfers to all developing countries since 1999, compared with 33 per cent from 1990 to 1999. Commensurately, the share of non-HIPC developing countries declined from 60 per cent between 1990 and 1999 to 48 per cent, on average, since 1999. The increased share of resources to HIPCs suggests that debt relief has become a significant vehicle of resource transfer to this set of countries.

The effect of debt relief on poverty-reducing expenditures has been difficult to establish empirically, given data limitations and the multiplicity of channels at play. Empirical work has instead focused on the link between debt relief and poverty reducing expenditures, which is easier to measure than social outcomes. For HIPCs, there appears to be a strong positive correlation between the reduction in debt service and the increase in poverty-reducing spending. As a result of the HIPC initiative the average debt-service payment relative to GDP for 33 post-decision-point countries has declined by about 2 per cent - falling from 3.9 per cent of GDP in 1999 to 1.5 per cent of GDP in 2007 (table 5.4). At the same time poverty-reducing expenditures (in areas including health, rural infrastructure, and education) have been increased by about the same amount – rising from 7 per cent of GDP to 8.8 per cent of GDP. In relation to government revenue poverty-reducing expenditures have risen on average from 34.7 to 47.2 per cent of GDP. In nominal terms, total poverty-reducing expenditures amounted to about US$21 billion in 2007, which represents an increase of almost US$15 billion since 1999 (IDA/IMF 2008: 65).

5.7 Impact of the Current Global Crisis on the LICs

The global financial crisis that grew into an economic crisis, now risks becoming a human and social crisis with political implications. In many instances, already dire human security conditions will likely deteriorate in the poorest countries, and probably not only there. Developing countries will be hit by global recession and declining world trade. The poor countries are particularly vulnerable as they have much less cushion

to withstand the events. They will be affected through reductions in export volumes, commodity prices, remittances, tourism, foreign direct investment, and possibly even foreign aid. These shocks in turn will hurt public revenues, adding to the sizable negative fiscal impact of the food and fuel crises, and putting further pressure on public expenditure programmes (World Bank 2009: 2–21).

The impact of the global financial crisis on developing countries is reflected in sharp reductions in their projected GDP growth. For developing countries as a whole, growth is now projected to fall to 1.6 per cent in 2009, from an average of 8.1 per cent in 2006–07. Growth in Sub-Saharan Africa is projected to slow to 1.7 per cent in 2009, from 6.7 per cent in 2006–07. The sharp slowdown in growth can seriously set back progress on poverty reduction and other Millennium Development Goals.

Strong economic growth in developing countries in the past decade had put the MDG for poverty reduction (halving the proportion of the extreme poor in the population between 1990 and 2015) within reach at the global level. But the triple jeopardy of the food, fuel, and financial crises adds new challenges. The rise in food prices between 2005 and 2008 pushed an estimated 160 million to 200 million more people into extreme poverty. The growth slowdown resulting from the financial crisis will add to the poverty impact of high food prices. Past trends show that a decline in the average GDP growth rate in developing countries by one percentage point can trap as many as 20 million more people in poverty. Estimates of the poverty impact of the growth slowdown in developing countries as a result of the financial crisis range from 55 million to 90 million more poor people in 2009 than anticipated before the crisis. At current growth projections, overall poverty rates in the developing world are still expected to fall in 2009 but at a much slower pace than before the crisis.

The impact of the crisis upon poverty, or put in other words, on human security, and other security sectors as well, will vary across regions and countries. In Sub-Saharan Africa and South Asia (except India), the growth slowdown essentially eliminates the prospect of continued reductions in the poverty count in 2009. Within these regions, which already have high poverty rates, rising poverty can be expected in some of the more fragile and low-growth economies, which may experience declines in the per capita incomes as a result of the growth slowdown.

Progress in reducing hunger and malnutrition, i.e. improvement of food security, has also been affected. Although the proportion of people who suffer from hunger has fallen since 1990, there are serious shortfalls in achieving the goal of halving the incidence of hunger and malnutrition. The recent food crisis is eroding some of the hard-won past gains in fighting hunger and malnutrition. High prices have increased the number of people without sufficient access to food. Before the onset of the food crisis in 2007, there were about 850 million chronically hungry people in the developing world. This number rose to 960 million people in 2008 and is expected to climb past 1 billion in 2009. The financial crisis and the resulting fall in economic growth are likely to exacerbate this impact.

Of greatest concern are the overall human security and development goals. With the world already off track on most of these goals, the financial crisis threatens to further set back progress. In the face of the economic crises, both household and public investments in human capital tend to suffer. With falling employment, wages, and asset values, and with weak social insurance systems, poor households in developing countries may not be able to cope with the economic shocks without cutting investments in human capital. Faced with declining revenues and limited financing options, government social sector spending is also likely to come under pressure. Experience suggests that growth collapses from financial crises are costly for human development outcomes. Countries that suffered economic contractions of 10 per cent or more between 1980 and 2004 experienced more than 1 million additional infant deaths. Human security and development outcomes tend to deteriorate more quickly during growth decelerations than they improve during growth accelerations. The projected slowdown in growth in developing countries is likely to sharply slow progress in reducing infant mortality. Based on current projections of lower growth, preliminary analysis shows that infant deaths in developing countries may be 200,000 to 400,000 per year higher on average between 2009 and the MDG target year of 2015 than they would have been in the absence of the crisis; that translates into an additional 1.4 million to 2.8 million infant deaths during the period. In poor developing countries, education outcomes such as school enrolment also tend to deteriorate during economic crises. Evidence indicates that fluctuations in income have a larger impact on survival and school enrolment among girls than among boys.

The long-run implications of the crisis for human development/human security outcomes may be more severe than those observed in the short run. When

poor households withdraw their children from school, there is a significant risk that they will not return once the crisis is over or that they will be unable to fill the learning gaps resulting from the lack of attendance. And the decline in nutritional and health status among children who suffer from reduced (or lower-quality) food consumption can be irreversible, retarding their growth and cognitive and learning abilities.

Even though the global economic crisis will slow progress, the target for reducing income poverty remains within reach at the global level based on current growth projections, which envisage a recovery in growth starting in 2010. The goals for gender parity in primary and secondary education and for access to safe water have also seen relatively good progress and are expected to be met at the global level by 2015, although prospects for gender parity in tertiary education and other targets about empowerment of women are less promising. Of greatest concern are the no income human development goals. Based on current trends, most human development MDGs – especially for child and maternal mortality, but also for primary school completion, nutrition, and sanitation – are unlikely to be met at the global level.

Within this global picture, considerable variation occurs across regions and countries. At the regional level, Sub-Saharan Africa lags on all MDGs, including the goal for poverty education, which on current trends will be achieved or nearly achieved in all other regions. Thanks to rapid growth, especially in China, the East Asia region has already succeeded in halving extreme poverty. South Asia is on track to achieve the poverty reduction goal, but it is seriously off track on most human development goals. On the goals relating to health, most regions are off track, though the rate of progress varies substantially across regions, with East Asia, Europe and Central Asia, and Latin America in general doing better than the other regions.

Middle-income countries have made the most rapid progress toward the MDGs. These countries as a group are on track to achieve the target for poverty reduction. Many of these countries, however, continue to have large concentrations of poverty, in part reflecting high levels of income inequality. This factor, together with the large population size of some middle-income countries, means that these countries remain home to a majority of the world's poor in absolute numbers. Many of these countries also continue to face major challenges in achieving the no income human development goals.

Overall progress toward the MDGs has been weaker in low-income countries, although here too performance varies considerably across countries within the group. Progress toward the MDGs has been slowest in fragile and conflict-affected states. Wracked by conflict and hampered by weak capacities, these states – more than half of which are in Sub-Saharan Africa – present difficult political and governance contexts for effective delivery of development finance and services. Fragile states account for close to one fifth of the population of low-income countries but more than one third of their poor people. Looking ahead, the challenge to achieve the MDGs will increasingly be concentrated in low-income countries, especially fragile states.

The deepening human and development crisis in poor countries leading in some cases to extreme security threats, e.g. in the Sudan, calls for urgent actions of the international community to assist these countries to lay the ground for a recovery of strong growth and accelerated progress toward the MDGs. Additional development assistance is essential to lessen the impact of the global crisis on these countries. At the recently concluded London summit of the *Group of Twenty* (G-20), held on 2 April 2009, donors reiterated their commitment to meeting ODA pledges made at Gleneagles.[19] The prospects of reaching the Gleneagles targets remain uncertain as some donors may cut their aid budgets. Indeed, there is a risk that aid flows could decline (World Bank 2009: 113–134).

5.8 Conclusions

The main aim of the chapter was to enhance the understanding of the economics of debt relief in low-income countries, and to evaluate the *Heavily Indebted Poor Countries* (HIPC) Initiative's potential for accelerating growth and reducing poverty. In addition, a preliminary survey of the links between debt relief and economic security of individuals and of human security in poor countries has been developed.

The main conclusions of this chapter are:

19 At the Gleneagles G-8 meeting donors promised, with other donors, to double their aid to Africa by 2010 – an increase of $25 billion a year compared to 2004 amounts – and to increase overall aid by $50 billion a year by 2010. However, in real terms, aid in 2008 was US$29 billon short of the Gleneagles target of the US$130 billion per year by 2010. Aid do Africa was about US$20 billion short of the 2010 target of US$50 billion per year.

1. The HIPC Initiative combined with the *Multilateral Debt Relief Initiative* (MDRI) has substantially lowered the debt burdens of poor countries. However, the evidence on post-HIPC debt sustainability is not encouraging. Debt relief itself cannot guarantee to maintain debt sustainability, which in the long run will depend on prudential borrowing policies, strengthening public debt management, lowering the structural weaknesses and high sensitivity to export shocks as well as implementing growth-enhancing policies to boost the repayment capacity.
2. The empirical work on the growth effect of debt relief in heavily indebted low-income countries is mostly positive. Although the predicted impact is rather small (a growth increase between 0.2–1.1 percentage points), the cumulative effect should not be neglected. The HIPC Initiative has created a potential for accelerating economic growth and reducing poverty in HIPCs, but in order to realize its potential HIPCs must sufficiently reduce macroeconomic and structural distortions, as well as high economic and political risks that might otherwise constrain growth. Moreover, debt relief must be additional to existing aid flows, not a substitute for aid, in order to have a positive impact on growth and poverty reduction. The evidence suggests that debt relief provided under the HIPC Initiative after 2000 has been significantly additional to other net resource transfers, which means that debt relief has brought more resource for poverty reduction. But serious questions remain. *First*, whether poor countries, with still weak institutions, will be able to effectively use the resources freed up by debt relief for the benefit of the poor. Much depends on the quality of the fiscal system (not only public expenditure management but also the ability of revenue institutions to mobilize the necessary additional domestic resources through taxation). Extensive analytical work is needed to assess the distribution of public spending and the changes in their composition induced by the HIPC Initiative, as well as to track the additional resources to their final destination. *Second*, if the HIPC Initiative raises growth, it should reduce income poverty, but it is not clear whether the growth reaches the poorest regions. An analysis must be undertaken to determine the poverty impact of growth, and whether the PRSP has been effective in raising a country's poverty elasticity of growth.
3. For accomplishing the broader objectives of growth, sustainable development, and poverty reduction, debt relief is a limited tool, in several ways. *First*, the resources that can be generated from debt relief are limited by the existing stock of debt. The potential gains from debt relief are modest compared with those from trade liberalization and increased access to markets. *Second*, the benefits of debt relief can quickly be erased if relief is not accompanied by sustained improvement in policies and a prudent new strategy for future borrowing. The history of debt relief is filled with countries that failed to reform their policies and began once again to build up debt after having their debts forgiven. *Third*, if donors provide debt relief by reallocating resources already earmarked for aid (as it was a case before 2000), the recipient countries will see no net increase in resources. In the future a necessary condition should be that the donor community increase its overall aid resources, and not reduce other aid flows to finance the debt relief.
4. The current global financial crisis resulting in the sharp slowdown in growth in low-income countries, can seriously set back progress that has been achieved in all areas which determine overall security and human security, i.e. economic growth, debt sustainability, and poverty reduction. Without increasing foreign aid many HIPCs will not be able to maintain debt sustainability nor achieve the MDGs by 2015.
5. High level of indebtedness of low-income countries should be viewed as a source of security threats in all sectors in those countries. It concerns especially economic security at the grassroot level and has a direct impact on human security. Therefore in any-security oriented discourse debt relief should be treated as a part of an improvement of human security. Due to the fact that in too many instances the discourse on human security is hampered by too general considerations, the example of economic and financial analysis of the impact of debt relief on the situation of the poor countries should be treated as an introduction to more rigorous economic security and human security-oriented research.

Further research on growth and poverty effects of debt relief and its links with a broadly defined security should consider the following issues:

1. The channels through which debt relief affects key development variables.

2. The poverty impact of growth and the poverty reduction elasticity of growth.
3. The distribution of public spending and the changes in their composition induced by the HIPC Initiative.
4. Elaboration of a policy-oriented theoretical framework of studies on how the debt of low-income countries influences their security in all sectors with a special attention given to economic security at the grassroots level and subsequently, to human security. In such a case, detailed economic and financial analyses of the debt reduction policy of the poor countries and of its effectiveness, may become a methodological instrument of security studies.
5. Since the debt usually affects the poorest countries, which in turn, are also affected by multiple other threats, beginning from environmental insecurity and ending with a lack of gender security, it may be worthwhile to put these studies into a broader framework of research on the Anthropocene, on HUGE (Human, Gender and Environmental Security) and HESP (Human and Environmental Security and Peace) as was suggested by Oswald Spring, Brauch and Dalby (2009).

Part II Securitization of Global Environmental Change

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6 Security Threats, Challenges, Vulnerabilities and Risks in the Evolution and Implementation of the European Security Strategy

Alyson J.K. Bailes

6.1 Introduction

On 12 December 2003, the heads of state and government of European Union (EU) member states attending the European Council meeting at Brussels adopted the EU's first ever European Security Strategy (ESS) – a 14-page paper with the title "A Secure Europe in a Better World".[1] The document had taken just seven months to produce since May 2003, when EU foreign ministers meeting at Kastellorizo on Rhodes asked the Union's High Representative for CFSP, Javier Solana, to produce a first draft. The version emerging from his staff was welcomed by the Thessaloniki European Council on 20 June, and was subjected to debate both at public seminars and among member states (through the Political and Security Committee[2] at Brussels) before a somewhat adapted version got the final seal of approval in December.

If the nature of the document and also the process of creating it were novel, the circumstances behind its emergence were also special and in some ways unprecedented. In early May 2003 the wounds were still raw from one of the worst political crises in EU history. The rift that had been widening since mid-2002 between EU member states who were sympathetic to, or opposed to, the USA's tough stand on Iraq became an open break when the UK, Italy, Spain and others accompanied the US invasion of that country in March 2003. France and Germany not only condemned the action but adopted a common stance against it with the Russian Federation – until recently, Western Europe's arch-enemy. Almost as the first shots were being fired in Iraq, however – on the morning of 17 March, 2003 – a special "seminar" session of the Political and Security Committee was held to launch work on an EU strategy for the specific issue of proliferation of Weapons of Mass Destruction (WMD)[3], implicitly seeking a way of tackling further challenges in that field that would be both less divisive and less costly for the Europeans than Iraq had already revealed itself to be. By the time the Foreign Ministers at Kastellorizo requested a more comprehensive draft strategy from Solana, there was an even clearer recognition throughout the enlarging Europe[4] that the EU nations must demonstrate, both to themselves and the world, their determination to retrieve their unity for external action on a firm conceptual as well as operational basis.

This background is essential to bear in mind when judging the ESS as a whole and, more specifically, the way it deals with risks, challenges and threats to European security. The select group of Solana's advisers who first drafted it were more than familiar with the intellectual and policy trends that had been transforming the whole notion of "security" for the Western democratic community since 1989/90. Robert Cooper, one of the most influential drafters, had himself written more than one classic work[5] on the way that nations' grip of security processes was being challenged by the growing power both of supranational

1 European Council, 12 December 2003, "A Secure Europe in a Better World", text at URL http://www.consilium.europa.eu/cms3_fo/showPage.ASP?id=266&lang=EN&mode=g, 25 September 2007.

2 The PSC was created in 2000 as part of the new structures of the *European Security and Defence Policy* (ESDP), and consists of Ambassador-level representatives from all member states.

3 Interim documents on this subject were adopted in June and the complete WMD strategy at the 12 Dec. 2003 European Council: see the latter text at <www.consilium.europa.eu/uedocs/cmsUpload/st15708.en03.pdf>, 25 September 2007.

4 The ten Central European and Mediterranean nations to join the EU in Spring 2004 had already been selected by 2003: they were invited to join in the process of finalizing the ESS, and to associate themselves with it.

5 See especially Cooper (2003).

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organizations and of sub-state, non-state and transnational actors ranging from terrorists to multinational corporations and non-governmental activists. The whole story of the EU's gradual emergence as a security power underlined that traditional, military defence was no longer the sole or even the determinant field for international power-play: the fortunes of developed nations and their peoples would now also be decisively affected by success in handling internal security challenges, "functional" security (energy, environment, infrastructure etc), and challenges to "human security" including low-level violence and disorder, disease, natural disasters, economic and social malfunction and denial of basic rights.[6] In the military operational sphere, the various phases of the Western Balkan wars since the early 1990s – as well as a series of non-European conflicts that called for European action often because of post-colonial ties – had kept Europe's defence planners tightly focussed on the demands of voluntary crisis management operations, and were also deepening understanding of the need to combine military with political, economic and other civilian tools of intervention. (This was also, of course, the field in which EU leaders decided at the Helsinki European Council of December 1999 to give the Union a collective military role in the shape of the new European Security and Defence Policy (ESDP).[7]) Last but not least, the great gain in relative safety for "core Europe" following the collapse of the Soviet empire had not only allowed the EU and NATO to extend their respective security communities to practically the whole European continent through enlargement, but had raised the relative priority of extra-European concerns and of fully global security issues for both institutions. By 2003 the EU had not only adopted two successive Russia strategies, but also its first China strategy.[8]

All this said, however, the primary explanations of the ground covered by the ESS and of its language, priorities and recommendations should not be looked for in the general evolution of European (official or academic) security thinking, and still less in the objective balance of European security conditions between May and December 2003. The Iraq conflict was the midwife of this particular brainchild and, for the ESS's drafters, Iraq stood as the ultimate manifestation of a security analysis and strategic response developed by the *United States* after the massive terrorist attacks it suffered on 11 September 2001. The resultant US strategy focussed on "new", "asymmetric"[9] threats from the worldwide forces of terrorism and the risks of WMD diffusion and misuse, and it called for robust – even "pre-emptive"[10] – responses making use notably of the USA's unique superiority in military force. Some European countries (most obviously, but not only, the UK) found that this ruthless, geographically unlimited reaction against unconventional enemies chimed with elements in their own security traditions and national interests. For many others, the very idea of using such force against non-state opponents and of using conflict as a conscious tool of change – especially in the name of "democracy" as defined by the current US Administration – was ethically as well as intellectually suspect. Washington's new strategic vocabulary thus became also the language of an internal European rift; and the main preoccupation of European drafters as they started work on the ESS was how to

6 A study on a "human security" doctrine for Europe was commissioned by Solana in 2003 and finally published in September 2004 as "A Human Security Doctrine for Europe: the Barcelona report of the study group on Europe's security capabilities¨ (text at <http://www.lse.ac.uk/Depts/global/Publications/HumanSecurityDoctrine.pdf>, 24 September 2007). This document's focus is, however, on EU intervention missions rather than on global problem analysis or the overall impact of EU policies; its key recommendation is for a standing EU civil-military force.

7 For the founding documents of ESDP see the Presidency Conclusions of the Helsinki European Council, 10–11 Dec. 1999, Part II and Annex IV, URL http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/ACFA4C.htm, 25 September 2007.

8 EU strategy towards China, presented by the European Commission as COM(2001) 26 Final of 15 May 2001 and repeatedly updated, most recently in 2007 (all references available online at http://ec.europa.int/external_rekations/china/intro/index.htm, 25 September 2007). The "strategy" as a type of EU policy document was formally introduced in the 1997 Treaty of Amsterdam, but the Council had adopted "strategies" on Central European accession, Russia, and the Baltic Sea before that date and adopted three more before 2003 (Russia again in 1999, Ukraine 1999, Mediterranean region 2000). The Amsterdam provisions placed the process for generating strategies clearly in the Council domain whereas the Commission had previously drafted most such documents (and continued to do so after 1997, but with different titles).

9 An asymmetric threat was defined in this context as one involving major or existential damage by a smaller and weaker actor against a powerful one.

10 The case for pre-emption of imminent major threats was set out in *The National Security Strategy of the United States of America* published on 17 Sep.2002; see at: <http://www.whitehouse.gov/nsc/nss.pdf>, 25 September 2007.

absorb what should and must be absorbed from the US analysis while moderating and transmuting it into something all Europeans could recognize as their own. To put it another way, they were not writing on an empty sheet but seeking to deconstruct and then re-compose an existing body of strategic analysis, for which the most obvious source was the USA's own National Security Strategy (NSS) of September 2002.

While most of the ESS's eventual features can be explained by this single thesis, there were other reasons, too, why it would have been unrealistic to look to such a document in 2003 for a reasoned *tous azimuths* threat analysis and situation assessment of the sort familiar from national (and NATO) military documents. Not only were the drafters themselves civilians, but the EU had in 2003 no real organ of risk assessment, no experience of evaluating "harder" military threats, and only the most rudimentary intelligence exchanges.[11] The best European capacities of those kinds were still lodged in NATO, and a deep reluctance among many EU members to stray into NATO's analytical or policy territory will have played a large part, even if only unconsciously, in determining the conceptual space that the ESS eventually occupied.

With these explanations as a starting point, the present chapter will start by surveying the treatment of risks, challenges, threats and vulnerabilities in the ESS document of December 2003 and seeking to relate both the process and vocabulary used, and the document's substantive judgements, to the particular circumstances of its creation (6.2). The following section will outline relevant developments in the first three years following the adoption of the ESS (i.e., up to late 2006/early 2007), asking what new internal and external factors modified or should have modified the EU vision of security challenges over that period (6.3). There follows a necessarily brief discussion of how far the process of follow-up to the ESS as such was helpful to the EU in tackling both the original, and the newer, revised, threat constellations (6.4). The concluding section addresses the relevance of the ESS to handling Europe's further strategic challenges from 2007 onwards, in the light inter alia of the EU's own formal review process carried out in 2008 (6.5).

6.2 The ESS as a Risk- or Challenge-based Document[12]

Given the points made above about the EU's limited capacities for threat or risk assessment, it may seem surprising to note that as many as 5 of the ESS's 14 pages (in the final version) are devoted to problem analysis. The USA's National Security Strategy (NSS) of September 2002 (White House 2002) – the document against which the ESS was in many ways matching itself – launches straight into a statement of the Administration's intent with little initial scene-setting. However, the US connection is the key to understanding this aspect of the ESS as well. Its drafters wanted at the same time (a) to show that the EU took the USA's new security vision seriously and shared the underlying concerns; (b) to nuance the treatment of the major "new threats" in line with different European perceptions; and (c) to highlight other threats and challenges that the EU saw as equally serious with – and/or causally linked with – terrorism, proliferation and dysfunctional or deviant states. Purpose (a) mattered for EU governments precisely because they had not worked together on such an assessment before. Purposes (b) and (c) were linked with the need to justify strategic prescriptions in which the EU nations

11 A "SITCEN" was set up for ESDP purposes but developed only slowly after 2000 and was shaped by the fact that ESDP missions were limited to essentially altruistic, extra-European crisis management. It was given more powers, and intelligence exchange was stepped up, by decisions taken after the Madrid terrorist bombings of March 2004.

12 A great deal could be written about the relative meaning, and merits, of the expressions "risk", "challenge" and "threat" to express the substance of contemporary European security concerns. "Threat" was the standard expression for the starting point of security analysis and response in cold war times, but today is most properly reserved for cases where there is a conscious human intent to harm. "Risk" is potentially the widest term since it can include hazards not usually thought of as belonging to the security policy sphere such as traffic accidents or financial collapse. (For the author's own views on this see Bailes, 2007.). However, this author has found no evidence that the varied use of these terms in the ESS - on which see details in the main text, below - is based on consistent theoretical differentiation or, indeed, on anything much more than familiarity, euphony and ease of translation. (It is telling that the non-specific "problem" is the second most frequently used word in the ESS after "threat", see note 15 below.) It would be strange anyway to expect much depth of conceptual refinement and consistency in a text produced by months of inter-governmental bargaining.

would more openly signal an alternative 'European way' of tackling shared Euro-Atlantic problems.[13]

Common elements of analysis between the ESS and the 2002 NSS are both generic and specific. Both documents agree that the interests of the Euro-Atlantic community are threatened, in twenty-first century conditions, by non-state actors and transnational movements as much as – or even more than – by traditional military opponents. Both give credit for the easing of more traditional strategic concerns in Europe: the EU paper's opening line is that "Europe has never been so prosperous, so secure or so free". Both accordingly treat Russia as a potential partner rather than an adversary, while at the same time signalling that the West has not made a "new Yalta" agreement and must be free to continue spreading its own influence Eastward. The ESS states: "Our task is to promote a ring of well-governed countries to the East of the European Union....with whom we can enjoy close and cooperative relations". Both documents stress that new risks and challenges arise increasingly from *global* phenomena and both argue that the West's responses must be both proactive and potentially equally global. A much-quoted sentence from the ESS is that "with the new threats, the first line of defence will often be abroad." In practical terms, both strategies prescribe the use of a mixture of traditional and non-traditional, military and non-military instruments; and last but not least, both link the promotion of western countries' national and collective security interests with the promotion of democratic values, human rights and good governance worldwide.

As to specific risks and threats, the ESS follows the NSS in discussing at greatest length those from international terrorism and the proliferation of WMD. It describes the combination of these – the risk that terrorists will use WMD for their attacks – as "the most frightening scenario" of all. Already here, however, we can see the first signs of the EU drafters' nuancing their approach in order to embed these threats in a European world-view that paints motivation and identities in shades of grey rather than black and white, and that seeks to understand, transform and embrace hostile actors rather than to stigmatize and destroy them. While the NSS detects threats only outside the USA's own shores, the ESS acknowledges that "this phenomenon [alienation as a root cause of terrorism] is also part of our own society." The ESS also presents terrorism as a symptom rather than a cause of other security abnormalities (conflict, weak states, bad governance and social ills), and sees the desire of countries to acquire WMD as reflecting something more generally amiss in their and/or their region's security environment. Significantly, the EU document never uses the world "enemy" which is liberally scattered through the NSS,[14] while it does use "threat(s)" 24 times.[15] European "vulnerability" is mentioned only once, in connection with dependence on external energy supplies.

Perhaps most significantly in terms of analysis, the final version of the ESS contains several paragraphs – much increased from Solana's earlier draft – on the phenomenon of conflict as a problem in itself (for human values and international order as well as European interests) and as a powerful contributory cause for the "new threats" as well as for state weakness and human suffering.[16] This conflict-averseness reflects a strong strand in both the EU's philosophy and its members' experience – open fighting over Kosovo was still a recent memory in 2003! – and it helps to explain why the ESS deliberately distances itself from the NSS's famous or notorious doctrine of forceful "pre-emption" when it comes to the prescriptions.[17] Even if the UK, Spain, Denmark and others were willing to join the USA in deliberately starting a conflict (in Iraq) to stop another perceived threat, the EU at 25 could never endorse such a position. Finally, the ESS sketches out more fully than the NSS (in proportional terms) the importance for Europe's security of

13 The ESS's prescriptions are not fully analysed in this chapter; for details see Bailes (2005).

14 Similarly, the ESS avoids using US-type terminology about "rogue states": the nearest it gets is "countries (that) have placed themselves outside the bounds of international society," adding that "It is desirable that such countries should rejoin the international community."

15 And "challenge" twice, "risk" just once, "danger" twice and "problem(s)" (in the security sense) eight times.

16 Conflict is actually the very first "threat and challenge" mentioned in the document.

17 The word "pre-emptive" was actually used in the Solana draft, but in a paragraph (p. 10) calling for "pre-emptive *engagement*" when necessary to assure development and justice for all citizens (a context far removed from the US version of military pre-emption *á la* Iraq). During the inter-governmental debate on the text this wording was dropped under pressure from Germany and others, and the idea of "preventive engagement" was used instead when discussing failing states, proliferation and humanitarian emergencies. More generally, the ESS distances itself from the US doctrine by stressing the need to respect international organizations and defend their rules.

global *economic* cooperation and the correct handling of *social* challenges especially in poorer countries: and this greater focus on the "softest" security problems–which can neither be tackled militarily, nor unilaterally–helps to explain why the ESS's supreme prescription is "effective multilateralism".

In all these respects, it can be shown that the drafters of the ESS were sensitive to empirical differences between the risk/threat perceptions of the wider European population and those of the US popular mainstream. A "Transatlantic Trends" opinion poll published in autumn 2003[18] showed that 70 per cent of both US and European respondents thought the threat from terrorism extremely important", but significantly fewer Europeans than Americans were similarly concerned about the North Korean and Iranian WMD challenges or Islamic fundamentalism. Only on the Arab-Israel conflict was European opinion more concerned than US respondents (46 per cent compared with 39 per cent).

A Eurobarometer poll taken around the same time also showed that the top five concerns of EU citizens included fighting organized crime, and – with even higher scores – "fighting unemployment" and "fighting poverty".[19] This last finding is also interesting because the percentages of those expressing concern were much higher than the numbers of the actual unemployed and poor: and it goes to reinforce the conclusion that the European conception of threat and challenge (at least at this time) was significantly *internalized* as compared with the USA's persistent inclination to *externalize* – and often personify! – evil influences.

To revert to the point made above about the ESS's incompleteness as a "360 degree" threat assessment, it is worth briefly noting what was *not* covered in the EU document. In retrospect, the treatment of challenges to human and state security in the domains of energy, the environment and epidemic disease was pretty perfunctory, and human migration (with its consequence, growing multiculturalism) was touched on only obliquely. Challenges from individual states were almost absent: thus, not only was the continuing ambiguity of strategic relations with Russia not discussed - which, as argued above, could have been construed as NATO's business - but China and India received only the briefest of (positive) references as "strategic partners" (Bailes 2006). Finally, it was perhaps not surprising that the Iraq issue itself was shrouded in silence, but slightly more surprising that no specific analysis was offered of the operation ongoing since end-2001 in Afghanistan where Europeans of all shades of opinion were contributing (most of them through the UN-mandated *International Security Assistance Force* (ISAF). The only conflict locations receiving detailed comment in the ESS were the Israel/Palestinians conflict and the Western Balkans.

6.3 Five Years Later: (i) The Changing Scene

Contemporary history moves fast. In less than half a decade since the adoption of the ESS, both the EU's own circumstances and the outside influences on its security vision have been in many ways transformed. Internally, the planned "big bang" enlargement was completed on schedule when 10 new member states joined the Union in May 2004,[20] but the EU's new draft Constitution (bringing governance changes that were supposed to safeguard the larger Union's efficiency) was rejected by voters in national referendums in France and the Netherlands just twelve months later.[21] The somewhat watered-down Reform Treaty ("Lisbon Treaty") that was drafted in 2007 to replace the Constitution, after a rather lengthy pause for reflection, likewise ran into a roadblock when an Irish referendum on it failed in Spring 2008.[22] Contrary to all previous orthodoxy, the EU has therefore been obliged – at least in the short run– to "widen" itself radically without any institutional "deepening". At the time of writing, the Lisbon Treaty remains the focus of reform ambitions and has been ratified by a major-

18 Findings available in several languages at: <http://www.transatlantictrends.org/trends/index_archive.cfm?year=2003>, 25 September 2007.

19 Eurobarometer poll taken in May 2003, quoted in: *Financial Times*, 17 September 2003.

20 Estonia, Cyprus, the Czech Republic, Hungary, Latvia, Malta, Poland, Slovakia and Slovenia became EU members on 1 May 2004. NATO admitted 9 new members in March the same year.

21 In referendums on 29 May and 1 June 2005 respectively. For the text of the draft constitutional treaty see at: <http://europa.eu.int/scadplus/constitution/index_en.htm>.

22 Treaty of Lisbon, 13 Dec. 2007: for information and text see <http://europa.eu/lisbon_treaty/index_en.htm>. The European Council in December 2008 adopted a game-plan to try to change Ireland's position through a new referendum, allowing the Treaty to come into force by end-2009.

ity of member states, but how and when the Irish blockage can be overcome remains moot.

The delay in constitutional reform has disappointed hopes, among other things, of a stronger central apparatus for managing EU foreign and security policy. Both the Constitution and the Lisbon Treaty would have given the European Council a long-term Presidency, and elevated Solana to the status of a European "Foreign Minister" sitting simultaneously in the European Commission and supervising all existing external-affairs staffs and funds.[23] The first set of failed referendums also triggered, however, a more general crisis of confidence in and among the European leadership. The symptoms included a growing popular backlash against enlargement (also a motive for the French and Dutch peoples' "No" votes on the constitution), and a hardening of resistance in certain countries—again, especially France – against the idea of according full membership to Turkey which began its formal accession talks in October 2005. These popular attitudes were linked with a more general reaction against the "dilution" of European societies by immigration, and against the opening of European industries and markets to competition that might threaten "national economic treasures" and employment. The resulting "enlargement fatigue" did not stop the planned accessions of Bulgaria and Romania in January 2007, but did render very remote any idea of accommodating the next "tier" of countries like Georgia and Ukraine. The leaders installed in these last two nations by the "rose" and "orange" democratic revolutions of 2003 and 2004–2005 respectively suffered serious policy setbacks and eroding personal images as their governments had to grapple with harsh realities, reinforcing the message of pessimism and caution among Western observers. By 2006 a number of the newly integrated Central European states had also run into domestic turbulence characterized by a surge of nationalist, Euro-sceptical sentiment at popular or government level or both.[24] Many pundits had forecast that seeking unity on tricky strategic issues would be difficult in an EU of 25 (now 27) members, but most assumed that the new states would act – as in the 2003 Iraq debate – as a fairly coherent, militarily robust pro-Atlantic bloc. Few could have guessed either how far the ten Central European capitals would themselves become split on key European issues, nor how far Poland in particular would be prepared to go in blocking majority decisions. The final shock in this Eastern context came, of course, with the Russia-Georgia conflict of August 2008 and resulting Russian part-occupation of Georgia: an episode that called in question not just Russia's strategic intent, but also Georgian judgement and the whole credibility of Western policies beyond the EU (and NATO) border.

It was, thus, a *politically, mentally and institutionally vulnerable* Europe that had to cope with the fast-evolving threat picture of the years 2004–2008.[25] The main changes impacting upon it will be addressed here first in terms of the ESS template, and then of what the ESS did *not* (directly or adequately) cover. First, the threats of terrorism and WMD proliferation became if anything more real for Europe after 2003 than they appeared to most people in that year. The mass-casualty attacks of 11 March 2004 in Spain and 7 July 2005 in the UK not only drove the general lesson home but shook national self-confidence in different ways: the Spanish attack because it was *not* carried out by the "familiar enemy" of Basque terrorism, the British attacks because they *did* come from "home-bred" terrorists. Nuclear proliferation took a tangible step forward with North Korea's nuclear test of October 2006, while Iran's progress towards potential nuclear weapon capability was not halted either by the EU's mediation efforts (Bailes 2006a) or by the USA's tougher stance. Opinion poll figures from mid-2006 showed that 52 per cent of European respondents now thought the threat of Islamic fundamentalism "extremely important" (as against 47 per cent in 2003 and 41 per cent in 2005), although general terrorism-related concerns were somewhat lower than in 2003; and extreme concern about Iran had gone up from 46 per cent in 2003 to 58 per cent in 2006 (even higher in Germany and Poland).[26] Over the same period, however, the main counter-stroke by the US-led coalition against such "new threats" – the invasion and oc-

23 For the specific impact of the Lisbon Treaty on ESDP see Biscop and Algieri (2008).

24 Best known examples during 2006 were the confrontational policies adopted by the Kaczynski brothers in Poland and the violent protests against the government led by Prime Minister Ferenc Gyurcsány in Hungary.

25 The West's sense of *economic* vulnerability was also sharply increased in 2007-8 by an extreme surge in oil prices, a parallel global shortage in some foodstuffs, and a protracted credit/financial crisis that spread from the US to affect all European to some degree (incidentally making the management of the Euro even more difficult). These problems should be borne in mind as deepening European policy-makers' sense of instability and inadequacy, but it is not possible to analyse them in any further detail in this text.

cupation of Iraq – came to be seen overwhelmingly in Europe (and by a majority of the US population) as a mistake of tragic proportions, likely only to strengthen the forces of terrorism (and more indirectly, the temptation to proliferation) and to further destabilize the greater Middle East. The "Transatlantic Trends" poll in 2006 found that 45 per cent of Europeans considered the violent and divided state of Iraq an extremely important threat in itself, with an even higher figure in the UK – the EU member with the largest remaining military investment there.[27] According to the Pew global organization,[28] in Spring 2006 41 per cent of UK respondents (and 56 per cent in Spain, 40 per cent in Germany and 36 per cent in France) saw the US presence in Iraq as "a danger to world peace" and 45 per cent were equally concerned about the unsolved Israel/Palestinians conflict, while just 34 per cent saw Iran, and 19 per cent saw North Korea, as a comparable danger.[29] Overall, the number of European respondents considering US leadership in the world "desirable" had fallen from 64 per cent in 2002 and 45 per cent in 2003 to just 37 per cent in 2006.[30]

To sum up, in the first five years after 2003 the common security challenges facing the USA and European did not ease and if anything became more clear, but the passing of time brought even greater disagreement and confusion over how to prioritize them and on the USA's way of tackling them. This meant an unhealed, or even deepening, crisis of confidence in Atlantic relations just at the time when EU leaders were abnormally un-confident about their own grip of the Union's affairs. Paradoxically, however, the trans-Atlantic debate at political level was fairly muted in 2005–2008 as European leaders (such as Germany's new Chancellor Angela Merkel) tried to build common ground on the less controversial, generic anti-terrorist and anti-proliferation measures or the shared Afghanistan mission, and the US Administration eased up on some of its more extreme prescriptions. Parallel weaknesses made each side reluctant to shake popular trust further by a mutually damaging war of words. Overlaid on this situation, however, came a surge from early 2005 onwards in two further, new or renewed sets of security concerns each with its own divisive overtones.

First was the sharpened European concern about a set of "functional" security concerns: the security of energy supply (starting from an episode in January 2006 when a temporary stoppage of gas supplies from Russia to Ukraine also hit European consumers); the likely impact of climate change and associated environmental damage; and the fear of a new (post-SARS) killer epidemic evolving out of avian influenza. If the last of these was not inherently divisive, the energy issue impacted US and European opinion differently – President Bush vowing to cut down dependence on Arab sources of oil and gas while Europe was both obsessed with and divided by the question of Russia's reliability[31] – and on climate change, it was easy for Europeans to see the USA as the "bad guy" given its refusal either to join the Kyoto Protocol or (at federal level) adopt strict measures of economy and self-restraint. The Pew poll of mid-2006 already quoted showed that 51 per cent of Spaniards, 46 per cent of the French and 30 per cent of Germans were "very worried" about global warming while the US figure was as low as 19 per cent.[32] As for policy solutions, EU leaders did manage on 9 March 2007 to unite on a new policy to deal with climate change including unprecedentedly low voluntary limits on certain emissions.[33] They could reasonably feel vindicated when Senator Barack Obama, the winning candidate in the USA's November 2008 Presidential elections, committed himself explicitly to move US policy in a more 'European' direction. However, European agreement on a common energy policy as such

26 *Transatlantic Trends 2006*, key findings at: <http://www.transatlantictrends.org/trends/index.cfm?id=37>, 25 September 2007.

27 *Transatlantic Trends 2006*: see previous footnote 24.

28 Pew Organization, 'America's Image slips, but Allies share U.S. Concerns over Iran, Hamas', 13 June 2006; at: <http://pewglobal.org/reports/display.php?ReportID=252>, 25 September 2007.

29 *Transatlantic Trends 2006*, see previous footnote 24.

30 *Transatlantic Trends 2006*, see previous footnote 24.

31 The effect was intensified by a further Russian stoppage (of deliveries through Belarus) in January 2007 and by Russian-German plans to open a new direct pipeline, bypassing Poland, the Baltic and Nordic countries who feared Russia might then be able to cut off supplies to them while still cooperating with Berlin.

32 Interestingly also for revealing the mechanics of divergence in US and European concerns, 99 per cent of Spaniards had *heard about* bird 'flu but only 74 per cent about Iran's nuclear ambitions: 90 per cent about Abu Ghraib prison (a location of US atrocities in Iraq) and Guantanamo Bay, but only 68 per cent about Hamas's gains of power in the Palestinian elections

33 See para 29–38 on "Climate protection" and "Energy policy" of the Presidency Conclusions of the European Council of 8 and 9 March 2007; at: <www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf>.

proved more elusive, given conflicting interests over freeing up the intra-EU market, but also because of concerns in Central Europe over the burden on industry. If the Georgia shock of 2008 showed more nakedly than ever the destabilizing and divisive cost of EU members' energy dependence on Russia, the 2008 economic crisis threatened to sap both the will and time-pressure for finding better alternatives. The December 2008 European Council did reach agreement on continued European leadership in climate change restraints, but independent campaigners criticized the small print of its decisions for backsliding.

The second set of concerns related to the general challenge of Russia's increasingly high-handed behaviour both at home and abroad from late 2005 onwards. Fuelled by gains from high oil prices, President Putin used the "energy weapon" without compunction even against his closest post-Soviet neighbours; was clearly implicated in political manipulation of some major corporate relationships where foreign firms came off worst; embarked upon major increases in defence spending and the armed forces' equipment, and was widely suspected of complicity in a number of ruthless actions (including as-yet-unsolved murders) against political opponents at home. Institutional relations became affected when work on a Russia-EU partnership agreement broke down in December 2006, ultimately because of a unilateral ban by Moscow on Polish meat exports. In principle this resurgence of challenge from the East should have led (and at earlier points in history would have led) to a reinforcement of US-European solidarity in NATO. However, by 2006 NATO had almost completely shifted its focus away from Europe's own security to the pursuit of overseas deployments like the one in Afghanistan: all Western Balkans peace missions except KFOR (in Kosovo) had been transferred under the EU's authority. Two new "expansionist" US initiatives launched in 2006 – a "global partnership" with like-minded non-European states and the opening of membership prospects for Ukraine and Georgia – proved too much for the Europeans to stomach and failed to be adopted at NATO's Riga Summit in November. Opinion polls showed that only 55 per cent of Europeans in 2006 considered NATO "essential" for their interests in 2006 as against 69 per cent in 2002: although by mid-2008 the figures had improved again slightly.[34]

A further setback with more directly military overtones came in February 2007 when Putin used the platform of the annual Wehrkunde conference in Germany[35] to attack the West over the USA's plans to set up missile defence bases – positioned to cover a possible Iranian threat – in Poland and the Czech Republic.[36] Putin argued that these not only violated repeated assurances given by NATO since 1990 that it would not station foreign forces on its new members' territory, but also the terms of the US/Soviet INF Treaty signed in December 1987 which banned intermediate-range missiles on both sides in Europe – and which Russia itself might now not wish to respect.[37] A few months later he declared that Russia would "freeze" its implementation of the Conventional Forces in Europe (CFE) treaty, of which Western countries had in any case declined to ratify the latest version. While the USA robustly rejected all Putin's criticisms and claimed to have consulted and reassured Moscow, European reactions gradually revealed (a) that the programme for the USA's new European bases had not been debated and pre-approved by NATO as a whole and (b) that many Allies were actually unsure of their rationale. Throughout 2007–8, NATO in particular had to devote more energy to reconstructing some element of Western consensus than to trying to convince the Russians, who in any case showed more and more plainly that they relished the quarrel. Still more fuel was added to the flames by the EU and US decision to endorse Kosovo's unilateral declaration of independence in February 2008 (and provide for continued Western deployments there) while Moscow rejected it. The Georgian crisis against this background was only the last straw that broke the camel's back of Russia-West "partnership", leading to the suspension of most NATO/Russia cooperation and a further delay in negotiating the new Russia-EU agreement.

34 *Transatlantic Trends 2006*, see previous footnote 24. Key findings of Transatlantic Trends 2008 are at http://www.transatlantictrends.org/trends/index.cfm?id=122.

35 T. Hunter: "Putin's posture", in: *The Washington Times*, 13 February 2007.

36 The USA was also planning to create transfer and storage bases in Poland, Bulgaria and Romania for future conventional-force deployments in the Middle East "arc of crisis".

37 The *Treaty on the Elimination of Intermediate-range and Shorter-range Missiles* (INF Treaty), entered into force on 1 June 1988.

6.4 Five Years Later: (ii) The Fate of the ESS

As stressed by many analysts, the ESS was never a "strategy" in the sense of providing a detailed action programme on a rigorous defined set of strategic challenges, and/or a framework that could directly guide military actions.[38] Its status as a political document, generated in the EU's Council of Ministers framework, did not allow it either to create new EU law nor to create and allocate new EU funds.[39] It could only impact on day-to-day EU policies by being translated into more detailed "sub"-strategies or corresponding documents, making clear who should do what under them and from what sources any expenses would be met. In fact, the European Council that adopted the ESS in December 2003 also adopted an initial follow-up programme calling for further policy development in four areas: EU-UN relations, anti-terrorism, the Western Balkans and the Middle East.[40] (WMD issues were not mentioned because a strategy on those was already prepared, and a number of specific advances in ESDP mechanisms and operations were made by separate decisions in 2003–2004.) In the event, progress in anti-terrorist cooperation was boosted unexpectedly by the Madrid incidents of 11 March 2004. The European Council that met two weeks later adopted an ambitious package of measures including a declaration of mutual "solidarity" against all such attacks and the decision to draft a full anti-terrorist "strategy".[41] A document laying out a "comprehensive policy" for future EU actions in and responsibilities to Bosnia-Herzegovina was endorsed by the European Council in June 2004 and a whole raft of documents about EU-UN cooperation in the spirit of "effective multilateralism" were approved from September 2003 to May 2004.[42] Only on the Middle East did the EU fail to make any clear breakthroughs, conceptual or operational, in the first years after the ESS's adoption – constrained as it was by a lack of influence and resources, and its commitment to work within the international Quartet with the USA, UN, and Russia.[43]

In its own terms and by the EU's usual standards, this stands out as a coherent and reasonably creditable follow-up. However, caveats can be expressed both about the final *output* and impact of the EU policies covered, and about what the follow-up programme did *not* address. On the first point, the anti-terrorism field probably shows the best harvests of results both within the EU, and in EU–US cooperation (e.g. on aviation security and travel documentation, judicial measures, vulnerability mapping and emergency response): but even here the results may be seen as too little from one viewpoint – still too much national divergence and too little coordinating power in Brussels[44] – or too much from the standpoint of EU citizens' rights and liberties.[45] In the Western Balkans, the EU has assumed fuller responsibility for post-con-

38 See Heisbourg (2004), Freedman (2004); and European Institute for Security Studies (2004). It may be added that the ESDP missions launched since 2003 have not clearly fitted the ESS's prescriptions and priorities.

39 For further discussion of these procedural points against the background of evolving notions of "strategy" within EU governance see Bailes (2005), esp. pp. 7-8, 22, 25 and 27.

40 See European Council, "Presidency Conclusions of the meeting at Brussels on 12–13 December 2003"; at: < http: //ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/78364.pdf >.

41 European Council, "Declaration on Combating Terrorism", 25 March 2004; at: <http://ue.eu.int/ueDocs/cmsUpload/79635.pdf.

42 For details on these topics see Bailes (2005: 31).

43 Since the end of 2004 when the first cycle of ESS follow-up was complete, no new "package" of sub-strategies has been commissioned but some important specific ones have been tabled, e.g. by the European Commission on Africa: "The EU Strategy for Africa: Towards a Euro-African Pact to accelerate Africa's Development", published on 12 October 2007 and adopted by the General Affairs and External Relations Council on 12 December 2007; for a summary of the security implications see at: <www.isis-europe.org/ ftp/Download/ARTICLE%203.pdf>, 18 August 2007 and a "Strategy to combat illicit accumulation and trafficking of SALW and their ammunition", adopted by the European Council on 15–16 December 2005; at: <http://register.consilium.europa.eu/pdf/en/06/st05/st05319.en06.pdf>, 18 August 2007. The 21–22 June 2007 European Council adopted "The EU and Central Asia: Strategy for a New Partnership" (Council of the European Union document 10113/07 of 31 May), see para. 47 of Presidency conclusions at <www.consilium,europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/94932.pdf>, 15 September 2007. There are intriguing signs of the Commission re-gaining ground in long-range policy formulation generally, as a function of the more "economic" nature of new preoccupations (see below) and/or political exhaustion in Solana's team and some key national regimes.

44 A central "terrorism coordinator" post (first held by Gijs de Vries) was created under Solana in 2004 but at a modest level, with no power e.g. to command relevant resources in the EU's first and third "pillars", while states have blocked the Commission from acquiring new relevant competence .

flict transformation in Bosnia-Herzegovina (BiH) and for coordinating its different inputs there, but little progress has been made in "re-centralizing" the country's security structures and policies, while the EU's "enlargement fatigue" makes it harder to wield the stick-and-carrots of conditions for eventual accession against the BiH élites themselves. This last point perhaps even more seriously affected the EU leverage for gaining Serbia's acquiescence for the managed independence of Kosovo – a far greater and still unresolved test of the EU's credibility in the sub-region. As regards global security challenges, the EU could neither convert the UN's 50th anniversary summit declaration in September into more than a very partial success for "effective multilateralism", nor rein in the disorder and violence that marked the Middle East in 2004–2007 (including an open attack by Israel on Lebanon).

With all this, the most serious change against the ESS and its follow-up process is probably still what they failed to address. When the concern over energy security reached its first peak in January 2004, the Europeans had to start virtually from scratch in devising a common policy, with the mixed results that have already been noted. Work to prepare common responses to avian 'flu or other epidemics centred from early 2005 on a new European Centre for Disease Control (at Stockholm),[46] not even envisaged at the time of the ESS's drafting. The frenzied work in 2006–2007 to prepare and agree a policy that would place the EU in the lead in mitigating global warming was led by the European Commission rather than by Solana's team. Here lies a retrospective clue to some of the ESS's key limitations: bold as the document was in shaping new lines for external security policy, it studiously avoided trespassing (at least in terms of prescription) on functional areas at the intersection between security and economics or trade, if they belonged formally or presumptively to the Commission's competence in the Union's "first pillar". The ESS did make the obvious point about the need to combine tools from all parts of the Union's structure to implement strategic aims, but dodged the details of coordination or hierarchy between them. Conversely, as already noted, the long-standing EU/NATO role division – perhaps combined with several member states' concern not to "militarize" EU policy – prevented the ESS from either anticipating or offering solutions for the new directions taken by Russian misbehaviour from 2004 and the splits it was to re-open in European ranks. (As one result, the task of preserving any kind of momentum in European nuclear or conventional *arms control* was left dangerously in limbo between the institutions, contrasting with the new push to control the global arms trade through an EU-backed Arms Trade Treaty (ATT).) Last but not least, the whole US-European strategic relationship that provided the spur for creation of the ESS – and which explains the choices made in almost every single sentence of the document – was just too large and painful a challenge for the Union's leaders to address frontally and frankly in any open political statement in 2003. For the most part it still is.

6.5 The Future History of the ESS

None of these lacunae in the ESS's legacy should detract from its historic importance in symbolic, inspirational, and even lasting philosophical terms. It said what it needed to say, and was silent where it needed to be, to succeed in rallying European nations at a particularly dangerous moment in Spring 2003 and in inspiring concrete advances in several security-related fields. Considering the period of internal weakness and division that was to follow over the draft Constitution, with several key European leaders entering their lame-duck periods in parallel, the swift repair-work carried out by the ESS looks even more crucial in retrospect for allowing at least some minimum of common European strategic purpose to survive through to the potential renaissance of 2007. Indeed, a striking feature of EU activity in 2004–8 was precisely the way that external strategic affairs – including the burgeoning set of ESDP missions – provided a rare zone of steadily progressing achievement and relative "good behaviour" among the contributing states. The Central European regimes who caused such difficulties for EU internal and functional security decisions did not after all appear to be a brake on the development of ESDP as such.

On this showing alone, there would be no case for the EU to disavow its formulations of 2003 when considering how to take its strategic development forward from 2008 onwards, under a new set of leaders in Britain, France and Germany and with a radical change imminent in the White House. Moreover, sev-

45 The new common European Arrest Warrant (EAW) ran into particular difficulties, with constitutional courts in Germany and some other member states finding that insufficient safeguards for the rights of citizens facing extradition had been incorporated in national implementing legislation.

46 More information at: <http://www.ecdc.europa.eu>.

eral of the substantial judgements and guidelines within the 2003 text are also looking even better today than they did originally, in the light of the now-mounting costs of the Bush Administration's hard-line alternatives. In particular, the doctrine of "effective multilateralism" has won reinforcement as the USA has found itself obliged to tone down its advocacy of *ad hoc* coalitions, to accept new elaborations of the UN machinery[47] and to work harder once again for the renewal of NATO as an institution, as well as accepting or even engineering multilateral solutions for some other regions' security problems.[48] Latest experiences of conflict management and peacebuilding, not least in Iraq and Afghanistan themselves, have further underlined the limitations of the military instrument and the importance of local will and "ownership" in securing real transformations. Even if latest events have shown the huge difficulties of making Russia into a "partner", and many of the doubts about China's ultimate acceptance of that role remain, the USA's experimentation with harsher and more rejectionist approaches to such non-Western powers has only aggravated Western divisions as well as Western exposure and highlighted the urgent need for more imaginative and constructive approaches. Overall, it could be concluded that any security strategy based too much on "threat" and on assumed existential confrontations is liable to be an impoverished as well as a high-risk one: and the ESS's way of softening, of qualifying, and even of deliberately leaving things out from the "threat" picture may hold a kind of modest wisdom of its own.

Nonetheless, today's clearer appreciation of the gaps in the ESS's coverage – and the sketchiness of many of its prescriptions – is bound to raise the question of whether the EU needs to revise or even replace the document as it moves into a new and possibly more effective stage of its strategic maturation. Such a revisiting of the ESS became official policy in December 2007 when – under particular pressure from France which was in parallel overhauling its national defence strategy – the European Council agreed to give Solana twelve months to examine implementation of the Strategy and suggest elements that might both improve its implementation and "complement" the document itself.[49] As with the original draft, discussions proceeded in parallel during 2008 among governments and in academic seminars (coordinated by the EU Institute of Security Studies)[50] on what could and should come out of this exercise.

The Strategy review process was timely and the related intra-elite debates useful in themselves, given the coincidence with an impending change of US leadership – which European countries realized they would need to match with robust ideas of their own – and the obvious need to re-think all Russia-related and former Soviet Union-related policies. However, there were other ways in which the context did not favour any major, *a priori* re-imagining of EU strategy in late 2008. The trouble was not only that the issues themselves – Russia but also Iraq, Afghanistan, energy security, immigration, the financial crisis and more – needed more time and work to be digested before a proactive EU consensus (not a mere papering-over of rifts) could emerge. The whole governance context was also out of joint because of the postponement of the Lisbon reforms meant that Solana's team were still operating in an essentially inter-governmental, 'foreign affairs' context, rather than having one foot also in the Commission and being able to debate the strategic relevance, and use, of all the Union's mighty economic and functional capacities.

The December 2007 mandate implicitly recognized this by noting that the current review should take note in particular of the experience of ESDP missions, on which Solana's team are the experts but which play only a limited and perhaps unrepresentative role in the emergence of "Europe as a power".[51] It is relevant also that the EU has adopted another French idea for an independent wise persons' study on the 'horizon' for Europe's development by 2020–

47 The UN Summit of September 2005 reached agreement on the creation of a Peacebuilding Commission and a new form of Human Rights Council, both of which were in place by mid-2007.

48 The most obvious case is the agreement on handling the North Korean nuclear problem reached at the Six-Party Talks hosted by China in February 2007, but the USA has also been obliged to agree to the start of talks with and among Iraq's neighbours on handing border security problems there. Some passages confirming the USA's conceptual acknowledgement of the uses of multilateralism (eg in regions with many weak states) will be found in the new version of the NSS published in March 2006, text at <http://www.whitehouse.gov/nsc/nss/2006/>, 25 September 2007.

49 Presidency Conclusions of the European Council 13–14 Dec. 2007, para. 90, Council document 16616/1/07/REV1, available at http://consilium.europa.eu/cms3_fo/showPage.asp?id=432&lang=EN&mode=g.

50 See the information and papers at http://www.iss.europa.eu/index.php?id=247.

51 See Bailes (2008) and other articles in International Affairs Vol 84 No 1 of Jan. 2008.

2030, and it is arguably in that exercise – to be undertaken as and when forward motion is resumed on the Lisbon Treaty – that any major re-thinking of the EU's strategic identity should find its place. Last and not least, at a time when European populations were facing serious pain from the economic turndown, it would have been suicidal for European politicians either to give the impression that they were wasting major energies on lofty long-term visions, or, indeed, to attempt a new strategic breakthrough that might have alienated as many citizens as it inspired.[52]

Sensibly enough, Solana's drafters adopted - and the European Council on December 11–12 2008 accepted - a prudent and workmanlike approach. The European Council "endorsed the analysis" in a 12-page report made to the Council of Ministers "on the implementation of the European Security Strategy",[53] but did not itself adopt the paper for publication – making clear it was not replacing the original Strategy. The paper replicated the approach of the first ESS in stating general desiderata for EU policy rather than conveying new decisions (or mentioning money); thus, such concrete steps as were ripe for adoption in the defence/security field – notably a new Declaration on ESDP goals,[54] a package of decisions on global WMD issues and changes in the European Neighbourhood Policy's Eastern and Mediterranean dimensions – were announced in separate declarations by the Council and European Council.

The report itself made a fair attempt to remedy some of the generic imbalances of the ESS e.g. by saying more on economic and energy problems (and the connection between security and development); acknowledging the newly fashionable topics of cyber-sabotage and piracy; playing up the issues and needs created for the EU's own territory by the risks of terrorism, crime and migration; and in general, taking a more holistic approach to the internal and external dimensions of European security. In terms of institutional partnership it stressed UN supremacy more clearly than before – perhaps hoping to strike a chord with President-elect Obama! – but also echoed recent shifts in French national policy by expanding on the need and scope for cooperation with NATO.

It seems unlikely that this new text will attract more than a fraction of the academic attention lavished on the original. Even a first reading confirms, however, that the drafters did not manage – or perhaps even try – to overcome some of the ESS's more basic omissions. The challenge of Russia for Europe's own security is again dodged to an extraordinary extent, with the bland statement appearing on page 10 that "Our relations with Russia have deteriorated over the conflict with Georgia." Even less are the conundrums of the USA's role in European and global security, or the rise of China, addressed; and the discussions of the Western Balkans, EU neighbour regions and Iraq are superficial and complacent. Those who criticized the first ESS for lack of true 'strategic' thinking[55] will find no greater satisfaction here; nor is it easy to imagine ordinary European citizens finding much that would resonate with their own day-to day anxieties. At least, the 2008 report includes one concluding paragraph acknowledging that "Maintaining public support for our global engagement is fundamental."

How much do these continuing inadequacies matter? Arguably, the EU is more likely to define active and correct responses to today's security changes through separate sectoral decisions ('sub-strategies' adopted by the Council, or Commission-led policy developments) than it could ever be expected to do in a conceptual paper covering so many great issues so thinly. Moreover, the EU's future weight in the global system and the way it changes global practice for good or ill depends in almost every field on how it relates to other great powers – the USA, Russia and increasingly China – than on any policy it can formulate in full independence. For managing those tricky but vital relationships, Europe's leaders are unlikely to refer to any single documentary road-map even if the ESS had been able to offer them a good one. In the last analysis, strategies are created for men and not men for strategies. What the EU needs in order to confront the more multiform threat and risk environment of 2008 onwards is, not so much to re-imagine the document that first emerged in June 2003, as to recapture the spirit of resolve and unity in which Europe's leaders first endorsed it.

52 Research during 2008 into reasons for the failure of the Irish Lisbon Treaty referendum suggested some voters had been scared off by the belief that a common 'European army' was being planned.

53 Council Document S407/08 of 11 Dec. 2008, text at http://www.consilium.europa.eu/cms3_applications/applications/newsroom/loadDocument.ASP?cmsID=363&LANG=EN&directory=en/reports/&fileName=104630. pdf.

54 Annex 2 to Presidency Conclusions of the European Council 11-12 Dec. 2008, text at http://www.consilium.europa.eu/cms3_applications/applications/newsroom/loadDocument.ASP?cmsID=221&LANG=EN&directory=en/ec/&fileName=104692.pdf.

55 See footnote 38 above.

7 NATO's Traditional Security Problems

Pál Dunay

7.1 Introduction

Whenever attention has been paid to alliances during the last two decades reference is exclusively or nearly exclusively made to the *North Atlantic Treaty Organization* (NATO). Consequently, except for historical works, NATO serves as the ideal type of alliance (Walt 1990). This presents a variety of problems. First of all, NATO "was always intended to be both more and less than a military alliance" (Howard 1999: 164). More in the sense that NATO has always been the most important avenue of transatlantic security dialogue and less in the sense that NATO is not a fighting alliance. During its entire duration it never had to use force for the defence of the member states' territory. This may well be its greatest achievement. If this is true, it is not entirely convincing to draw conclusions from this alliance for alliances generally (Howard 1999). Given the very few recent alliances, it is unconvincing to base alliance theory exclusively on NATO. It would be just as unconvincing to base any theory of alliances on NATO and the Warsaw Treaty, two very dissimilar entities of Cold War history. Methodologically, it is furthermore questionable to base the thinking on alliances exclusively on NATO as a full extrapolation one would thus apply is scientifically unsound.

When NATO's success is mentioned reference is regularly made to the Alliance's age. In spring 2010 the organization was 61 years old. It has certainly achieved a lot beyond its survival for such a long time. It is, however, again problematic to attribute some of the successes frequently mentioned to NATO. The success of deterrence during the Cold War, the success to end the East-West confrontation, the successful management of several post-Cold War conflicts, rallying support to counter terrorism, the collective attention attributed to cyber warfare, and the danger of proliferation are all cases in point. NATO has certainly been present at all these junctures since its inception in 1949 and at least has contributed to manage many of them. A closer look would not attest NATO's prime role, rather its contribution to the change of European, Euro-Atlantic and, since the end of the Cold War, of global security.

This chapter attempts to discuss a narrow and specific though certainly crucial matter on NATO's agenda: Its role in addressing traditional security problems. Although such a matter could be narrowed down to the application of the collective defence article of the Washington Treaty of 1949, it is necessary to broaden the subject further. The question has to be raised, which are the contingencies that would invoke the collective defence commitment of the Alliance. This leads to the question of what could be identified as traditional 'hard' and new 'soft' security threats (chap. 2 by Brauch). This chapter will not address other, however, important matters of the Alliance (Dunay 2008: 713–725).

7.2 Security Threats, Risks, and Challenges

The history of NATO's existence can be divided into two phases. During the Cold War it functioned as a classical military-political alliance. It was its main task to deter a well-identified adversary, the Warsaw Treaty under the leadership of the Soviet Union (Schwartz 1983; Simon 1988). With the end of the Cold War and the advent of a new era the situation has changed fundamentally. The classical function to provide for protection and defence against another group of states, 'against whom' became irrelevant, interestingly at a time when the so-called 'long peace' (Gaddis 1989) of the Cold War came to an end and force was used again on the old continent. It gave way to a far less clearly identified threat. This was a threat originating from the emergence of certain phenomena and not associated with any country or coalition of states, i.e. NATO's activity was moved to providing protection

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'against what?' Since then NATO has found it difficult to present a clear view of the prime threats it is facing.

Departing from the Cold War threat perception, the search for new threats occurred during a long transitory period. During that time NATO had difficulties to adapt to the changed security environment. In want of a classical threat the member states had two reactions: 1. There were attempts to portray the protraction of the residues of the old threat. 2. The Atlantic Alliance went 'out of area'.

During the last phase of the decline and near collapse of the Soviet Union and in the first publicized strategic concept of the Atlantic Alliance the 'old' Soviet threat was assessed to exist based on the size of the Soviet, among others, nuclear arsenal (NATO 1991: para. 10).[1] The approach based on net capabilities combined with political uncertainty was excessive, although NATO lost its traditional adversary not much later, since Russia was sliding into chaos (chap. 13 by Sergunin; chap. 14 by Dunay). Russia's weakness was far more significant than Russian strength for most of the 1990's. Analysts nevertheless contemplated Russia's potential to reappear as a threat to Europe (Glaser 1993: 19–21). The doubts that surrounded the credibility of such an approach were mounting and hence it was difficult to conceive that NATO could form cohesion on that basis. The Russian threat was simply not credible and intensive enough to underline NATO policy.

The situation has changed since the early 21st century. Russia has since appeared more prominent on NATO's and its member states' agenda for at least three reasons:

1. The Russian Federation under the leadership of Vladimir Putin has reconsolidated its statehood and allocated more resources to the military than in the 1990's. Furthermore, in the second half of the decade the Russian Federation has embarked upon a defence reform. Although it has remained inconclusive (Fedorov 2009) it carried the promise that Russia will one day have a more effective military.[2] Furthermore, in the last years of the century's first decade Russia returned to the long overdue modernization of its nuclear arsenal.[3]
2. The number of those NATO member states conditioned by history, which have lively concerns about Russia, has increased through enlargement. Estonia, Latvia, Lithuania, and Poland are preconditioned by history to feel strongly about developments in Russia and to interpret them as worrying.
3. The actions of Russia in the second half of the first decade of the 21st century to assert her dominance in the post-Soviet space and curtail the freedom of choice of countries as far as their international alignment underlined the concerns of some NATO member states, if not the alliance as a whole. This has been exacerbated in 2008 when the Russian Federation used military force in an interstate contingency against Georgia, although the former did not initiate it. Even though the changes of Russia may affect the security perception of the Atlantic Alliance, they could be hardly sufficient to influence the entire alliance and shape its security agenda. With this in mind there is no security threat in Europe that could live up to the threshold of response of the Alliance as such.

There was very little to do to defend the sovereign territory of the then 16 NATO member states from external powers or their emerging alliance throughout the 1990's. As it did not seem to change any time soon, NATO had to consider other security functions. It was not only a matter of survival for the organization as also one to retain continuing relevance. For the first half of the 1990's it was not particularly difficult to find the new wherewithal of NATO. The war in the former Yugoslavia that Europe hoped to be able to manage on its own landed on the agenda of NATO. It happened in spite of the fact that the Strategic Concept of 1991 did not envisage participating in any crisis management or peacekeeping operations. This was the first geographical extension of the activity of the alliance. NATO decided to be Europe's military crisis manager irrespective of the effect of the given crisis on the alliance or its member states. Yugoslavia was clearly not a contingency for the collective self-defence of the Alliance. NATO as an all-European institution retained its security relevance at a price of departing from its sound treaty base and thus arriving at an ambiguous situation. That was not positively greeted by states that opposed the expansion of NATO as an all-European institution.

1 See: "The Alliance's New Strategic Concept agreed by the Heads of State and Government Participating in the Meeting of the North Atlantic Council", 7–8 November 1991; at: <http://www.nato.int/cps/en/natolive/official_texts_23847.htm>.

2 The new Russian military doctrine was approved on 5 February 2010 (Voyennaya 2010).

3 The document on the Russian state policy on nuclear deterrence was also approved on 5 February 2010.

Fostering the resolution of the war in the former Yugoslavia broadened the scope of NATO's activity as a crisis manager to Europe as a whole. The next step, although still carried out in Europe, and hence was no further geographic broadening compared to the previous one, represented a fundamental change in NATO's approach to the security of the continent. The 1999 war against Yugoslavia was a humanitarian intervention or a collective coercion verging on aggression. This was a fundamental turn as the 78 days of bombardment, even if it according to many served a noble purpose, could not be legitimized as a defensive action, nor did it have the endorsement of the UN Security Council.

There could be convincing arguments to conclude that the circumstances of the NATO operation were unique, that Yugoslavia (Serbia) under the leadership of Slobodan Milosevic had had a long history of confrontation with NATO. These facts could reassure non-NATO member states that it was not a new era that started in NATO's history characterized by moving from collective defence to collective offence. For anybody who watched the unfolding series of events from outside, in particular those who focused on narrowly defined legality of the spring 1999 operation, there could be hardly any doubt that this was a watershed in NATO's development.[4]

NATO adopted its Strategic Concept at the 50th anniversary summit of the Alliance in 1999 while the operation was going on in Yugoslavia. This has been the first Strategic Concept adopted after the collapse of the Soviet Union and in reflection on the strategic-political change of the 1990's. Regarding the security challenges and risks, the Alliance should respond to, the concept has remained quite abrupt. The five paragraphs (20–24) that list the challenges includes "uncertainty and instability" (para. 20), "powerful nuclear forces outside the Alliance" (para. 21), "proliferation of NBC and their means of delivery", the illicit trade of materials and knowhow (para. 22), and "non-state adversaries" (para. 23). Acts of terrorism and organized crime were mentioned in passing (para. 24). The reference to uncertainty and instability was a clear indication that NATO had not agreed on a concept about its primary future threats. The cursory reference to terrorism demonstrated the absence of a consensus as far as the most important potential emerging threats. Hence, the Strategic Concept illustrated the constraints of prediction.

After having moved from 'against whom' to 'against what', and 'against what type of security phenomena' instead of what enemy, it was difficult to interpret which geographical region has priority on the agenda of the Alliance. For some time, it seemed the greater Middle East would be an area where the future of NATO should be decided (Asmus 2003), but probably in a traditional sense the ambiguity will have to be retained for the cohesion of the member states. It can be taken for granted that NATO's acceptance in the greater Middle East must be built up by years of tedious work, if not that of decades. It must include soft security measures, which are already on the agenda.

The 9/11 terrorist attack against the World Trade Center in New York and the Pentagon near Washington fundamentally rearranged the threat perception of the Atlantic Alliance. Terrorism has become the primary threat and will continue to remain on the top of the list of threats for the foreseeable future. This means that on the list of threats one that originates from non-state actors is on the top. States matter as much as they cannot control their territory fully and hence serve as platforms for terrorists (or others who present transnational threats). Since then terrorism, particularly in combination with the aspiration to acquire weapons of mass destruction and states, which do not control their territory effectively, and hence carry the risk to be exploited by groups carrying transnational security risks are the primary threats. It is necessary to fight against those states which may be hijacked by terrorists or which live in symbiosis with them. Somalia could be an example of the former, Afghanistan of the latter.

If NATO may well be threatened from (and not by) countries, which are inherently weak, unable to fully control their territory or, eventually, their statehood tends to move from fragile to failing or failed, it reconfirms the policy of the Alliance that conflict management and support for post-conflict recovery are essential elements of guaranteeing security of the allies and the broader community of democracies. That has resulted in the reconfirmation of two major trends in NATO policy: It has contributed to the further extension of the activity of NATO beyond collective defence to collective security, further eroding the boundaries between the two. It has also contributed to the confirmation of the thinking of NATO that the security of the North Atlantic area in the era of globalization cannot be confined geographically to the

4 During the Kosovo operation of 1999 some members of the Russian security establishment spoke about the 'loss of NATO's innocence', i.e. the vanishing of the moral superiority of the West.

territory of the member states, not even to Europe more broadly.

There was a full consensus in NATO and in the international community generally that Afghanistan carried the danger of the proliferation of terrorism unless the regime would change in that country. That's how Afghanistan not much after the September 2001 terrorist attacks has become the shared responsibility of NATO and of like-minded countries. It has to be emphasized, however, that not every member of NATO participated in the operation that resulted in the removal of the Taliban government, and it was not an operation of the Alliance. ISAF, a NATO operation only started later. In light of the preceding high intensity operation it would be difficult to regard it as a collective defence action although imagination may help get beyond it.

The fact that terrorism has been the highest ranked shared threat of the Alliance for a decade has challenged the frontiers of collective defence. The Alliance faced a delicate choice: It could stay with a narrow definition, i.e. focus on a classical interstate challenge against a member state's territory and due to the minimum likelihood of such a scenario lose its residual relevance. Or it could adapt to the strategic change flexibly, reflect actively on the changed strategic situation and regain some of its relevance. It is clear the Alliance practically had no choice. Moreover the choice was made long before 9/11. According to this author's assessment it happened when NATO refocused its attention to security threats ('of what?') and no longer had a state-identified threat perception ('by whom?'). Since then in a cautious and reactive manner the Alliance has been reacting to emerging security concerns. It has done so irrespective of whether the foundations of the Alliance have supported it or not.

As the policy of NATO has reflected upon and reacted to the emergence of new threats and risks, terrorism and organized crime could not remain the only transnational phenomena. When Estonia faced a cyber security challenge the Alliance demonstrated political solidarity and also established a small cyber security centre in the country, strengthening key Alliance information systems against cyber attacks. NATO declared, and in light of the increasingly frequent cyber attacks rightly and in time:

> We have recently adopted a Policy on Cyber Defence, and are developing the structures and authorities to carry it out. Our Policy on Cyber Defence emphasizes the need for NATO and nations to protect key information systems in accordance with their respective responsibilities; share best practices; and provide a capability to assist Allied nations, upon request, to counter a cyber attack (para. 47).

As energy security has emerged on the agenda for many NATO members the organization was also pulled into taking a position on it. Certainly, it was a divisive matter as member states were affected differently by hydrocarbon dependence. Hence, understandably the text agreed upon had to remain ambiguous and programmatic. It promised the

> formation and intelligence fusion and sharing; projecting stability; advancing international and regional cooperation; supporting consequence management; and supporting the protection of critical energy infrastructure (para. 48).

It certainly presents a problem for the Alliance that these new risks or threats although they do not qualify as armed attack, still they require reaction from NATO: "attacks against computer networks (cyber attacks), the release of hazardous material or the cut-off of energy supplies can hardly be seen as armed attacks but we still require solidarity and common action" (Kamp 2009). This fact notwithstanding, various circles ranging from U.S. Senators to the NATO Council have contemplated how solidarity could extend to such contingencies, which are definitely more likely than a classical article 5 based scenario.

7.3 What Would Collective Defence Mean for NATO?

The legal foundations of NATO are extremely solid. The basis of the Atlantic Alliance is the Washington Treaty. In article 5 the parties agreed

> ... that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and consequently they agree that, if such an armed attack occurs, each of them, in exercise of the right of individual or collective self-defence recognized by Article 51 of the Charter of the United Nations, will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area.[5]

Since the inception of NATO this article has been the core commitment enshrined in the Treaty. When the

5 See: "The North Atlantic Treaty, Washington D.C. – 4 April 1949", at: <http://www.nato.int/cps/en/natolive/official_texts_17120.htm>.

Treaty was drafted and agreed the 12 signatories had different preferences. For most West Europeans which faced a determined adversary victorious in World War II with huge conventional armed forces and a large area of forward deployment, collective defence, including the involvement of the United States in European security was the most important. For the USA it was much more article 2 of the Treaty that spoke about the objective of strengthening free institutions, by bringing about a better understanding of the principles upon which these institutions are founded that mattered. This could mean the consolidation of democracy in Europe for the coming historical era. Last, but not least, article 4 with its soft commitment to initiate consultation by any one member state could also be important as it could guarantee that no member of the Alliance would remain isolated with its security concern, founded or not.

If one takes a close look at article 5 the following can be stated: The article is a clear expression of the core of an alliance based on "collective self-defence" (Art. 51 of the UN Charter). The commitment, taken somewhat hesitantly by the USA at the time, is confined geographically. It extends to Europe and North America only. This was due primarily to the territories that first of all the UK and France controlled overseas as their colonies. It was also an important constraint that collective defence could only be invoked when an "armed attack" occurs. As this part of article 5 in fact refers back to the same expression in the UN Charter there is little room left for interpretation. That formulation excludes anticipatory self-defence or pre-emption as in those cases no armed attack actually occurs. International lawyers who pay no attention to strategic considerations would probably go down that road (Haines 2009; Cassesse 1999; Simma 1999; Frowein 1999). This could make this essential treaty article detached from reality and strategically irrelevant (Daalder 1999).

The most important ambiguity of article 5, however, is the definition of action that may follow. First of all it is necessary to identify that an "armed attack" has actually occurred. The states parties may conclude that it is impossible to define, whether the non-NATO member state has launched the armed attack or the member state itself. This could serve as ground for inaction. If NATO concludes that an external armed attack has actually occurred the Alliance is still not obliged to defend the member state. It may take such action as the Alliance and the member states deem necessary. This can range from virtual inactivity to forceful collective defence using massive force. It is at the discretion of NATO members to decide what follows. This may not be particularly reassuring for a member state that is under the impression of its facing a classical interstate security challenge. Even if a state under article 5 of the Washington Treaty does not get massive military support on the basis of collective defence it would not be left alone. It could share its security concerns with all the other member states under article 4. This may matter more than one could imagine on the basis of the text. Namely, if the concerns of the member state present a *prima facie* case for collective defence it would be difficult for others to ignore it without severely undermining the core commitment[6] inherent in NATO.

This may very well be behind the impression that NATO is hesitant, if not outright reluctant, to offer membership to countries with outstanding individual defence deficit that may end up becoming a collective defence problem. On the one hand this is fully understandable as NATO should not, irresponsibly, import security problems. But on the other hand it has to be taken into consideration that it is thus possible for states outside the Alliance to block the advancement of countries which aspire for NATO membership. They have to demonstrate resolve to oppose accession and present a picture whereby the aspirant country is pulled into a security quagmire. It requires extreme care from the Alliance on how to react to this. Whether to put the advancement of the aspirant on halt and thus in fact provide a veto right upon its choice by a third party or to continue with the approach to membership and import a potential collective defence problem. Although several factors make the matter far more complex this lies at the heart of the accession aspiration of Georgia and the opposition of Russia to it.

It may be found reassuring that no NATO member state has been attacked by a non-member since the inception of NATO.[7] During the Cold War this

6 In 1995 when Hungary was an aspirant for NATO membership this author asked a ranking U.S. official why there was so much fuss about Article 5 when the obligation of the member states to massively back the country claiming collective defence. His answer was succint: "Because we mean it."

7 On the contrary, a NATO member state has already attacked a non-member when Turkey launched an attack against Cyprus. Two NATO members, Greece and Turkey had a long series of lower intensity military exchanges. A non-NATO member, Libya, attacked Italy when it launched a rocket on the Italian island of Lampedusa that actually missed its target.

could have been due to the success of collective deterrence symbolized by the existence of NATO. Since the end of the East-West conflict, it cannot be attributed to that. Either one remains agnostic and concludes it is not known why there was no large-scale military confrontation in Europe or one realizes that intentions have been absent to use force in Europe to achieving political goals. Therefore article 5 of the Washington Treaty never had to be used during the Cold War. Deterrence worked and prevented the organization from facing the test of what it would mean in practice.

Article 5 of the Washington Treaty was invoked only once since the end of the East-West conflict. On 12 September 2001, the day after the deadly terrorist attack on the USA.

> The Council agreed that if it is determined that this attack was directed from abroad against the United States, it shall be regarded as an action covered by Article 5 of the Washington Treaty, which states that an armed attack against one or more of the Allies in Europe or North America shall be considered an attack against them all.[8]

It is clear that the day after the event it was difficult for the North Atlantic Council to draw the conclusion on legal grounds that the case fell under article 5 of the Washington Treaty. It was the explicit reason to which reference was actually made in the statement whether the case had an international element at all or it was fully domestic, confined to the USA. There the conclusion could be drawn easily that the matter was partly international. Some perpetrators lived in Europe and used their European residence to prepare the terrorist act. There was, however, a tacit issue as well. Namely, whether the terrorist attack could be regarded as an armed attack at all. In the end, the terrorists did not use arms; they used civilian aircraft and flew them into buildings. Irrespective of the legal ambiguity it is clear that not demonstrating solidarity with the victim of the attack, the USA could have given a very strange political signal. The United States' NATO allies with the statement expressed their readiness to "stand ready to provide the assistance that may be required as a consequence of these acts of barbarism".[9] NATO demonstrated political solidarity with the USA during those historical days and gave credit to collective defence even though the USA needed very little actual military support.

When during the period that led to operation 'Iraqi Freedom' Turkey wanted to get extra reassurance for contributing to the operation as a major springboard, it did not get a satisfying counter-offer to its request. Namely, Turkey basically wanted to get a guarantee that would have made article 5 of the Washington Treaty automatically applicable to mean defending Turkey in turn for an eventual Iraqi countermeasure for its helping the Iraq operation of the USA and its allies.

There were several problems with this proposition. First, this operation was not carried out by the Alliance. Second, it would have given a blank cheque to Turkey and could have been regarded as a very shaky precedent. For these reasons Turkey had to live with less (Gilmore 2003) and NATO could retain the ambiguity that has surrounded the content of article 5.

7.4 Dilemmas of a New Strategic Concept

The Atlantic Alliance decided in April 2009 to prepare and publish a new strategic concept. This will be the third post-Cold War concept of NATO. In light of the changes in international security since the adoption of the previous Strategic Concept in 1999 there is no reason to argue for the need of a new one. The Alliance invented a framework in which the preparation of the text will be somewhat non-traditional. Rather than letting the member states have a classical politico-diplomatic drafting exercise, member states have set up a three stage process where a 12-member expert group headed by former U.S. Secretary of State Madeleine Albright, the NATO Secretary-General Anders Fogh Rasmussen, and the member states equally play a role (IISS 2009). It seems the process is geared to avoid that member states, in an endless drafting exercise, would ground the new Strategic Concept and arrive at the lowest common denominator. Bearing in mind the objective difference in the position and interests of the member states and their preferences this may well be the best solution. However, member states have already noticed it and started to produce national position papers where they have outlined the minimum content acceptable for them.

The expert group tried its best to find an adequate balance between the Scylla and the Charybdis of different national interests of NATO's 28 member states and the strong opinion of the NATO secretary gen-

8 See: "Statement by the North Atlantic Council", Press Release (2001)124, 12 September 2001; at: <http://www.nato.int/docu/pr/2001/p01-124e.htm>.

9 See: "Statement by the North Atlantic Council", Press Release (2001)124, 12 September 2001.

eral in its analysis (NATO 2010). However, this could only partially be successful. On the one hand, the group of experts found it crucial to reaffirm "NATO's Core Commitment: Collective Defence" while they also broadened the scope to extend the protection to unconventional threats (NATO 2020: 8–9) arguing

> the Alliance must maintain the ability to deter and defend member states against any threat of aggression. This commitment ... should be reaffirmed in unmistakable terms. At the same time, NATO ... must recognise that the potential sources of Article 5 threats have broadened and now include dangers that could arise either inside or outside the Euro-Atlantic region" (NATO 2010: 19).

This approach may balance the matters important to varying extent for different members. Furthermore, it advocated establishing "Guidelines for Operations outside Alliance Borders" generally, while separating, and thus emphasizing the crucial importance of one operation outside the territory of the Alliance: Afghanistan (NATO 2020: 9). It remains to be seen in what form these delicate balances will be preserved in the forthcoming Strategic Concept of 2010. The recommendations of the Group of Experts have indicated a realistic approach.

All the current ambiguities of NATO's orientation ('against whom' vs. 'against what', 'global' vs. 'regional', 'collective defence' vs. other tasks of the Alliance) have appeared in the national position papers. A kind of compromise will be achieved certainly at the NATO Lisbon Summit of November 2010. It will require finding the right balance between states, which represent one view or the other in the three matters outlined above as a minimum.

For the purposes of this chapter it will be the most delicate to find the balance between non-article 5 activities of the Alliance, which dominate the agenda ranging from stabilization operations, like in Afghanistan, to broader conflict management tasks on the one hand and the reconfirmation of article 5 guarantees on the other. For Estonia, Latvia and Lithuania, and maybe also for Poland, a strong and credible verbal reassurance of article 5 is essential. This is particularly the case when Russia has put (the continuation of) NATO enlargement high among the threats in its military doctrine.[10]

On the other hand, those countries, first of all the United States, which sacrifice the most in international operations should also gain reassurance that the Alliance may add to global international security beyond political reassurance. This requires some commitment from the other member states to "include the narrowing of the investment and capabilities gap among the Allies, improving the usability, interoperability, deployability and sustainability of the Allied forces, conducting the missions in Afghanistan, the Balkans, and Iraq" (Necas/Terem/Kelemen 2009).

It is fortunate that article 5 did not have to be invoked more frequently, and thus the Alliance could refocus its attention on other matters and hence in the strategic concept the balance is to be established between the 'alliance in being' and the 'alliance in doing'.

7.5 Conclusions

NATO has never been a classical defence alliance. During the Cold War it still more resembled one than it has since 1990. Since then it has been continuously adapting to changing circumstances, first and foremost to the globalization of international security both functionally and geographically. The move from 'defence against whom?' to 'defence against what?' adequately reflecting strategic uncertainty and ambiguity logically led to the erosion of boundaries of traditional security. The most important change that stems from it is the blurring of collective defence and collective security on the Alliance's agenda. NATO has become an institution with a broad security agenda ranging from defence against terrorism to conflict management to guaranteeing cyber security and contributing to energy security. It is difficult to imagine how the Alliance could deliver on the many often ambiguous promises in spite of the vague formulation. The other broadening of Alliance activity is geographical from the territory of the member states to conflict management in Europe (former Yugoslavia) and then more broadly. These changes have eroded the strategic cohesion once shared in the Alliance.

The main dilemma that has resulted from the changes mentioned above could not be resolved. In an environment where the strategic interests of the

10 The text of the Russian military doctrine formulates it in a complex manner. It mentions "the attribution of global function to the force potential of the *North Atlantic Alliance* (NATO) in violation of international law, the approach of the military infrastructure of NATO member-states to the borders of the Russian Federation, including through enlargement" (Voyennaya Doktrina Rossiyskoy Federatsii 5 fevralya 2010-ogo goda" [Military Doctrine of the Russian Federation of 5 February 2010]: point 8, para. a; at: <http://www.kremlin.ru/ref_notes/461>).

allies are not held together by sharing the existential threat where they are by far not identical and where their security perceptions vary, the alliance is held together by constantly seeking and finding compromise. The fact that one member of the Alliance has preponderance may also help overcome the differences. Consequently, it is a matter of constant balancing first and foremost in NATO documents and often also in reality that has been necessary to maintain the balance of interests. This can be overshadowed by diplomacy as well as by the prominent role and leadership of one member state that helps find reconciliation in the Alliance; however, it cannot be taken off the agenda. Short of a fundamental change in European security the muddling through will have to continue.

8 European Responses to Security Threats in the Mediterranean in the Early 21st Century

Eduard Soler i Lecha

8.1 Introduction[1]

According to the *European Security Strategy* (ESS 2003) European security cannot be tackled without considering the security of neighbouring countries (chap. 6 by Bailes). Threats to the security in countries in the Southern and Eastern Mediterranean can rapidly become security threats for the *European Union* (EU) as a whole, and can particularly affect countries of Southern Europe. In this context, the Euro-Mediterranean area has been described as a single security complex (Biscop 2003: 191) or as a system of security complexes (Bremberg Heijl 2007: 2). Similar considerations were also made from a sub-regional perspective for the Western Mediterranean (Haddadi 1999). Moving beyond this debate, this chapter attempts to highlight the threats affecting the Euro-Mediterranean area, or some countries that comprise it. It examines to what extent the European Union has succeeded in providing sufficient cooperation mechanisms for improving security conditions in the region.

While there are numerous security doctrines in security studies, this chapter uses the 'human security doctrine'.[2] It emphasizes threats undermining the security of citizens on both rims of the Mediterranean. Among various definitions of the human security concept (UNDP 1994), the 'freedom from fear' approach will be used here. That is, a narrower concept which focuses on threats to physical security of individuals.[3] However, the chapter acknowledges that a wider definition embracing socio-economic needs ('freedom from want') could offer relevant insights. It also takes threats to state security (e.g. classical territorial disputes) into account as long as they affect, directly or indirectly, the personal security of citizens.

If states' security would be the exclusive focus of this chapter, an ideal scenario for the EU and Mediterranean countries would be to agree on a collective security system to eradicate violence or the threat of violence among them and to defend collectively the interests of each state. This ideal scenario would turn the Euro-Mediterranean area into a security community (Deutsch/Burrell/Kann/Lee/Lichterman/Lindgren/Loewenheim/Van Wagenen 1957). From a human security approach the concerns of citizens' security is crucial. A collective security framework should be accompanied by measures guaranteeing the respect for the individual and for fundamental freedoms as well as fighting against crime.

How can these goals be reached? Which stages are needed for this framework? Is the Barcelona Process (and since 2008 the Union for the Mediterranean) a suitable framework for the implementation of these goals, or should other cooperation frameworks be adopted? This chapter is divided into five different sections. The first part outlines the discussion on the existence of old and new threats (8.2), the second differentiates between intra-states and domestic threats in the region (8.3), the third identifies some of the most relevant threats for the physical integrity of citizens (8.4), the fourth deals with the existent cooperation initiatives relevant to the security realm (8.5) and in the conclusion, this chapter outlines alternatives that may lead in the medium term to a situation where the citizens of the Mediterranean, together with all Europeans, will live in security.

The Mediterranean is one of the greatest challenge for Europe's security, besides being a region where the EU must become more involved in security

1 The author thanks Fadela Hilali, assistant of the Mediterranean Programme at CIDOB Foundation, as well as for the comments of the three anonymous reviewers which improved this text.

2 The report: *A Human Security Doctrine for Europe, The Barcelona Report of the Study Group on Europe's Security Capabilities* applied this doctrine to the European external and its security policy.

3 For a similar focus see Serra Serra (2008, 2009); Chourou (2005, 2009); Soler i Lecha (2007); Morillas and Soler i Lecha (2006).

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issues (Serra Serra 2008: 24; 2009). This is a key task for the EU in the 21st century.

8.2 The Mediterranean Under Threat

In security debates 'new' and 'old' wars (Kaldor 1999) are distinguished, as are new and old victims or new and old threats. On Mediterranean security, rather than speaking of new and old phenomena, these phenomena have attracted more attention over time and their effects have always been visible. Many of the 'new' threats in the early 21st century – e.g. natural disasters or new forms of terrorism – have affected the Mediterranean for many years. However, now their effects are more acute and more attention is being paid to them.

Regardless of being 'old' or 'new', 'hard' or 'soft', 'classic' or 'modern', some of these threats produce a climate of insecurity that Mediterranean states and citizens experience now. These threats are: 1) regional conflicts, including situations of occupation and the perceived threat of attack by neighbouring countries or their allies; 2) domestic political conflicts that may lead to outbreaks of violence; 3) international terrorist acts; 4) threats to personal safety deriving from various criminal groups or other threats that are combated ineffectively by the security forces; 5) threats to personal safety from the abuse of their own citizens by governments and police forces; and (6) effects of natural disasters.

These threats cannot be viewed as isolated phenomena, as many of them are interlinked. There are links between international terrorism, persistent regional conflicts, and organized crime networks. Some states notoriously oppose measures to foster democracy or human rights, and they justify this stance with a need to safeguard their states from other states or terrorist actions. Finally, the effects of natural disasters are much greater where the state lacks preventive mechanisms, or sufficient ability to react to such emergencies.

8.3 Regional and Internal Conflicts

The key regional conflict is the Arab-Israeli conflict that is a system of conflicts comprising the occupation of the Palestine Territories, the occupation of the Golan Heights, and the repercussions of these acts on relations between Syria and Israel besides the tense relations between Israel and Lebanon, which erupted in armed conflicts. In all these cases, escalation or even maintenance of conflict do not only affect states' security but harms the daily life and the survival of this region's citizens. Its geographical range has widened due to the links between Syria, Hezbollah, and Hamas. Iran has become a key actor and the declarations by certain Iranian leaders seriously threatening Israel and the fears over its nuclear programme have widened the scope of conflict and its possible consequences for regional stability.

Besides these Arab-Israeli conflicts, the Mediterranean has experienced other confrontations among neighbouring states, although the possibility of an escalation into violence varies. In the Eastern Mediterranean, Greece and Turkey still have open disputes despite the *rapprochement* since 1999. For instance, the behaviour of the countries' armed forces (e.g. aerial chases among aircraft) illustrate that relations are not yet normal. The partition of Cyprus and the deployment of Turkish troops in the north show that there is much work ahead (Pfetsch 2003).

The destabilization potential of the ongoing United States occupation of Iraq is significant. The situation in Iraqi Kurdistan and Turkey's reaction may unleash spiralling tensions in the Middle East. The Western Balkans is also vulnerable in security terms. The future of Kosovo, Serbia's nationalism, and the delicate balances in Macedonia, point to an uncertain future.

In the Western Mediterranean, the situation is more stable, being completely stable in the North but less so in the South. The still unresolved Western Sahara issue, where sovereignty is disputed between Morocco and the Polisario Front, has ramifications throughout the region. Morocco's involvement in the conflict implies considerable resources are allocated for the military instead of being used for the basic needs of its population.[4] For the past three decades, the Saharaui people have been forced to live in terrible conditions in refugee camps. For the Maghreb, this conflict prevents progress towards integration beyond the Union of the Arab Maghreb, a formal structure with limited leverage.

Relations between Spain and Morocco worsened in 2002 with the confrontation over the sovereignty of

4 According to *El País*, Morocco's defence budget in 2009 will almost double, reaching 34,625 millions dirhams (3.2 billion €), This represents 16 per cent of the state's budget and 4 per cent of its GDP; at: <http://www.elpais.com/articulo/internacional/Marruecos/duplica/2009/presupuesto/militar/elpepuint/20081214elpepuint_9/Tes> (23 December 2008).

the tiny island of Perejil (Parsley) in the Strait of Gibraltar. This resulted in the occupation of this tiny patch of land by both countries' security forces (Cembrero 2006; Gillespie 2006; Bremberg Heijl 2007). The incident showed armed confrontation can arise even between countries from the north and south of the Mediterranean. Since 2002, great efforts were made in Spanish-Moroccan relations to avoid such situations.

Besides these conflicts between two or more states, there are internal conflicts that have threatened to spread into neighbouring countries. Among them is Algeria's bloody undeclared civil war in the 1990's, for which definitive figures of the dead, disappeared, and otherwise affected people were never released. This episode shows how these threats to security interact, as the Algerian government referred to a 'terrorist threat' to justify violations against fundamental freedoms.

The danger of confrontation in Lebanon is still urgent. The growing polarization of Lebanese society, the use of terrorist methods to eliminate political rivals, the persistent fracturing of communities, and the existence of new dividing lines all represent bad omens. Equally dramatic are the divisions within the Palestine Territories after the collapse of the government of national unity that was formed in February 2007, when tensions increased between supporters of Hamas and Fatah and both territories became virtually separated into two political entities: 'Hamastan' in Gaza and 'Fathia' in the West Bank.

This case clearly demonstrates the extent to which the action and inaction of international actors, such as the European Union and the United States, can inflame such conflicts. Following the victory of Hamas, both the EU and USA marginalized this movement instead of backing Fatah and the Presidency of the Palestine National Authority. The international community ignored the fact that an agreement among all parties is needed for peace in Palestine and for a lasting peace agreement between Palestine and Israel.

8.4 New or Old Threats?

One may categorize those linked to international terrorism or the consequences of climate change as 'new threats', although the violation of fundamental political freedoms and the access to basic resources for survival are phenomena that have a long history in the region. Beyond the debate over whether these threats are 'new' or 'old', there is a growing fear from a new kind of international terrorism that justifies its actions using religious pretexts. Al-Qaeda has become one of the highest profile threats throughout the world, specifically in the Mediterranean, that furthered regional cooperation (Reinares 2005; Bicchi/Martin 2006). After the 9/11 attacks, there were many attacks in this region, 14 German tourists died in Djerba (Tunisia) in 2002, 46 people died in a suicide bombing in Casablanca in May 2003, 57 civilians died in Istanbul from a similar attack in November 2003, while on 11 March 2004 Madrid experienced the worst bombing in its history with a death toll of 191 people. In 2005, 60 people died in Amman from a similar attack.

There is a growing number of terrorist groups in the Maghreb (Al-Qaeda in the Islamic Maghreb) which claim to be the heir of the *Salafist Group for Preaching and Combat* (GSPC). In 2007, Algeria was particularly affected by these terrorist groups, which caused fears of a return of the nightmare of the 1990's. Furthermore, other countries that previously succeeded in eradicating this phenomenon (Mauritania, Libya) became a theatre of operations for these violent movements (Echeverría 2007; Steinberg/Werenfels 2007). There were jihadist threats in the Sahel and growing fears that the porous borders in the Sahara may result in more terrorist threats in North Africa (Gregorian 2007).

Without minimizing the importance of international terrorism, other phenomena threaten personal safety, such as criminal activities and transnational organized crime. Trafficking in arms, people, and drugs generates insecurity and weakens state structures. Mafia-type structures in certain areas have become a joint concern in both North and South. There are links between such phenomena and terrorist activities.

Some arses in the Southern Mediterranean are threatened by anti-personnel mines (Sánchez Mateos 2000), some dating back to the Second World War (Kadry Said 2003). Algeria, Libya, and Egypt are most affected by this problem and have called on the EU and its members for assistance in mine clearing, but so far, their pleas were not successful.[5]

International terrorism has not only diverted attention from these problems, it has also been used by some regimes to justify human rights violations in their countries. To increase the efficiency in fighting problems (e.g. terrorism) that affect both, violations

5 The Barcelona Euro-Mediterranean Summit (2005) agreed that "the EU is also prepared to examine appropriate technical assistance in the field of clearing areas affected by land mines."

of fundamental freedoms and human rights were often ignored, what contributed to a perpetuation of authoritarian regimes in the Southern and Eastern Mediterranean. While the EU and its members have continually debated whether to promote stability or democratic reform, the threat of terrorism has strengthened the arguments of those championing the former. In addition, since 11 September migration flows have increasingly been securitized (Joffè 2008).

The effects of natural disasters pose another threat to the Mediterranean (Brauch 2003c) due to its climate and geography. The region frequently experiences forest fires and flooding, and is also regularly hit by oil spills and slicks. Several Mediterranean countries, including Algeria, Morocco, Greece and Turkey, are also at severe risk of earthquakes. Desertification affects the lives of the region's inhabitants (Nasr 2003; Brauch/Oswald Spring 2009).

In the Mediterranean many threats converge, some clearly affecting the security of states and indirectly hamper citizen's security, while others solely affect the security of citizens and do not compromise state's survival. Similarly, some threats only affect countries in the Southern and Eastern Mediterranean, while others exist throughout the region (Brauch 2001, 2003). The Mediterranean is highly vulnerable to multiple security challenges that require suitable responses that must be sufficiently flexible to deal with the range of threats described above, and should be adaptable to the particular circumstances of each place.

8.5 Catalogue of Cooperation Initiatives

There are many cooperation frameworks in the Mediterranean basin to turn the region into an area of peace and security and to guarantee that its states embrace cooperation where the EU and its member states have played a fundamental role.

8.5.1 Barcelona Process and Union for the Mediterranean

The Barcelona Process (since 1995) emerged from the Italian-Spanish proposal for a *Conference on Security and Cooperation in the Mediterranean* (CSCM). It is structured along three baskets (political, economic and cultural).[6] At the first Euro-Mediterranean conference, the Barcelona Declaration (1995) was approved with the goal to turn the Mediterranean into an area of peace and stability (Brauch/Marquina/Biad 2000). Fourteen years later, the Euro-Mediterranean cooperation was not promising in the security realm. Rather, the old threats persist and are often reinforced, while new ones have appeared.

During the first years various efforts were made to develop confidence building measures, and work on a Euro-Mediterranean Charter for Peace and Stability started (Aliboni 1999). After several years of negotiations efforts failed to approve it during the French EU presidency in the year 2000. This document would have been an important step towards a concept of shared security, and for turning the Mediterranean into 'a security community'. After the Al-Aqsa Intifada in 2000, diplomatic efforts linked with security have failed.

However, in three areas progress was made: a) the fight against terrorism, b) civil protection, and c) bilateral cooperation in the framework of the *European Security and Defence Policy* (ESDP). During the Euro-Mediterranean summit (2005) a 'code of conduct for fighting terrorism' was adopted,[7] in an area that had provoked most controversy since the inception of the Barcelona Process (Barbé 1996). There were strong disagreements on how to define a terrorist action (Bicchi/Martin 2006). The code lacks a definition of terrorism and thus made its practical application impossible.[8] The only agreement the parties reached was to complete the 'General Convention on International Terrorism' before the 60th session of the United Nations General Assembly in 2005 that contains a legal definition of terrorist acts.[9]

Some observers (especially Spanish diplomats) insisted that the code's added value was not the definition but other aspects of the text. The code expresses a unanimous condemnation of terrorism in all its forms and manifestations, as well as a determination

6 Since 2005 it incorporated a Justice and Human Affairs basket which mainly dealt with migration issues.

7 "Euro-Mediterranean Code of Conduct on Countering Terrorism", Brussels, 28 November 2005, press release 328 (15075/05).

8 Jesús Núñez: "Las Carencias de la Cumbre de Barcelona" in: *El Mundo*, 1 December, 2005, claimed that "the failure to agree on a definition of terrorism and the general vagueness of the document, which is stuffed with well-intentioned declarations that are open to multiple interpretations and calls for cooperation to be voluntary, hardly manages to conceal its ineffectiveness."

9 As is commonly known, a wide gulf exists between Israel's standpoint and those of Lebanon and Syria that argue for a differentiation between terrorist acts and acts of resistance to occupation.

to eradicate it and to fight all those supporting it. The document contains a commitment to refuse political asylum to terrorists, condemns terrorism, and to not associate terrorism with any religion or culture. Equally important is the document emphasizing that cooperation in this field must not be carried out at the expense of citizens' fundamental rights, and that victims of terrorist actions should be given priority attention (Soler i Lecha, 2007).

On civil protection advances have been made here in a discreet but effective manner. These activities emerged from an initiative launched by Egypt and Italy in 1996 for cooperation on the effects of natural disasters (Courela 2004). Subsequently, Algeria, France, the European Commission, and the Council joined this initiative, known as the Bridge project.[10] The next step was to turn it into a regional framework with a Euro-Mediterranean scope, or to move towards a Euro-Mediterranean system of civil protection.[11]

Such a system is entirely in harmony with the Work Programme adopted at the Barcelona summit in 2005 for the following five years. This document specified that the signatories would collaborate in "crisis management and activities as well as in the areas of civil protection and the prevention of natural disasters."[12] At a meeting in Porto on 24 October 2007, the chief executives for civil protection of the EuroMed programme and their European counterparts agreed on steps in this direction with the aim to develop such a fully-integrated Euro-Mediterranean system. The Euro-Mediterranean conference in Lisbon in November 2007 made further progress.[13] But in this specific field the Euro-Mediterranean cooperation faces a major obstacle: the lack of a real EU system on civil protection.

Finally, the third area where some progress has been made is the bilateral cooperation within the ESDP, most particularly with Morocco. This country is attempting to strengthen its ties with the EU, opening up new areas of cooperation between both, including on security. Based on a mutually agreed Advanced Statute, Morocco will be granted a wider role in ESDP mechanisms and missions. Morocco has already participated in the ALTHEA mission in Bosnia-Herzegovina, and was the first country to designate a contact point in the Council. Morocco is also interested in strengthening the cooperation with the *Political and Security Committee* (PSC).

During the French EU Presidency on 13 July 2008 a "Union for the Mediterranean" was established. This proposal, which initially envisaged the participation of all countries bordering the Mediterranean, was enlarged to include all EU members. This new body formally adheres to the Barcelona *acquis*, launches new multilateral projects, and is to raise private funds and, above all, it implies significant changes in the institutional dimension of the process (including a co-presidency, secretariat). However, in the initial steps of this new initiative, security cooperation was rather marginal, except for the proposal to foster greater cooperation on civil protection (Bremberg/Driss/Horst/Soler i Lecha/Werenfels 2009). Thus, despite the changes introduced in 2008, continuity prevails in dealing with security issues in Euro-Mediterranean relations.

8.5.2 European Neighbourhood Policy

The negotiation of Morocco's Advanced Statute coincided with, and was in line with the development of the new *European Neighbourhood Policy* (ENP) that was initially devised for East European countries, but later extended to all Mediterranean countries. Being strictly bilateral, the ENP intends to promote reforms more effectively and through specific action plans which, adapted to the needs and capacities of each country, also consider how to offer member countries suitable incentives to carry out these reforms (Johanson-Nogués 2004; Attinà/Rossi, 2004; Del Sarto/Schumacher 2005; Kelley 2006; Danreuther 2006).

A few years after its launch, the ENP shows its weak points. In December 2006 the European Commission declared that the policy needed to be revised, and called for a *Strengthened European Neighbourhood Policy*.[14] The contributions of the ENP in the field of security are very limited, and especially regard-

10 The actions carried out in this project are detailed on: <http://euromed-protection-civile.eu/>

11 "Communication from the Commission to the Council and the European Parliament on the preparation of the Lisbon Euro-Mediterranean Foreign Affairs Conference (5–6 November 2007)", [SEC(2007) 1309], Brussels, 17/10/2007, COM(2007) 598 final, p. 6.

12 *Five-Year Work Programme*, Brussels, 28 November 2005, 15074/05 (Press release 327).

13 The participants supported the setting up of a new stage of the Bridge project, the "Euro-Med Programme of Prevention, Reduction and Management of Natural and Man-made Disasters", for the period 2008–2010.

14 *Communication from the Commission to the Council and the European Parliament on Strengthening the European Neighbourhood Policy*, Brussels, 4 December 2006, COM(2006)726 final.

ing conflict resolution. References to such issues in ENP action plans are rather vague because the EU cannot offer many incentives in this area.[15].

In these action plans, when it comes to security issues, regardless of the usual lack of thoroughness, there is a bias towards European preoccupations: control of borders, fighting organized crime, etc. Concerns that are fundamental for the security of these countries' citizens (prison reform, fighting torture and ill-treatment, reforming security bodies, etc.) are dealt with casually and, in some cases, they are not even included on the agenda.

Due to its tailored approach and sophisticated political conditionality, the ENP should be able to promote political changes in neighbouring countries and thus contribute to the respect for fundamental freedoms and human rights of the citizens of those countries. But in this area the effects of this new policy are still to be proven.

8.5.3 Besides the EU: 5+5 and NATO's Mediterranean Dialogue

Beyond the EU framework, other security cooperation frameworks exist where EU member states and some Mediterranean partners participate. Two examples are the defence initiative 5+5 and NATO's Mediterranean Dialogue. The 5+5 process is an intergovernmental cooperation framework of Western Mediterranean countries, which can be traced back to the early 1980's. Countries participating include Portugal, Spain, France, Italy, Malta, Mauritania, Morocco, Algeria, Tunisia and Libya.

In 2005, a security dimension was added (as a French initiative), and the 5+5 began organizing meetings of defence ministers. This is known as the "5+5 initiative in the area of defence". This framework has an informal nature and a light architecture, and its main areas of action are maritime surveillance, civil protection, and aerial security. Thus, it does not represent a catalogue of ambitious objectives able to guarantee regional security in the short term; instead, it is a modest step forward which, in the medium and long term, could increase trust between the armed forces of the countries concerned (Coustillière 2007).

Meanwhile, NATO's Mediterranean Dialogue is a framework launched in 1994, with the participation of the members of the alliance, Egypt, Israel, Jordan, Mauritania, Morocco and Tunisia and, since 2000, also Algeria. While NATO's interest for the Mediterranean surged after the Cold War, the tragic events of 11 September have helped clarify its functions and objectives (Bin 2002). The aim of this framework is to strengthen political dialogue, fight terrorism, modernize the armed forces, and improve the interoperability between military forces of different countries. In spite of the efforts made by these countries, the initiative's influence was undermined by several factors, including the non-participation of some states in the region, the aversion some states feel towards American policy in the region, and its neglect of conflict resolution.

8.6 Concluding Remarks

So far the balance sheet of all these Euro-Mediterranean initiatives is mixed. On the positive side, there have been political efforts to formulate and reformulate cooperation frameworks that were based on a bottom-up approach to create conditions for greater cooperation in the area of security which, in the medium or long term, could lead to the establishment of a collective security mechanism. A somewhat preferential attention has been given to natural disasters, and as far as terrorism is concerned, Euro-Mediterranean partners have started to pay more attention to the victims of such attacks.

On the negative side, the EU and the Euro-Mediterranean countries in general have failed to tackle regional conflicts. This has paralysed other spheres of cooperation. This strategy is equals of the Arabic saying of "unrolling the carpets before having built the mosque" (Chourou 2001: 64). Unless these conflicts are resolved, it will be very hard to achieve positive results in any dialogue on security issues.

Some recent EU documents seem to reflect this criticism. The European Security Strategy stipulates that "the resolution of the Arab-Israeli conflict is a strategic priority for Europe, because without it, there is little chance of solving other problems in the Near East. The European Union should carry on intervening, and be prepared to promise resources until the conflict is resolved" (ESS 2003). The document "A Strategic Partnership with the Mediterranean and the Middle East" also stresses that the resolution of this conflict is a strategic priority, and that "it is obvious that an area of peace, prosperity and progress cannot be attained until a lasting resolution to the conflict is achieved."[16]

This remark may be extended to a lacking consideration of inter-state conflicts in cooperation frameworks. A climate of conflict has an impact on democ-

15 Fraser Cameron and Rosa Balfour (2006) have made specific proposals for improvement in this field.

ratization processes and on the respect for human rights (Barbé 1999: 220). Specifically in these two areas progress has been the weakest. Therefore, human rights violations and authoritarian regimes are a blot on the integrity of the Euro-Mediterranen project. And what is even more serious, as a consequence of Europe's reaction to the Hamas victory in the Palestinian elections in 2006, the EU has lost much credibility among democrats in the Arab world. The dilemma between promoting democracy and the need to maintain stability is still an issue, especially when it comes to dealing with terrorism.

Five conclusions may be drawn. *First*, given the many cooperation initiatives and potential overlaps, there must be a rationalization and more efficient distribution of resources. *Second*, although some progress has been made, the measures undertaken in the different cooperation and dialogue initiatives had a limited impact on the improvement of security conditions for states and citizens of the Mediterranean. *Third*, the resolution of regional and domestic conflicts and the promotion of fundamental freedoms (personal safety, political freedom, etc.) are still unresolved in Euro-Mediterranean cooperation. *Fourth*, a more comprehensive view of security requires that the fight against specific threats does not create additional harmful effects which could strengthen other threats. Thus, it must be highlighted that the fight against terrorism and organized crime should not be carried out at the expense of citizens' freedom and rights. Consequently, cooperation must be continued by reinforcing current instruments and incorporating new mechanisms which pay further attention to the security needs of citizens. And *finally*, the EU and its member states have a particular responsibility in this region, and – given their geographical proximity and the strength of their links with all Mediterranean countries – the EU should play a more important role. But in many fields, it has to seek the support of third countries such as the United States, Russia and China or, at least, guarantee that the actions of these countries will not counter or weaken European efforts.

16 European Council: *Final Report. EU Strategic Partnership with the Mediterranean and the Middle East* (Brussels: European Council, 18 June 2004).

9 Inside/Outside: Turkey's Security Dilemmas and Priorities in the Early 21st Century

Mustafa Aydin and Asli Toksabay Esen

9.1 Introduction

Turkey has undergone major transformations and a number of ups and downs during the past two decades. At the end of the Cold War, Turkey was an outdated flank country, whose 'strategic value' to its Western allies was at best diminished. Yet, its location suddenly opened up new windows of opportunity to exploit in the newly emerging world (dis)order, although these, more often than not, also entailed risks and challenges. Turkey's economic, social, and political transformations during the late 1980's from a mixed economy to a more liberal approach, from a military tutelage to a multi party representation once again, and from an intensely secluded country to one that is ever increasingly interconnected with the world at large, had prompted it to try and play an influential role in its neighbourhood (Aydin 2003a). Thus, in the post-Cold War era, Turkey launched a number of new initiatives in the Caucasus, Central Asia, Middle East, the Balkans, and the Black Sea; areas where the Turkish government believed that Turkey would have inbuilt comparative advantages because of its historical, ethnic, linguistic, and political affinities with local populations. Yet, most of the 1990's saw a Turkey that 'wasted' opportunities through contradicting initiatives, overblown expectations, misused resources, inefficient coalition governments, infighting between ethnic, religious, and political cleavages, political mismanagement, and coordination weaknesses at the top of the state, etc. (Barkey/Taspinar 2006: 2). Thus, the end of the 1990's found Turkey woeful for its diminished strategic significance of the Cold War *temps perdus*, resentful of its alienation from successive waves of European Union enlargement, and bitter for failing to achieve the ambitious targets it had set for itself at the end of the Cold War.

Yet today, Turkey is a country negotiating for accession to the European Union, an emerging regional power, a member of the only surviving global military alliance, an active participant in international peacekeeping or peacemaking efforts, a mediator in its region, an aspiring energy hub, and an elected member of the UN Security Council for 2009–10. All these do not preclude the fact that Turkey today continues to face several challenges, both in domestic politics and regarding its regional and global role. As domestic cleavages persist on both ethnic and religious grounds, thus the continuing salience of perennial identity discussion, the EU negotiation process has come close to stalling (ICG 2007: 32). Turkey faces dilemmas in defining a position for itself in the post-9/11 world before it could even put its post-Cold War role into perspective. The US intervention in Iraq and pressure on Iran and Syria, the re-emergence of Russia with a renewed claim to international supremacy, and a confused EU about the role it should play in the wider Eurasia all contribute to the delicacy of the various balances that Turkey has to maintain in terms of its regional and global alliances.

While the world's geopolitical balances are constantly changing, Turkey's regional and international security concerns have become somewhat less visible in the domestic domain in recent years. Almost overwhelmed by the unceasing series of political crises and power struggles within its governing elite, the public in general, and to a large extent the intelligentsia, have lost their appetite for a discussion on international issues. Although this apathy stems primarily from the salience of domestic political complexities, the EU-fatigue and the dominant focus on external threats coming especially from the spiral of constant Iraqi crises since the early 1990's have also contributed to the weariness in the Turkish public opinion.

The Turkish domestic political scene has since the 2002 elections been characterized by a division between the government (a religiously and socially conservative but economically globalist single-party government) and the state (or rather, the establishment, which includes secular republicans, left and right wing

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nationalists, the military, and part of the civilian bureaucracy), which have had different conceptions of security, perceptions of insecurity, and priorities in policy-making, including the foreign policy realm. This, and the mutual animosity and mistrust between the two sides of the equation, has led to a shift of attention to domestic woes and clashes. Recently however, the schism between the government and the state appears to have withered away to a certain extent, to the advantage of the governing party. The repeated successes of the AKP at the ballot box, the accomplishment of having seated a party member at the presidential palace, and certain requirements of the European Union accession process, have been effective in somewhat alleviating the stand-off. Nevertheless, the societal polarization and animosity prevails. For instance, the *Ergenekon* legal case appears to onlookers as a major achievement that should boost the sense of security and safety for the Turkish public, for its avowed mission is to eliminate clandestine paramilitary groups, organized within 'the deep state', plotting to cause social chaos through terrorist acts and ultimately undermine or overthrow the government. However, the case causes concern for a large segment of the society as they perceive the prosecution as a hotchpotch that brings a large number of diverse people whose only common denominator appears as their opposition to the AKP together under the shadow of a single allegation, and hence a counterplot by the government to eliminate its critics. Indeed, Turkey's major security challenges today seem to stem from identity problems and disputes within, while the government chooses to pursue a "zero-problem-with-neighbours" policy (Davutoglu 2008: 80). As the balance of power between the government and state elite shifts to the benefit of the former, the latter finds itself to have lesser say in policy-making, and its concerns resonate less among the people. This signals a reversal of traditional policy-making and of the conventional threat perceptions that have hitherto been conceived as quite static (Aydin 2003b; Bilgin 2005).

One immediate impact of the shift in attention to domestic affairs and the growing indifference towards international concerns is a decrease in the perception of immediate security risks (in the traditional sense) and a greater confidence that the country is better equipped to tackle them, which probably also partly explains the lesser sense of insecurity for the masses. Nevertheless, not only are Turkey's external woes interconnected with internal ones and becoming more so within the context of the EU accession process (Aybet 2006), but they also exacerbate the domestic divide across policy-making stakeholders when concerns are not shared and acted on jointly.[1] Besides, several international and regional issues and problems spill over into Turkey, irrespective of how hard Turkey may try to avoid them. Developments in connection to Iraq since 1991 are just one glaring case in point (Aydin/Özcan/Kaptanoglu 2007).

Meanwhile, it is worth noting that the official understanding of security in Turkey has come to include issues other than traditional ones, following the popular mood that had entered a similar phase of transformation much earlier (Aydin 2003b).[2] Hence, climate change, energy and hydropolitics as well as human security issues have become mainstream in Turkey's security concerns. Accordingly, this chapter provides an overview of the salient domestic (9.3) and international (9.4) issues for today's Turkey, as well as the wider security concerns (9.5), and will try to demonstrate the ways in which these categories overlap, interact, and exacerbate one another, affecting Turkey's security conceptualization and prioritization (9.6).

9.2 Conceptual Framework

The conceptual framework for the following overview of the Turkish scene addresses a familiar one that has been subject to controversy for decades. The interaction between domestic and international realms has been the subject matter of numerous theoretical and practical explorations in the international relations literature. The debate that ensued Waltz's introduction of the three images into international relations analysis in his quest for an explanation for war has been lively (Waltz 1959). The interdependence school led by Robert Keohane and Joseph Nye (1977) and the classic article by Gourevitch (1978) where he 'reversed' the second image have been notable and influential contenders to Waltz. With the advent of globalization, the controversy over the question of interconnectedness between the domestic sphere and the international realm has become all the more vivid. A signifi-

1 Although Robins (2007) disagrees, the time differential might matter: the latter part of 2007 and 2008 have helped the differences in both domestic and foreign politics in Turkey surface and become much more ostensible.

2 See also other contributions by this author to previous volumes of the Hexagon book series: Aydin and Acikmese (2008a); Aydin and Kaptanoglu (2008); and Aydin and Ereker (2009).

cant contribution, or rather, intervention, to this debate came from R.B.J. Walker, who advocated in his *Inside/Outside* (1992) the arbitrariness of the division separating the two realms and disputes the territoriality and sovereignty that is defined, demarcated and reified by the act of drawing boundaries. Walker then moves on to suggest the ephemeral quality of this particular spatial/temporal construct that is called the nation-state, the basic premise that underlies international relations, and the challenge posed against it by globalization.

While we feel that the process that blurs boundaries is far from complete and the nation-state still an object of analysis, this chapter feeds on the sentiment that both hard and soft security issues are increasingly creating further interconnections between the domestic, the regional, and the global scenes, and Turkey obviously is not immune from this process. With the trend of globalization, be it economic, political or criminal; and with the pervasiveness of certain problems (health, environment, finance, etc.), hard or soft security issues transcend boundaries and build a dense network of bridges between the 'domestic' and the 'foreign'.

Several authors, some of which are cited below, have already pointed to the shift of Turkish foreign and security policy priorities in the last decade; thus the primary purpose of this chapter is to offer an overview of the issues at stake. The discussion rests on a combination of factual data and discourse analysis, with the nebula of perceptions and representations of security issues at the background. The highlighted cases and issues below, chosen among several possible alternatives, are arbitrary to an extend that reflect the authors' preferences and understanding that they can satisfactorily demonstrate the complexities of policy-making and changes in Turkey's security understanding.

9.3 Domestic Politics

Turkey's domestic concerns today, as indicated by the military and civilian security bureaucracy most ostensibly in the National Security Documents and the proceedings of National Security Council meetings, stem mainly from ethnic insurgency and Islamic or Islamist resurgence. In fact, neither question is new to Turkey, having inherited them from its Ottoman predecessor and struggled to tackle them since its inception. The two issues were intertwined in the early stages of the Republic, they parted ways with the rise of an avowedly Marxist and Leninist Kurdish movement in the late 1970's, but are coming full circle to unison again.

9.3.1 The Rise of Political Islam as a Threat

A secular Turkey has sensed the threat of Islamist activism ever since its genesis and rising religious fundamentalism has been one of Turkey's major concerns throughout the 1990's. The activity of Islamists groups like the *Hizb-ut Tahrir* and *Hizballah*[3] and the rise of political Islam in Turkey have deeply troubled the Turkish establishment, so much so that the military forced the coalition government of the Welfare Party (RP) with True Path Party (DYP) to resign in 1997 through a well organized and orchestrated public campaign following tensions over its prime minister's ostentatiously 'Islamic' moves both in domestic and foreign policy areas. This was a critical juncture in Turkish republican history, one which came to be termed as 'the post-modern coup' of 28 February 1997. The same supposedly 'Islamic' behaviour of the then prime minister Necmeddin Erbakan, especially in the foreign policy domain, has also led an intra-party group (the so-called 'youngsters') to first criticize him within the party for causing trouble with the military and leading the country into humiliating positions in the international arena,[4] and then to break away from the tradition to set up their own party (*Adalet ve Kalkinma Partisi*), the Justice and Development Party (AKP).

The rise of the AKP to power in 2002 with the first general elections it contested in stirred up a similar alarm among the secular establishment and the secularized, modernized segments of the society that an 'Islamist' party was now in office with a powerful stronghold based on a parliamentary majority and a single-party government.[5] The AKP, however, tried to alleviate these concerns by an assertion that party officials had undergone a profound transformation, an

3 Turkey's Hizballah is different and independent from the various groups operating under the same name in the Middle East.

4 While visiting Libya in 1996, Prime Minister Erbakan stood listening to the ranting of Muammar Al-Gathafi on Turkey's supposed human rights abuses, democracy deficit, and its treatment of Kurds, while being referred to as 'my commander'. The Libya incident was the final straw in the long list of controversial foreign visits and led to severe criticism of Erbakan within his own party, notably by the Minister of State Abdulah Gul, who later lead the way of intra-party opposition, thus contributing to the emergence of AKP.

avowal that the party identity was one of 'conservative democrat' rather than 'Islamist', as well as via a fervent pursuit of Turkey's EU vocation. However, the secular establishment and the opposition retained their sceptical outlook on the AKP amidst concerns that the latter has a hidden agenda of Islamicizing the society and ultimately the state.

The division appears unbridgeable despite brief periods of détente and rapprochement between the two sides (Baran 2008). Although issues deemed vital to Turkey's national interests can be sources of cooperation, they easily become sources of confrontation due to diversions in outlook and action. While the European Union reform process had united the government, the opposition and the Turkish civilian and military bureaucracy throughout a period of euphoria in the early 2000's, it has become a source of contention in the last few years following the onset of the (now stalled) negotiations due to what has come to be seen as 'unnecessary and futile concessions' to the EU on behalf of the government (Toksabay Esen/Bölükbasi 2008: 192–195). The Cyprus issue and the shift of the official policy on this by the AKP government has been a source of covert conflict, as well as other issues considered central to the Turkish official line and national security, the chief one being the struggle against Kurdish terrorism. It is worth noting at this point that the resistance in these issues stems mainly from the loss of the EU membership perspective and the widespread sentiment that the AKP government is compromising Turkey's interests for no good reason.

The domestic cleavage in Turkey in this sense has several manifestations in the tension between the civil and the military; the new versus the old elite; the conservative versus the progressive[6] segments of the society and finally, the state versus the government, ascribing therefore a complex outlook to the picture. Whatever the context may be, however, the common thread is the deep lack of mutual confidence across the two sides of a fault line that divides both the popular masses and the ruling elite in Turkey. The divisions, the power struggle, and the striking schism between the state and the government, in the final analysis, shape and are in turn shaped by Turkey's foreign policy and security questions.

9.3.2 Threat to Territorial Integrity of the State: Ethnic Separatism

Turkey's long-term inability to come to terms with its Kurdish population has been exacerbated in the last few decades following the foundation of the terrorist *Partiya Karkerên Kurdistan* (Kurdistan Workers' Party [PKK]). Turkey's initial reflex to underestimate the PKK in the late 1970's was followed by a tendency to respond to the violence induced by the PKK through military means. An attempt to make political processes work failed in the early 1990's when the newly elected MPs of Kurdish origin from *Halkin Emek Partisi* (People's Labour Party [HEP]) saw their inauguration ceremony as an opportunity to make a scene at the Parliament.[7] The 1990's witnessed the climax of PKK terrorism which claimed more than 40,000 lives to date, and poisoned Turkey's relations with its neighbours, as well as the EU that condemned harsh Turkish measures in its struggle with terrorism, and some European countries that alleg-

5 The use of the term 'Islamist' in referring to the AKP is disputed by both its leaders and many Turkish political scientists. The latter, complaining about the tendency to lump such unlikely groups as AKP, *Gamaa Islamiyya* of Egypt, *Al-Qaeda* and others together under the banner of Islam, point out the differences in both rhetoric and action of AKP from others. The AKP leadership on the other hand variously defines their party as 'conservative democrat', 'Muslim democrat' and recently 'centrist', but never as 'Islamist' or 'Islamic'. For further discussion from both flanks see Akdogan (2004); Balci (2008); Fuller (2002); Özbudun (2006).

6 The categories of progressive and conservative, as well as the distinctions between them, seem to have become quite blurred in the case of contemporary Turkey. For example, a supposedly progressive left wing *Cumhuriyet Halk Partisi* (Republican Peoples Party [CHP]) easily defends a limitation on the freedom of speech through its support for the infamous article 301 of the Turkish Penal Code that penalizes 'insulting Turkishness', while clearly conservative AKP can become the agent of change (see Onar 2007).

7 The parliamentary immunities of four HEP MPs were swiftly lifted by a unanimous vote of the Parliament and the State Security Court of the time sentenced them to 7.5 years in prison (Ergil 2000). HEP was consecutively replaced by the *Demokrasi Partisi* (Democracy Party [DEP]), *Halkin Demokrasi Partisi* (People's Democracy Party [HADEP]), *Demokratik Halk Partisi* (Democratic People's Party [DEHAP]) and *Demokratik Toplum Partisi* (Democratic Society Party [DTP]). All of the former three were banned by the Constitutional Court on the grounds of being the focus for secessionist activities against the state and the integrity of the territory and the nation, while the fourth dissolved itself when a similar case was pending. A closure case against DTP is also pending today. The parties cited above are generally considered to be the legal political wing of the PKK (Uslu 2008: 99).

edly offered sympathy and support to the PKK's cause (Aydinli 2002: 213–217).

For a while, the organization struggled to recover from the shock and disorientation following the capture of its leader Abdullah Öcalan in Kenya in 1999, declared a unilateral ceasefire and withdrew from Turkey to its hideouts in the mountainous terrain of northern Iraq. Although Öcalan's pleading and appeasing performance during his trial was quite a disappointment to separatist Kurdish groups, he nevertheless managed to revive his leadership eventually, and the PKK resumed its terrorist activity in the countryside of the southeast as well as in urban centres in western Turkey. Although the PKK has become less visible on the public agenda from the mid-2000's onwards compared to the 1990's except for some urban bombings and few large-scale hot clashes with security forces, the figures indicating the scope of its activity remain quite striking: within the first nine months of 2008, more than 100 soldiers and civilian village guards (*korucu*) died in the struggle, while the PKK lost some 1,000 members, including those that died, surrendered, or were captured.[8]

Although the Turkish Parliament is once again hosting a party (DTP), which represents a segment of the Kurdish population that also supports the PKK, a political solution is yet to come. Kurds find the reforms inadequate and pretentious (Uslu 2007), while DTP refuses to condemn the PKK violence and fails to disprove the common understanding that it endorses terrorism. Meanwhile, the nationalist hardliners, both Turkish and Kurdish, do not believe in the possibility of a resolution through democratic reforms or wider liberties. In addition, Turkish nationalists insist that the reform process will divide Turkey for good (Avci 2003: 164). The ongoing violence also hampers the popular support for a peaceful resolution.

The struggle against terrorism is a significant point of division between the state establishment (particularly the military bureaucracy) and the AKP government, which has a Kurdish faction among party ranks and therefore has until recently given more weight to political and cultural solutions in its discourse, much to the dismay of hardliners.[9] The state establishment implicitly blamed the government for failing to live up to the terrorism challenge. The detrimental impact of the Kurdish problem on relations with neighbours and the EU today is not comparable to the 1990's, but the issue continues to mould Turkish foreign policy; so much so that it has had its toll on the relations with the United States following the latter's intervention in Iraq. Segments of Turkish society feel that the USA (as well as the EU) decline to cooperate in the struggle against terrorism and tacitly support the formation of an independent Kurdish state. This latter possibility is one of Turkey's nightmares due to the belief that this will fuel separatist aspirations among Turkey's Kurds (Gordon/Taspinar 2006). Thus, despite fluctuations, the Kurdish problem persists both as a political issue and as a source of threat to security.

9.4 Global and Regional Politics

For the past few years, numerous authors and observers have commented about Turkey's frustration and alienation with the West, and some have asked whether Turkey may be turning to the East (Önis/Yilmaz 2005; Gordon/Taspinar 2006; Menon/Wimbush 2007; Oguzlu 2008; Baran 2008). Regardless of the sense of confidence stated above, Turks do not feel any more sympathetic to foreign countries. Despite a recent dose of amelioration, public surveys repeatedly indicate that the Turkish population disfavours the USA, Israel, and the EU as well as a majority of its immediate neighbours (GMFUS 2007, 2008). While Turkey is evidently experiencing disappointment with its traditional Western allies and a trend of diversification in Turkish foreign policy is ostensible, it is premature to say that Turkey is turning away from the West. Even when we leave civilizational aspirations aside and think in *realpolitik* terms, this stickiness in orientation hardly stems from the fact that Turkey appreciates the USA and the EU as reliable allies and part-

8 The figures are compiled from the website of the Office of the Chief of General Staff of Turkey; at: <http://www.tsk.mil.tr> (25 October 2008).

9 One implication here is that the DTP (or from another perspective the PKK) is no longer the only player standing for the population of Kurdish origin Turkish citizens in the political arena. Indeed, recent elections indicate that the support for DTP is on the wane in the Southeast of Turkey where the PKK is most active, while AKP is expanding its influence in the region. In the 2007 elections, the DTP received 17 per cent of the votes in Eastern and 25 per cent in Southeastern Anatolia, while the AKP raised its votes from 33 per cent in 2002 to 56 per cent to 2007 in Eastern Turkey and from 26 per cent in 2002 to 52 per cent in 2007 in Southeastern Turkey. See the analysis by Oflazoglu and Benli in: *Radikal Daily* (8 November 2007); at: <http://www.radikal.com.tr/haber.php?haberno=238214>.

ners, but merely indicates that it finds the alternatives no more palatable (Aydin/Erhan 2006) despite the cold shoulder that it insistently, in fact increasingly, receives from the EU.

9.4.1 Western Connection Questioned

The greatest uncertainty that Turkey is facing today in its foreign policy emerges from the fact that Turkey and the United States, which deemed one another as 'strategic allies' during the Cold War and 'strategic partners' since the end of it, have found it difficult to readjust their relationship to the changing parameters of the post-Cold War and post-9/11 era (Baynham 2003; Lesser 2006; Aydin 2007 & 2008; Larrabee 2007; Menon/Wimbush 2007; Oguzlu 2008). While the fallout between Turkey and the US over the refusal of the Turkish parliament to open a second front via Turkey in the 2003 Iraq War has left its scars (Park 2004), problems have remained on the horizon as Turkey has maintained several points of disagreement with the United States in its Middle Eastern policy, has been troubled by developments in Iraq, and found it difficult to offer support to US pressure on Iran and Syria (Oguzlu 2008).

Although definitive judgements would be premature, the ascendance of Barack Obama to the US presidency and his attempts to remedy the havoc wrought by the Bush administration and to mend fences with the Islamic world, as well as the apparent change of values in his global outlook, are issues that should be taken into consideration in order to discuss the prospects of Turkey-US relations. While Turkey still requires and seeks US cooperation to take action in its neighbourhood (Olson 2007; Aydin 2007) and maintains a collaborative stance towards it, there is a likelihood that Obama's government will try to make sure that this positive trend in relations and cooperation is wrought with more consent than coercion, at least on the discourse level. Obama's global agenda is also likely to alter the security definitions and priorities somewhat, with soft security possibly taking the lead over hard security. In turn, collaboration with the US in regional affairs will probably be more readily received and digested by the Turkish public opinion.

Turkey's relations with the EU on the other hand are not on a good track, even though there appears to be very little disparity in Turkey's foreign policy with that of the EU's *Common Foreign and Security Policy* (CFSP) (Aydin/Acikmese 2007). The discontent in Turkey-EU relations is mainly a result of second-guessing in some EU countries of Turkey's 'Europeanness'. The persistent unfavourable mood in some EU countries about Turkish membership despite the 1999 Helsinki Summit decision to start negotiations aiming at full membership, and the emerging discourse on arrangements that fall short of full membership have had a dramatic impact in undermining the morale in Turkey and brought the reform process close to a stall (Patton 2007; Narbone/Tocci 2007; Toksabay Esen/Bölükbasi 2008). The discourse on Turkey's 'non-Europeanness', the limits of the EU's 'absorption capacity', 'privileged partnership' alternative, and the 'Union of the Mediterranean' have had a massive toll on an already delicate relationship.

This was not always the case: after two major letdowns in 1987 and 1997, the EU had given Turkey a green light at the Helsinki Summit. This then led Turkey to strive, quite successfully and surprisingly to outside observers, to handle major reform packages under the two unlikely governments of the DSP-MHP-ANAP coalition[10] and the AKP single party government.[11] However, it appears that Turkey has been the follower rather than the leader and the determinant of the dynamics in the cyclical pattern that Turkey-EU relations have followed (Narbone/Tocci 2007) and as the mood towards Turkey in the EU member states soured, Turkey found little motivation to try and push relations forward. The impasse also hampers the transformation of Turkish politics by diminishing incentives for reform and arousing scepticism on the part of the establishment about the 'security during transformation', i.e. the control over domestic threats *during* the reform process and *prior to* actual membership (Toksabay Esen/Bölükbasi 2008). The current scheme with a tilted balance of power against a back-

10 *Demokratik Sol Parti* (Democratic Left Party [DSP]) is a left-wing nationalist party with affinities to the structuralist arguments of the 1970's, whose late leader Bülent Ecevit was known for his hawkish attitude on Cyprus; while *Milliyetci Hareket Partisi* (Nationalist Action Party [MHP]) is a right-wing nationalist party with a hard-line approach to many issues, including the Kurdish problem, Cyprus and even the EU itself. *Anavatan Partisi* (Motherland Party [ANAP]) was a central-right party that was considered the only likely champion of the EU within the coalition, and has indeed been an engine in the process. Ultimately, the government passed many significant reforms, including controversial ones like the abolition of the death penalty.

11 As outlined above, the AKP's pursuit of the EU goal was most unexpected due to its origins in the anti-Western political Islamist movement. See Toksabay Esen/Bölükbasi (2008) for a detailed account of the possible rationale and the reversal of their favourable approach.

drop of poor rule of law makes domestic affairs more fragile. As an additional factor, the EU's interventions in Turkey's domestic struggles, which have at times indicated minimal understanding or empathy of the country's dynamics or problems, have always left a certain segment in Turkey disenchanted and enraged (Baran 2008), deepening domestic divisions and casting a shadow on the EU perspective.

The downturn in the Turkey-EU connection also slowed down Turkey's rapprochement with Greece to an extent and adversely affected the political environment in Cyprus (Aydin/Acikmese 2008b, 8–10). Despite the recent amelioration in the Turkish-Greek relations following the advent of 'seismic diplomacy' in the aftermath of the 1999 earthquakes (Aydin/Ifantis 2004) and the apparent – albeit conditional – support that Greece offers for Turkey's EU membership (Tarifa/Adams 2007; Ifantis 2007), Turks feel that Greece (and Cyprus) chose to use the EU as a platform to engage rather than alienate Turkey for the resolution of long-standing disputes by imposing demands in the form of conditionality on the latter. Against an appearance of congruence, the sense of insecurity prevails. The Greek/Cypriot perception of threat from Turkey remains high. Turks meanwhile sense no guarantee that Greece and Cyprus will not use their veto power once all the concessions they demand are met, but at the same time see that Cyprus is one of the biggest stumbling blocks on the road to EU accession (Tarifa/Adams 2007: 69). In fact, Turkey feels a sense of betrayal vis-à-vis the EU over the Cyprus issue (Gordon/Taspinar 2006): The twist of politics on the part of Turkey in 2004 to make room for a UN-inspired resolution in Cyprus was thwarted by the Greek Cypriots in a referendum, only to be followed by the full membership of Cyprus (in effect only the Greek Cypriot part as the *acquis* adoption is suspended in the north of the Island) to the EU, the EU's turn away from its promises to Turkish Cypriots as a result of Greek Cypriot veto threat, and finally the suspension of eight chapters in Turkey's accession negotiations when Turkey refused to open its ports to Greek Cypriot vessels. The issue has had domestic ramifications as well: the AKP's willingness to compromise over Cyprus (Barkey/Taspinar 2006), which has yet to produce tangible results, has become another breeding ground for the suspicions of the establishment over the government's standing in national interests, since the Turkish establishment views Cyprus as an indispensable, vital, unalienable matter of national security (Bilgin 2007).

All these then led to a questioning among the Turkish elite of the value of Turkey's alignment with the West in its external relations, and brought forward suggestions for alternative connections or for going-alone. Turkey's western orientation, seen from the Turkish perspective not simply as a question of alliances and/or affiliation, but as a matter of civilizational belonging, that it has boasted for more than a century, fails to deliver and comes under scrutiny as a romanticized ideal that has only helped hurt Turkey's interests in the wider framework. This sense of frustration and alienation is further fuelled by the mounting nationalism of both left- and right-wing politics and paralleled with an overarching emotion that Turkey is being abused and bullied in the process as the West "takes what it can, gives nothing back" (Toksabay Esen/Bölükbasi 2008). Depending on the political orientation of the speaker, questions as to why Turkey has distanced itself from the Muslim world which "promises religious fraternity and wealth;" why Turkey does not opt for a Russia-China-Iran axis that has supposedly been in the making and on the rise; or why South-South cooperation, integration with the Turkic world, or a lone-goer that relies on day-to-day alliances rather than a long-standing orientation have come to be voiced among the elite as well as the masses. These discussions inflame questions about Turkey's identity and belonging, for disassociation from the West implies a void, which is supposed to be filled through different means and with different attachments in the perspectives of different stakeholders in Turkey. This, in turn, taps into the domestic cleavages, feeds into an uncertainty that surrounds the country and hence leads to a feeling of insecurity in general.

9.4.2 Regional Environment

Turkey has for decades tried to detach and/or isolate itself from its surrounding regions mainly as a result of the early republican founding philosophy as well as constraints of the Cold War era, and was able to look at 'its region' with a positive view only at the end of the Cold War, when Turkey found itself in a power vacuum that it considered itself opportune to fill (Aydin 2005). Turkish foreign policy during the Cold War was meant to distance itself from the Middle East primarily due to the perceived incompatibility between a Middle Eastern orientation and the country's civilizational aspirations, as touched upon above. Recent developments, however, suggest that Turkey comes to see the Middle East as an important pillar of its effort

to diversify its foreign policy options both in a political and economic sense. Part of this has been by compulsion: the sudden focus on the Middle East after 9/11 has rendered it impossible for Turkey to ignore the region, and made it imperative that it is involved in the new configurations of power in the region (Aras 2005; Aydin/Özcan/Kaptanoglu 2007; Olson 2008). Besides, the rising significance of energy has been another compelling factor to do so. The other part has been shaped by conviction: many observers note that the AKP government feels more comfortable dealing with its Muslim counterparts than, say, the EU. Moreover, the wealth accumulated in the Gulf from the early 1980's onwards and the recent inflow of funds due to rising oil prices on the one hand and Turkey's dynamic economic performance and an FDI-seeking government on the other, made Turkey and the Gulf countries likely partners (Olson 2008). There is a strong likelihood that Gulf countries as well as the other Middle Eastern governments see Turkey in a different light now that a 'moderate Islamic' government is in office, which has the potential to make Turkey a better-suited role model for a combination of democracy and Islam compared to what was before.

The non-Gulf Middle East is no longer perceived by the Turkish government as a source of immediate threat either, with avenues of communication and cooperation sought with the hitherto unseemly partners in the region. But neither the region nor the relations promise any stability. Turkey has mended fences with Syria in the aftermath of the 1999 crisis, developing its relations to a point of becoming a trusted facilitator in the roundabout negotiations between Israel and Syria. However, the relationship still remains precarious given the US opposition to de-isolate Syria and the latter's connection to various terror organizations in the Middle East. Turkey also feels no immediate threat from Iran and cooperates with it on energy issues as well as against the PKK. However, this picture too can change rather suddenly should the latter's alleged efforts towards nuclear armament prove fruitful. The developments in Iraq and the possibility of an independent Kurdish state emerging from a divided Iraq are matters that still trouble the Turkish establishment, due to its connections with the domestic Kurdish issue. Although there are serious obstacles to the Middle East's becoming the primary orientation in Turkish foreign policy, global developments and the ongoing US interest in the region makes it likely that the region will be on Turkey's radar for a while.

Turkey's connections to the Black Sea, Caucasus, Central Asia, and the Russian Federation make up another cluster of regional politics (one may call it the Eurasian dimension) that has developed since the end of the Cold War. Russia and Turkey have a long history of friction and clashes, and Turkey has been wary of 'Russian intentions' since the Ottoman era, exacerbated by the Soviet threat during the Cold War. After the fall of the Soviet Union, as Turkey aspired to assume a leadership position in what it chose to call the 'Turkic world', i.e. the Central Asian countries and Azerbaijan (Aydin 2004a, 2004b), Turkish-Russian relations entered a period of influence competition. Despite allegations of pan-Turkism and in addition to a dose of sentimental affinity, concerns over *realpolitik* with Turkey trying to gain a renewed strategic significance following the 'fall of the wall', the efforts towards the diversification of foreign policy amidst another tense period with the European Union (Aras 2008), the profit potential of the new markets and a growing awareness on the vitality of energy resources were strong rationales for Turkey's activity in the region. Turkey stressed ethnic and cultural ties and tried to develop strong economic and political relations with Azerbaijan, Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan, but failed to deliver, not least because of Turkey's preoccupation with domestic woes. Although these countries still matter to Turkey due to various reasons, including their vitality as sources of energy, the web of relationships have become all the more intricate as Turkey's 'kin' chose to ally with others (ICG 2007).

As a result of the disappointment experienced about its policies towards Central Asia, Turkey has, since 1995, increasingly focused its attention to the Caucasus, where energy and various conflicts threatened to spill over into Turkey (Aydin 2004b). This focus, while accelerating Turkish-Russian competition briefly, resulted in building the Baku-Tbilisi-Ceyhan oil and Baku-Tbilisi-Erzurum gas pipelines providing alternative routes to Caspian energy resources to reach European markets (Winrow 2009). The process also made Turkey the main trading, political, and security partner of both Azerbaijan and Georgia.

Turkey's relations with Armenia, on the other hand, have not followed this pattern, as the latter quickly signed a security treaty with Russia in 1997, allowing its borders with Turkey to be guarded by Russian soldiers once again. Turkey's troubles with Armenia stem from a number of problems, including the reluctance of Armenia to unequivocally recognize the border between the two countries, allegations of Ar-

menia's support for challenges against Turkey's integrity, Turkey's solidarity with Azerbaijan over Nagorno-Karabakh, and Armenia's insistence to call the 1915 events as 'genocide' (Barkey/Taspinar 2006; Tocci 2007). Turks view the 1915 events as "the deportation of a large Armenian population who tragically perished due to adverse conditions during the war" and insist that the losses were reciprocal; while Armenians claim that their ancestors were subjected to a systematic and planned mass murder. Turkey has reacted harshly to several national legislations around the world that recognize the 1915 events as 'genocide', and Turks see the Armenians, whether those in Armenia or in the Diaspora, as the perpetrators of this defamatory campaign. The issue, while a challenge for Turkey in terms of global prestige, in effect pales in comparison to Turkey's concerns over Iraq and/or Cyprus. Nevertheless, under pressure from the recent developments in the Caucasus and with a realization that Turkey's claim for regional leadership would be lame while its land border with a neighbouring country remains closed, the Turkish government has recently been engaged in a rapprochement process with Armenia, initiated through what has come to be known as the football diplomacy. However, not only has the move drawn yet again the ire of nationalists who view the move as outright treason, but it has also profoundly upset Azerbaijan, which has retaliated against Turkey via its grip on energy resources and forced Turkey to take heed of its concerns. The rapprochement process therefore seems to come to an impasse.

All these developments of course reflected immediately on the Turkish-Russian relations, which are not exactly built on amicable foundations, but are not openly antagonistic either. The degree of perceived threat compared to the Soviet period is lower and the two countries have strong commercial ties; but a sense of rivalry and of mutual mistrust ensues. The recent developments in the Caucasus, Russia's attempt to return to the global arena as an aspiring major power, and the pressure by its Western allies on Turkey "to side with themselves" on the one hand; and its kinship ties, affinities and/or strategic interests that compels it to approach the Caucasian and Central Asian states differently on the other, forces Turkey to seek and maintain a delicate balance in its relations with its Eurasian neighbours and the wider set of international actors, including its long-standing allies. The recent Russia-Georgia crisis has been indicative in terms of the potential dilemmas that await Turkey in its choices.

9.5 Soft(er) Security Issues Also Matter

Although the security understanding in Turkey heavily favours the traditional definition of security (Aydin 2003b), relatively new areas of security such as economic challenges, demographic and social trends, as well as environmental problems and energy dependency have increasingly come to appear in the discussions around security.

9.5.1 Global Economic Integration and Energy Dependency

Curiously, even though Turkey has been rapidly integrating with the global economy since the reforms of the early 1980's, a considerable portion of the population has failed to make peace with the idea of globalization. Indeed, there exists a large segment among the opinion-shaping elites who see globalization as a source of security threat; even a threat to Turkish territorial integrity. It is the political side of globalization with its weakening affects on the idea of the nation state that is considered as a threat among Turkey's top brass and decision-makers.

Economically, on the other hand, Turkey clearly benefits from the globalization process. Its significant industrial base, albeit less prominent than that of the BRIC countries,[12] allows it to be dominant in export markets in its region as well as making it increasingly attractive for *foreign direct investments* (FDI). Nevertheless, the very level of integration makes Turkey more vulnerable to international developments in economic terms. Economic and financial crises have troubled Turkey for decades, with the 1994, 2000, and particularly 2001 crises being the most severe ones. The economy has been open to contagion effect by meltdowns in other emerging markets, and has had vulnerabilities and volatilities of its own (Chibber 2004). Economic instability often went hand in hand with political instability, exemplified by the 2001 crisis triggered by a row among the top brass of the state apparatus. However, Turkey, having signed a stand-by agreement with the IMF has undertaken a sizeable transformation programme[13] that was pretty successful in reining in inflation, cutting back budgetary deficits, rationalizing the financial markets, and consolidating a banking system that had gone off the rails.

12 BRIC is the name given to the four leading emerging markets, namely Brazil, Russia, India and China.

The EU accession process has meanwhile served as an anchor for stability along with the IMF.

The 2008 financial crisis gives a patchy picture concerning Turkey's performance. Data[14] reveal that Turkey has in fact suffered severe damage, with exports down by some 33.3 per cent and imports by 43.4 per cent between April 2008 and April 2009. Capacity utilization dropped by some 10 per cent points throughout the same period in the overall economy, and almost 40 per cent in the public sector. These figures are indicative of a serious recession underway in Turkey. The biggest cause for concern, however, is the unemployment rate, which rose from 11.9 to 16.1 per cent between February 2008 and February 2009, and more significantly, youth unemployment, rose from 21.5 to 28.6 per cent in the same period. This can be compared to the United States[15] (9.4 per cent; up from 4.5 per cent) and the United Kingdom (7.1 per cent, up by 1.8 per cent),[16] which are considered to be among the countries that have suffered grave blows from the global crisis. Considering that Turkey still suffers from an overvalued lira, massive current deficits and foreign debt, and moreover that the crisis has clearly proved that there is no immunity from meltdown for any country, there is still room for concern for the economic security of Turkey.

Nevertheless, the psychological impact has been considerably milder. While newspapers report on the effects of the recession and businessmen call on the government to take action, the sentiment of 'insecurity' is not comparable to that experienced by citizens of advanced countries. It appears that there are at least three reasons for this: Firstly, Turkey has been through two major crises in one generation (1994 and 2001/2002) whose impact has been sudden and 'lethal'. The spillover of the 2008 crisis has been relatively gradual, and the Turkish public, which has already 'been there', has a relatively impervious attitude towards the crisis. Secondly, the banking sector, which the crisis in the world had started from and concentrated in since then, was reformed and reshaped substantially in Turkey after the 2001 crisis. As a result, Turkey was saved from the adverse affects of the initial phase of the crisis. Thirdly, the cogent and quite denialist approach adopted by the government vis-à-vis the crisis, epitomized by Erdoğan's now infamous statement, "The crisis will go tangent to Turkey," appears to have proved effective over the public opinion, although the relative inertia of the government in terms of taking measures will probably imply a deeper recession for Turkey as well.

In the same vein, energy has long been a delicate concern for Turkey considering the country's dependence on imports from its neighbours, and at the same time a trump card in the making particularly vis-à-vis Europe due to the country's role in transit (Barysch 2007). While Turkey aspires to be a major energy hub in the region, the prospects for this role are hampered by a series of issues. For one, Turkey is a latecomer to the issue, whereby existing contracts and alignments have already gained path-dependency. Moreover, technology and financial resources to be devoted to energy suffer severe constraints in the Turkish context. Turkey also faces grave difficulty in finding reliable partners: Iran and Iraq have proven volatile as trade partners given the sensitive political relations, while Kazakhstan and Turkmenistan choose to align themselves with Russia, partly due to path-dependency mentioned above. This left mainly Azerbaijan to tap for Turkey's energy needs as well as create alternative transit routes towards Europe. The competition between Turkey and Russia on regional influence is a major disincentive for Russia to cooperate with Turkey on energy and share the benefits of a scarce resource while it has the upper hand by a large margin. Developments in recent years in the context of Russian pressures and energy cuts towards Georgia and the Ukraine have raised concern that Russia may use the energy dependency of its trade partners towards political ends, which is also a challenge for Turkey due to its dependence on Russia for its natural gas, amounting to 65 per cent of its consumption. However, the energy race in Turkey's immediate neighbourhood is still ongoing with deals made and broken every other day.

Beyond energy dependency, vulnerability of pipelines passing through the country has also become an important security issue for Turkey in recent years with occasional ruptures on existing lines due to terrorist attacks, accidents or natural causes. Should Tur-

13 The economic reform programme in the aftermath of 2001 did not simply involve an IMF scheme but benefited largely from the experiences and the expertise of the Turkish bureaucracy that found the opportunity to channel its awareness about the problems in the economy to a list of maladies and remedies.

14 All data concerning Turkey's economic performance are retrieved from *Türkiye Istatistik Kurumu* (Turkish Statistics Institute [TUIK]); at: <http://www.tuik.gov.tr>.

15 May 2009 data; increase rate since December 2007, onset of recession. http://www.bls.gov/news.release/empsit.nr0.htm

16 Data belong to the first quarters of 2008 and 2009; at: <http://www.statistics.gov.uk/cci/nugget.asp?ID=12>.

key be able to expand its pipeline systems and truly become an energy transit country (even if not an energy hub), this issue will get even more attention both inside Turkey and also from the countries that depend on the continuous flow of oil and gas through pipelines. All in all, the area of energy is full of potentials for Turkey, as well as a great number of challenges en route.

9.5.2 Social, Demographic and Environmental Trends

Turkey has a young population, with a share of those under 25 standing at 53 per cent in 2007,[17] posing significant challenges concerning the education and health services to be provided to the population, employment opportunities to be created to absorb the new work force and the social unrest that will ensue if economic growth trends are reversed or decelerated. The demographic portrait, on the other hand, bears the potential to open up a window of opportunity in terms of Turkey's prospects, if these challenges can be met.

Turkey's economic transformation particularly in the aftermath of the 2001 crisis has been accompanied by a premature shift towards a sectoral redistribution typical of post-industrial economies: a shrinking agricultural sector and a growing services sector, both in terms of the size of the work force and the share in the national output. This has meant, however, massive migratory inflows from the rural areas to urban centres, with ensuing pressures in terms of employment creation, services provision, housing, social security, and urban safety, as well as fuelling cleavages. Despite creating new jobs thanks to a period of economic boom, Turkey has failed to bring unemployment figures down due to migratory and demographic pressures. The entire picture has resulted in considerable urban and rural unemployment, an unruly urbanization pattern, social unrest, and hostility against newcomers (at times matched with ethnic and religious tensions among the old and the new settlers) as well as poverty and deprivation among the uprooted population, all of which have also had significant political ramifications in electoral politics.

Immigration has not remained solely an internal concern. Turkey in recent years has become a transit route for flows of refugees and illegal immigrants from east to west (Emerson/Tocci 2004), but now also is evolving towards being a centre of attraction and a destination point itself. Men and women from the former Soviet republics, the Middle East, the Balkans, and Africa either come to Turkey in search of asylum or jobs, or are trafficked for illicit purposes. With a prospective change to its asylum policy,[18] Turkey is bound to face more migratory pressures from outside, particularly in periods of regional instability due to wars and political strife.

Turkey's awareness of environmental problems and their detrimental impacts is also quite recent, and the environmental sensitivity of policy-makers remains shallow to date. Turkey has signed the Kyoto protocol in February 2009, but its compliance with the EU *acquis* on the environment is far from satisfactory. The primary concerns for which the civil society strives to draw attention are air, water and sea pollution, deforestation, land erosion and desertification, as well as air and waterborne diseases (SPO 1998). Moreover, the impacts of climate change became obvious in Turkey primarily through the volatility in rainfall, drought and/or floods; water scarcity and the impact of the former on agriculture and food security, all of which has made the environment a growing security concern (Aydin/Ereker 2009). Turkey, being in an arid region where water can be a *casus belli*, has begun to include environmental concerns in its political agenda. The global food crisis, despite a rise in prices, has yet to have a comparable effect on Turkey, but it is widely acknowledged that the trend indicates more difficult times ahead for Turkish agriculture (Eraktan 2008). For the well-being of future generations, Turkey's adoption of a sustainable development framework appears to have become a matter of security.

9.6 Conclusion

Turkey finds itself in an ongoing phase of transformation as far as its domestic dynamics is concerned, the directions and the implications of which vary along with the transformation in its immediate neighbourhood and the wider global context. Major issues haunting Turkey today primarily derive from the lega-

17 TUIK (28 October 2008) on: "Population Trends Statistics"; at: <http://tuikapp.tuik.gov.tr/adnksdagitimapp/adnks.zul>.

18 Turkey has a reserve clause against the 1951 Geneva Convention that imposes a geographical restriction to preclude the right to asylum to persons coming from countries to its east and therefore only serves as a transit point for these asylum seekers. Turkey's asylum regime is undergoing transformation for conformity to EU practices and standards.

cies of its distant and recent past. This implies shortcomings on the part of the Republican nation-building scheme which resolved to break with the past and create a secular, democratic state of law and a monolithic society devoid of divisions along the lines of ethnicity, religion, and class. As the European Union which Turkey aspires to join is evolving towards a post-national, post-modern state of being, Turkey is, in a way, still struggling with the modernist project of nation-building 85 years after the foundation of the Republic.[19]

The EU accession process, in the face of the current impasse, fails to fulfil its role as an anchor. The moment of optimism at one point where major reforms were considered possible and the accession prospect promised remedy to Turkey's woes has failed to deliver, and worse still, left Turkey 'half-done'. What replaced the optimism is an anxiety for the state establishment that the political space opened up by reforms will endanger what remains of the integrity of the nation and the territory. To sum up, the blurring of the membership prospect has made Turkey's transformation thorny and contentious, lowered incentives for undertaking politically risky reforms and rendered domestic divisions more vivid. This left the country in between the Devil and the deep blue sea, where the national leadership finds itself unable to either push for further reforms or able to go back to 'good old days' when ruling an isolated, introverted, un-integrated country was much more manageable. The acute sentiment of an unsatisfactory position and the inability to move further or back away defines the current understanding of (in)security in Turkey.

Many challenges that Turkey faces in the regional and the broader international arena have also ostensible historical backgrounds, but what is more striking is their immediate relation to domestic concerns. Turkey today appears to view international relations through domestic political lenses: different actors perceive, define, and prioritize international challenges, threats or tendencies through different prisms of their respective fears and desires of the domestic sphere; which, in turn, translate into different preferences and tendencies in the regional and international sense, as well as securitization of different areas. On the other hand, actors view one another's foreign policy choices as means to gauge and judge one another's true colours. The overall picture indicates that not only do internal and external matters interact and/or coincide, but the domestic divisions and mistrust are nurtured by different conceptions of security, different orientations and expectations in the realm of global politics. This then creates in Turkey a much more pathological mood where every issue easily translates into a perceived new security threat or a cleavage over the fundamentals of, the state, nation, unity, territorial integrity or Turkish identity.

19 Barkey and Taspinar (2006: 3) seem to disagree, stating that the Kemalist nation-building project has accomplished its goals and is now struggling to "preserve and protect what has already been achieved."

10 Promoting Democracy as a Security Goal. The 'inward-outward' Paradox of the EU's Foreign Policy

Omar Serrano

10.1 Introduction[1]

This chapter looks at the influence of domestic political processes and public opinion in the framing of EU foreign policy. In doing so, policies which have been aimed at achieving regional security by means of promoting internal reforms are evaluated. The chapter emphasizes a mismatch between security concerns amongst policy-makers[2] and public opinion.[3] An increased concern on foreign policy-related issues (from domestic constituencies) it seems follows a similar pattern to the erosion of the 'permissive consensus' (Lindberg/Scheingold 1971) in the past decade.[4] There is strong opposition in many *member states* (MS) towards the effects of policies which comprise the extension of the 'four freedoms' (of capital, labour, goods, and services). The latter are the main incentives offered by both enlargement and New Neighbourhood strategies. This is relevant inasmuch as it suffices for public opinion to constrain a few MS for *European foreign policy* (EFP) as a whole to be affected. Since most areas in EFP are intergovernmental, a single member can in principle block or alter a common position.[5] Thus, the influence of domestic pressures should not be overlooked.

The paradox of the internal-external dimension suggests that a certain mismatch exists amongst the security perceptions (and security goals) of policy-makers and voters. European voters have stressed social (job insecurity) or societal (fear of immigration) dimensions of security, whilst policy-makers have emphasized external or political ones. Regional democratization strategies are particularly affected by this happening.

That the Eastern enlargement (whilst extremely successful in promoting democratic consolidation of the new member states) has heightened public concerns on EFP, has to do with the aforementioned paradox. In particular, given the strong opposition towards extending membership to some of the countries included in the 2004 enlargement (10.3). Although current voters' concerns have (so far) mainly affected some of the EU's democratization policies,[6] it is not the only foreign policy area where domestic

1 The author would like to thank Jonas Hagmann, Thorsten Wetzling, and four anonymous reviewers for helpful comments on previous versions of this chapter. He is also grateful to policy-makers from various MS permanent representations in Brussels, and at the Commission, who kindly provided their time and hindsight and whose interviews greatly enhanced this research.

2 By policy-makers, ideal types are considered. The aim is to capture the EU policy-making process as a whole, and not any individual cases. There was much divergence amongst the different representatives of *member states* (MS) in the run-up to the 2004 enlargement (O'Brennan 2006).

3 When measuring public opinion the study relies on Eurobarometer surveys. Aggregate EU-15 data are used for the 2004 enlargement, and in more recent cases the data are aggregated for the EU-25 or EU-27. In some particularly relevant cases, public opinion of individual MS is also examined.

4 Several authors (e.g. Norris 1997) have argued that this consensus began to disappear by 1989 and became clear with the opposition to the Maastricht referendum. Whilst this is the case for overall support to European integration (both from an affective and a utilitarian perspective) this does not seem to have directly translated into the realm of foreign policy. After all, this was one of the fastest growing areas of integration throughout the decade of the 1990's. The Eastern enlargement appears to have changed this 'benign neglect' as further enlargement policies given immigration or economic liberalization fears have met strong opposition.

5 In practice this works through coalition-building, as peer pressure can be strong and it is unlikely for a single MS to defend a position alone.

6 Chiefly the enlargements towards Turkey and the West Balkans, but possibly also to the New Neighbourhood policy if it were to be fully implemented (i.e. the extension of the four freedoms).

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politics might be of relevance. Somewhat ironically, through the promotion of democratization, the EU has brought on itself increasing calls for a more democratic foreign policy. Whether and how this has happened is a relevant topic for further research (in areas such as trade, defence, and justice and home affairs). This does not mean that all MS have been equally affected. There seem to be relevant differences as to the degree to which domestic politics influences behaviour of the 27 MS. Indeed, there might be groups of MS (e.g. old and new members or small and big MS) that behave in similar ways. This could have significant effects in the coalitions that are formed when formulating European foreign policy.

The chapter is divided as follows. A first part evaluates (from a theoretical and empirical perspective) the mismatch in security concerns of policy-makers and voters (10.2). This is followed by an empirical appraisal on the achievements of the EU in its diverse strategies for promoting democratization (10.3). A third section evaluates public preferences vis-à-vis the 2004 enlargement (10.4). A fourth part suggests a framework of analysis for the influence of domestic politics in European foreign policy-making (10.5).

10.2 Security and Democracy: An Inward-Outward Paradox

The aim of promoting democracy through enlargement was made explicit in article 49 of the Maastricht Treaty and following the incorporation of the so-called Copenhagen criteria (adopted as central components of the enlargement process during the European Council in the summer of 1993).[7] It must be noted that enlargement is only one of the various instruments the EU has implemented for promoting democracy. This objective has not been limited to regional policies as the promotion of democracy has been an integral component of EU relations with third countries.[8] This said, it is precisely regional policies (and in particular enlargement) where the effects of democracy promotion have been most successful (i.e. have achieved substantial reforms). It is also towards them that public opinion in the European Union has been most divergent.

Both the New Neighbourhood strategy and Enlargement can be seen to reflect a 'narrow' notion of security contained in the *European Security Strategy* (ESS).[9] This key document (a doctrine for European foreign and security policy) underlines the importance of enlargement as a foreign policy tool.[10] The ESS identifies terrorism, proliferation of weapons of mass destruction, regional conflicts, state failure, and organized crime as key threats (chap. 6 by Bailes). Under this optic, neighbourhood policies are directed towards "promoting a ring of well governed countries to the East of the European Union and on the borders of the Mediterranean" (ESS 2003: 13). The aims are the promotion of good governance in the Balkans and the Mediterranean rim; the main (although not exclusive) areas of concern for enlargement and neighbourhood policies.

Finding whether a mismatch amongst security concerns of voters and policy-makers exists, requires a careful examination of the concept of security. Buzan's (1991) widely shared typology conceives security threats as 'military', 'political', 'economic', 'environmental', or 'societal'. In this view, *military security* is centred along offensive and defensive capacities of states; *political security* on the organizational stability of states; *economic security* on access to resources to sustain welfare and state power; *environmental security* on the maintenance of the local and planetary biosphere; and *societal security* comprises sustainability of traditional patterns of language, culture, and religious and national identities and customs (Buzan 1991: 19–20; Brauch 2008, 2009).

This framework is useful when examining the objectives of the ESS as they fall in the external or political security typology. At the same time, both enlargement and neighbourhood policies touch upon

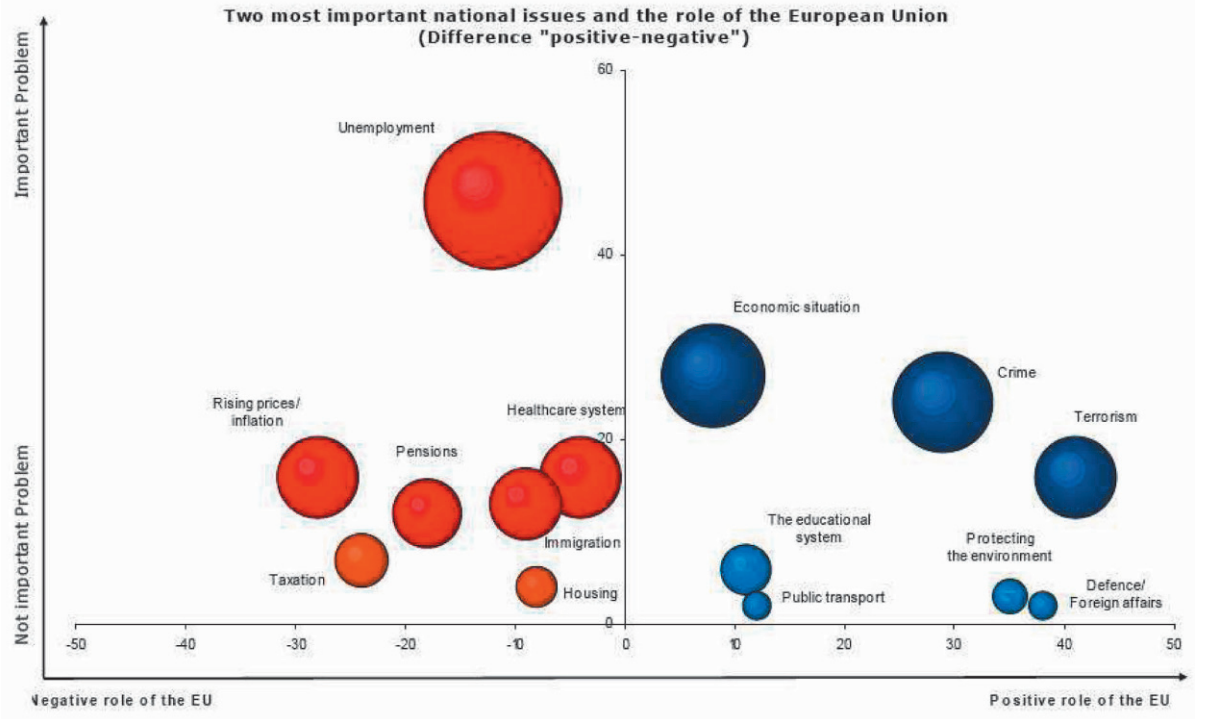
7 See European Council, 21–22 June 1993: Conclusions of the Presidency; at: <http://ue.eu.int/ueDocs/cms_Data/docs/pressdata/en/ec/72921.pdf>.

8 This aspect is not covered in this chapter. However, a recent conference organized by Annette Jünemann and Michèle Knodt deals extensively with the subject. In an ensuing publication (Jünnemann/Knodt 2007) diverse authors look at EU democracy promotion in Africa, Latin America and the Caribbean, Asia, Russia, East and Central Europe; as well as the Mediterranean and the Arab world. Their analysis is centred along dimensions such as the degree of interaction, economic potential, security advantages, internal security situation, and changes in the overall security environment.

9 See European Council, European Security Strategy 2003; at: < http://www.consilium.europa.eu/ cms3_fo/showPage.ASP?id=266&lang=EN&mode=g>.

10 "[T]he progressive spread of the rule of law and democracy has seen authoritarian regimes change into secure, stable, and dynamic democracies. Successive enlargements are making a reality of the vision of a united and peaceful continent" (ESS 2003: 3).

Figure 10.1: Important issues and role of the European Union in them. **Source:** Eurobarometer no. 62 (autumn 2004).



social and societal aspects which seem to be relevant security concerns for voters within member states. Thus, it is argued, there is a certain mismatch. It must be noted, however, that these categorizations are ideal types; a more careful analysis is thus required.

An assessment of possible differences amongst public opinion and policy-makers requires decorticating different meanings of security, as they are themselves contested. Baldwin (1997) proposes a useful framework for doing this through seven axes: referent objects (security for whom?); values (which values are to be secured?); amount (how much security is needed?); threats (what threats are to be conceived?); costs (at what cost?); time (for how long?); and means (by what means are they to be secured?). Some of these axes, used as analytical tools, seem helpful in clarifying where the aforementioned differences might exist (Hintermeier 2008).

By using these different axes and evaluating public opinion responses in Eurobarometer surveys, we may compare these preferences with the positions stated by the ESS. There is one caveat in following this methodology. As Cautrès and Monceau (2007) argue, Eurobarometer questions are subject to one dimension or to a simple contrast amongst two possibilities (e.g. tend to agree, tend to disagree). Public opinion dynamics, however, are likely to be more complex than this. The Eurobarometer surveys, nevertheless, provide us with a wide range of interrelated questions, which combined with the appropriate tools (such as factor analysis) may help us in gaining a more accurate picture. According to the research of the above-mentioned authors (in which the authors apply factor analysis to French Eurobarometer responses), they find similar results as the ones which shall be portrayed below. Nevertheless, in the present research sets of interrelated questions have been evaluated to minimize the above-mentioned biases.

The ESS aims at securing states or the EU as a whole. At the same time the most important concerns for voters according to Eurobarometer surveys have been unemployment, crime, and the economic situation.[11] These pertain either to individuals or to society as referent objects. European citizens, it seems, conceive threats along two different dimensions. A first one refers to the aforesaid fears of unemployment, crime, and the economic situation. A second relies on traditional (or external) threats such as terrorism – largely in line with those threats identified by the ESS. Societal concerns, however, are more present than external ones. They become more salient, given that in

11 This can be found in different Eurobarometer surveys. See for example the latest *Eurobarometer* (Spring 2007, no. 67); at: <http://ec.europa.eu/public_opinion/archives/eb/eb67/eb_67_first_en.pdf>.

relation to unemployment – the main concern for European public opinion – the EU's role is considered to be a negative one. Figure 10.1 taken from the Eurobarometer 62 (autumn 2004)[12] shows that threat perception (and the role of the EU in confronting threats) is dual; as there is an internal and an external dimension. The Y axis represents the concerns of a particular issue in public opinion. The X axis comprises the impact (positive in blue and negative in red) of the EU on these concerns. Time series of different Eurobarometer surveys show these responses to be stable over time.

The EU's role is seen as positive in areas such as the economy, crime, terrorism, and foreign affairs. At the same time, it is negatively perceived in fighting unemployment, inflation, and immigration. Said otherwise, the EU is perceived to play a relevant role in generating external security but a negative one when it comes to societal security. That said, EU involvement is favoured in both dimensions: fighting unemployment (44 per cent); poverty and social exclusion (40 per cent); keeping peace and stability in Europe (34 per cent); fighting organized crime and drug trafficking (30 per cent); terrorism (27 per cent).[13] These responses also indicate that societal security concerns are seen to be more acute than those relevant to external security. Considering that European unification has produced significant stability, these results seem understandable.

In themselves, these findings should not be problematic. Tensions arise, however, when external aims touch upon societal issues. This is the case of external democratization policies. When the means by which these objectives are furthered touch the societal dimension, they are (not surprisingly) strongly opposed. This, concerning not only enlargement, but also the wider neighbourhood policy which is perceived to be costly and even as a possible threat to the EU's prosperity and stability (in the case of the promotion of internal reforms).[14]

To avoid biases from issue-framing, it is useful to look at related questions (alternatively, quantitative methods such as factor analysis could be applied). A special Eurobarometer survey[15] on relations with neighbouring countries suggests European citizens consider the most important areas of cooperation to be: terrorism (90 per cent) and crime (90 per cent); followed by economic development (88 per cent); energy (87 per cent); the environment (87 per cent); and democracy (87 per cent). All of them are in line with the aims of the ESS. However, when asked on whether promoting reforms in those neighbouring countries would endanger the EU's own prosperity and stability, a high number of respondents agree. This is the prevailing opinion in fourteen member states (Portugal, Denmark, Italy, the UK, Latvia, Malta, Austria, Estonia, Slovenia, Luxembourg, the Czech Republic, Hungary, Ireland, and Slovakia). For the EU-25, nearly half of the respondents consider furthering reforms in neighbouring countries as a potential threat. This goes against policies aimed at democratization, which have been developed by the EU towards neighbouring countries. It also suggests scepticism as to the costs of such policies.

A further way of looking at these public concerns is by evaluating public opinion positions on the consequences of enlargement. The main stated consequences are: increased mobility within Europe (82 per cent of responses), increase of job transfers to cheaper locations (75 per cent), and increased settlements of workers from future members into old member states (73 per cent).[16] Respondents also consider that enlargement increases the risks of criminal activities (62 per cent); even if they also think it reinforces the capabilities of the Union to fight criminality and terrorism. The same pattern identified with earlier responses is confirmed.

So far, only enlargement has been mentioned. However, neighbourhood policies are affected by the very same concerns. What makes the *New Neighbourhood Strategy* so similar to enlargement is the proposed extension of the 'four freedoms'. As a consequence, the *New Neighbourhood Policy* has similar distributional consequences as enlargement (and can be expected to cause analogous opposition). Resistance is predictable on issues such as immigration or

12 Available at: <http://ec.europa.eu/public_opinion/archives/eb/eb62/eb62_en.htm>.

13 See *Eurobarometer*, No. 62 (autumn 2004); at: <http://ec.europa.eu/public_opinion/archives/eb/eb62/eb62_en.htm>.

14 See: special issue of: *Eurobarometer*, no. 285: "The EU's relations with its Neighbours: A survey of attitudes in the European Union" (September 2007); at: <http://ec.europa.eu/public_opinion/archives/ebs/ebs_285_en.pdf>.

15 Special issue of: *Eurobarometer*, no. 259 (October 2006); at: <http://ec.europa.eu/public_opinion/archives/ebs/ebs_259_en.pdf>; see also Special *Eurobarometer*, no. 285 (September 2007).

16 Special issue of: *Eurobarometer*, no. 253 (July 2006) on Enlargement; at: <http://ec.europa.eu/public_opinion/archives/ebs/ebs_255_en.pdf>.

the re-allocation of firms to countries or regions with cheaper labour, lower taxes, and laxer regulatory frameworks.

There is a caveat to the previous results. The issue of timing seems to be important. When a temporal dimension is added, opposition to enlargement drops.[17] This suggests that a slower enlargement (or liberalization) process is desired; which is understandable in light of the societal concerns expressed on public opinion surveys. Nevertheless, this poses a problem when confronted with external and political aims. It would have been extremely hard to include only a few countries in the 2004 enlargement (say Poland, Hungary and the Czech Republic) whilst leaving other candidate countries waiting for accession. It would also have weakened the incentives offered by the EU, which are central to the success of enlargement and New Neighbourhood policies (10.3). Moreover, the 'road map' of the Copenhagen criteria (even with its clause on absorption capacity), makes it extremely hard to delay accession once chapters are being closed. Recent developments related to the Turkish accession process (in which the French government has without much success sought to slow down the pace), underline the difficulties when the Commission faces attempts to delay the process.

In sum, European voters seem to support cooperation with neighbouring countries (along the lines stated in the ESS) as long as it does not touch upon social issues (in particular immigration and unemployment). These phenomena underline an external-internal paradox. External goals which affect societal issues will be opposed. Moreover, there is significant scepticism towards promoting internal reforms in neighbouring countries. As a consequence, the mismatch is not so much on the objectives, but on the policies or instruments by which these objectives are furthered. To provide a more detailed explanation of these objectives, the next section evaluates the way in which enlargement and neighbourhood policies have been implemented.

10.3 Promoting Democracy as a Security Goal: Enlargement and Neighbourhood Strategies

The 2004 enlargement is to be seen as part of a wider effort to integrate Eastern Europe into the West's political and military institutions. The political imperative to do so has been enormous, given both the desire from candidate countries and the historical determinants of the long-lasting division of Europe during the Cold War. This has posed enormous pressure on EU policy-makers to act. At the same time, for candidate countries, enlargement criteria have entailed significant restructuring of domestic institutions and public policies (Schimmelfennig/Sedelmeier 2004). The strategy has proven extremely successful in consolidating democratization processes, but also in the protection of minorities and the relations amongst governments and the military. The most pertinent examples of these effects are the Baltic States, the Balkans, and Turkey.

The Baltic States were reluctant to integrate sizable ethnic minorities.[18] The cases of Moldova and Georgia, where the OSCE had established *long term missions* (LTMs) after bloody infighting, warned of the potential dangers of such a situation.[19] An OSCE mission was proposed in both Estonia and Latvia to prevent similar developments. However, both Baltic countries were reluctant, in part given that it could divert foreign direct investment. The aim of joining the EU (and NATO) proved a strong element in persuading both of these countries to accept the involvement of the OSCE (and in complying with the requirements of the Commission on the protection of minorities).

In the Balkans, after a long series of policy setbacks throughout the conflict in Yugoslavia, the prospect of membership has been a relevant factor in ensuring the post-war stability of the region. In this sense, the incorporation of Slovenia to the Union has sent a powerful message to other former Yugoslav countries. The incorporation of Bulgaria and Roma-

17 Special issue of: *Eurobarometer*, no. 253 (July 2006) on enlargement; at: <http://ec.europa.eu/public_opinion/archives/ebs/ebs_255_en.pdf>.

18 In particular Estonia and Latvia. Estonia hosts a population of about 400,000 Russian-speaking 'non-citizens' and Latvia nearly 700,000 – approximately 30 and 40 per cent of their respective total populations (Ghebali 2004).

19 The conflict involved minorities in both Trasniestria and South Ossetia, to large extent holders of Russian passports, as is the case with Russian-speaking minorities in the Baltic States.

nia has reinforced this appeal; Croatia is likely to join in the near future. Gänzle and Sens (2007) argue that after the war in Bosnia (in 1995); the Kosovo War (of 1999); and the resulting Stability Pact, the EU has played a central role as an economic, political, and security actor.

These two cases had particular importance given the risks of violent conflict erupting or re-emerging. Furthermore, the incentive of joining the EU is likely to have helped opposition parties to consolidate and the mobilization of societies against authoritarianism. This could well have been the case in Slovakia under the Meiar government; Romania in the early 1990's; Croatia under Tudjman; and Serbia under Milosevic (Schimmelfennig/Sedelmeier 2004).

Current accession candidates have also engaged in wide-ranging democratic reforms. Turkey has reduced the involvement of its military in the country's political life. This has made possible the rise to power of the moderate Islamist government of Recep Tayyip Erdogan, less than a decade after the military overthrew the government of Necmettin Erbakan, due to its Islamic credentials (chap. 9 by Aydin/Esen). The reduction of the military's involvement in Turkish politics, its allowance of the rise and continuation of a moderate Islamist government, mark a watershed in this country's modern history. This might also have helped easing tensions towards Cyprus. The enlargement of Cyprus itself raised expectations of achieving a solution to the long-lasting division of the island. Even if these expectations proved premature, the possibility of joining the Union encouraged Turkish Cypriots to largely support a UN plan for reunification, which has opened new opportunities for a conflict settlement.

Overall, as Schimmelfennig (2007) argues, the transformative effect of the EU and other regional organizations (such as NATO or the OSCE), has occurred in two main directions. Either by creating a virtuous circle which reinforces and stabilizes norm conformance; or by assuring compliance with particular rules – as was the case of minority rights in the Baltic countries. In authoritarian or autocratic countries, such as Serbia and the Ukraine, domestic revolutions might have been encouraged by the prospect of membership in these regional organizations. Hence, the success in bringing about democratization and democratic consolidation depends on the pre-existence of conditions favourable to democratization, and on a credible conditional perspective of admission.

It is hard to find any counterfactual which would allow measuring the degree to which EU membership explains these developments by itself. However, given the important incentives provided by the EU; the 'road map' of the Copenhagen criteria; and the monitoring of the Commission, it seems unlikely that enlargement has not been important – if not essential – in bringing about these internal reforms.

The *European Neighbourhood Policy* (ENP) has been less successful. There have been a number of explanations for its much studied shortcomings.[20] A major element has been the lack of a clear policy. An example of this is the strategy towards the countries which were to join the 'Barcelona Process'. Until 1995, the strategy focused on promoting stability rather than democracy (e.g. the support to the Algerian coup in 1991). However, the aim for a more coherent foreign policy and a reassessment of European interests[21] brought about the *Euro-Mediterranean Partnership* (EMP) in November 1995 (Youngs 2002).

According to Schimmelfennig and Sedelmeier (2004), the shortcomings of the ENP vis-à-vis enlargement are to be found mainly as a consequence of the lack of a mechanism of conditionality – through which the EU has been able to transfer rules. Essentially, conditionality entails a 'bargaining strategy of reinforcement by reward' (Schimmelfennig/Sedelmeier 2004: 662). The lure of the neighbourhood strategy has not proven successful in bringing about significant democratization and reform, since it does not offer membership as an end goal. Moreover, beyond the EMP, the *Partnership and Cooperation Agreements* (PCAs) that are in force with Russia, Ukraine, and Moldova do not include preferential trade. Thus, a timetable for regulatory approximation does not exist. This limits even more the influence of the EU in bringing about institutional change in these countries. Pridham (2002) suggests that given the complexity and the length of democratic consolidation, long-term incentives and political conditionality (as required by the EU through the Copenhagen criteria) are essential.

Perhaps, not surprisingly then, the Commission's more recent approach towards ENP aims to reinforce the neighbourhood strategy through what it defines as a differentiated, progressive, and benchmarked approach.[22] This essentially means achieving reform through conditionality (in a similar way enlargement

20 For a full overview see: Jünnemann and Knodt (2007).

21 The belief that good governance and democracy were by themselves better ways of bringing about long-term stability in the region and containing radical Islam instead of supporting repressive governments.

Figure 10.2: Support for membership of the European Union. **Source:** Eurobarometer 67 (June 2007).

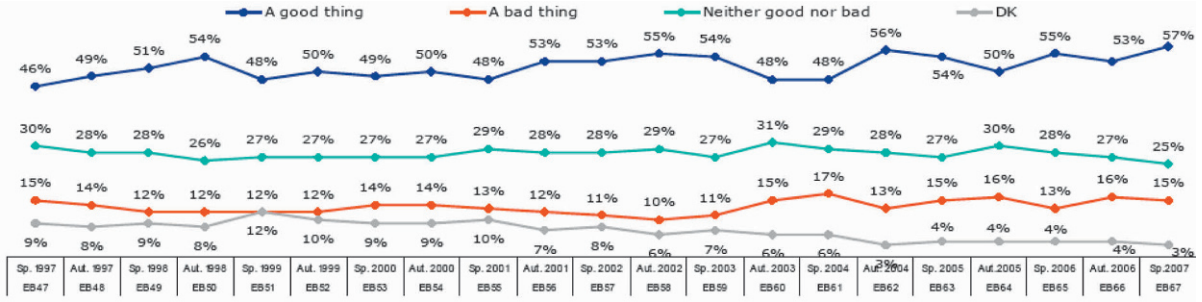
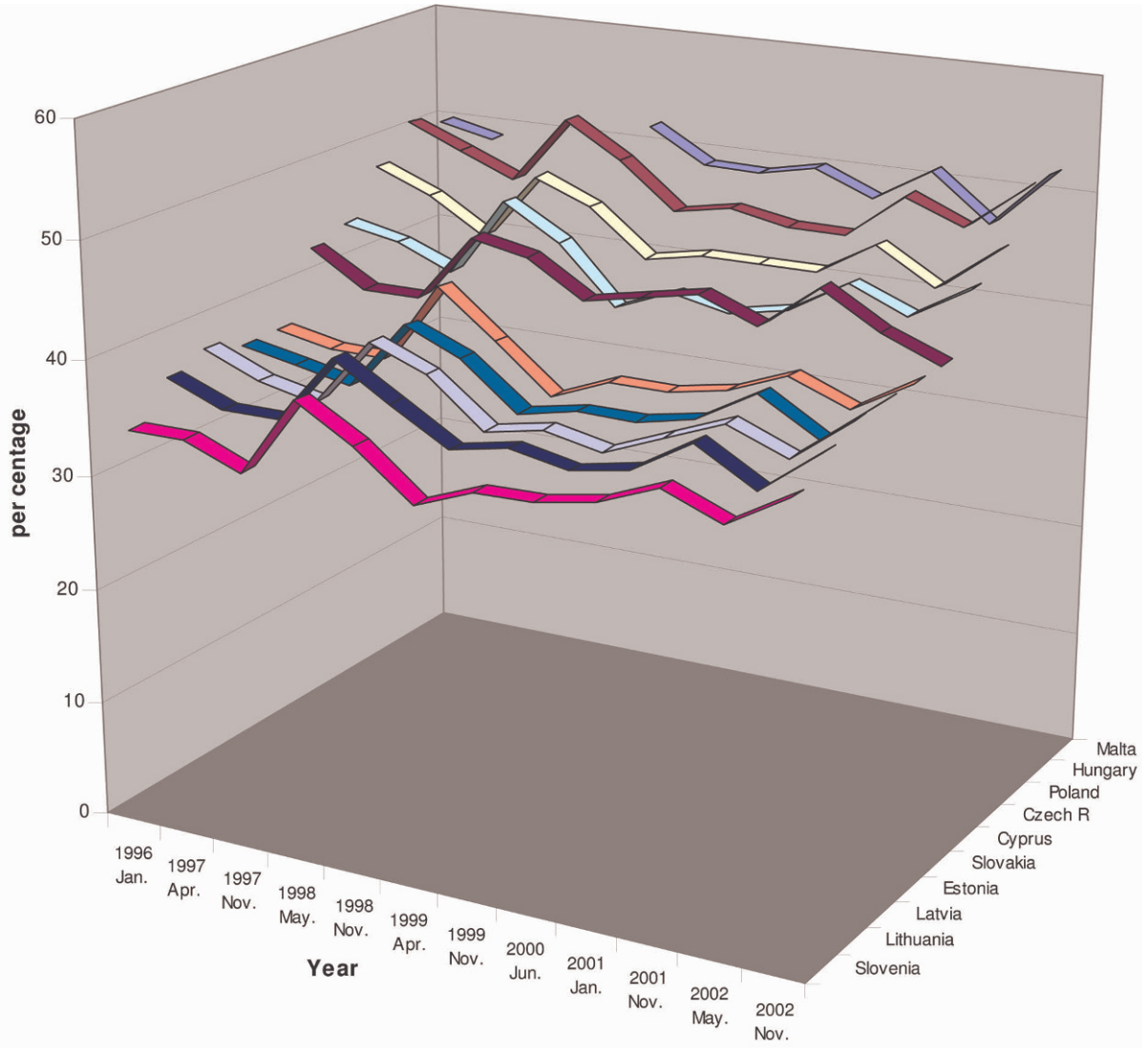


Figure 10.3: In favour of the EU enlargement with regard to the Eastern enlargement candidate countries in per cent. **Source:** Author's elaboration based on Eurobarometer (1996 to 2002) data.



has worked), while offering the 'four freedoms' (of capital, labour, goods, and services) as a reward.[23] This is to be achieved through negotiated consensual bilateral 'Action Plans' with each target state (Biscop 2008). As with enlargement, the success of this policy ultimately depends on the credibility of the reward

(that is on the extension of the four freedoms). However, the extension of the free movement of people risks facing strong opposition from domestic constituents. This might weaken the credibility, and thus the effectiveness, of the Union's policy – a similar dynamic to that which currently occurs with the enlargement process.

10.4 Public Support, the Eastern Enlargement and its Consequences for European Foreign Policy

There is plenty of evidence that public orientations can influence the European integration process, as can be seen in the outcomes of Maastricht, the failed constitutional referendums, and the impact of public opinion in policies such as the common agricultural policy, the implementation of the Euro, and the debates on enlargement (Laumen/Maurer 2006). At the same time, it is less clear to which extent they influence European foreign policy. A traditional view is that foreign policy (and in particular security policy) is the domain of the executive and that only in exceptional cases it affects policy decisions. In this sense foreign policy is seen to be an area shielded from public debate and as such little influenced by public orientations (10.5). Whilst this may be true in an important number of European countries (as seems to be the case for most of the new member states and perhaps even older members such as Germany),[24] this is certainly not what happens in MS such as France, the Netherlands, the UK, Ireland, and more recently Italy.[25] It is thus relevant to look at public perceptions on enlargement. Before that, however, it is pertinent to emphasize that throughout the period following Maastricht support for European integration has remained stable and overall high (figure 10.2). Thus, lack of support to enlargement cannot be directly attributed to a lack of support to the EU.

Support to enlargement has been low (and continues to be so). Moreover, it has been selective, with some candidate countries enjoying stronger backing than others. What is the more surprising is that (with

22 See European Commission, 2003: *Communication from the Commission to the Council and the European Parliament*: *Wider Europe – Neighbourhood: A New Framework for Relations with our Eastern and Southern Neighbours* (Brussels: European Commission, 11 March, 2003); at: <http://ec.europa.eu/world/enp/pdf/com03_104_en.pdf>.

23 'In return for concrete progress demonstrating shared values and effective implementation of political, economic and institutional reforms, including in aligning legislation with the acquis, the EU's neighbourhood should benefit from the prospect of closer economic integration with the EU. To this end, *Russia, the countries of the Western NIS and the Southern Mediterranean should be offered the prospect of a stake in the EU's Internal Market and further integration and liberalization to promote the free movement of – persons, goods, services and capital (four freedoms).*' (emphasis in original), in: *Communication from the Commission to the Council and the European Parliament*: *Wider Europe – Neighbourhood: A New Framework for Relations with our Eastern and Southern Neighbours* (Brussels: European Commission, 11 March, 2003: 4); at: <http://ec.europa.eu/world/enp/pdf/com03_104_en.pdf>.

24 The case of Germany is puzzling as on the one hand there seems to be an elite consensus on foreign policy and little public debate on foreign policy decisions. A case in point is the strong involvement of Germany in the Eufor-Congo mission which was strongly opposed by public opinion and the parliament. On the other hand, there are cases where policy does seem to be constrained by public opinion. The reluctance of the Merkel administration to increase the participation of German troops in the NATO mission in Afghanistan suggests so. At the same time, on enlargement, the CDU/CSU position on a privileged partnership as an alternative to Turkish membership has been much publicized.

25 France changed its constitution to require a referendum to any further enlargement and French President Sarkozy made his opposition to Turkey a central element of his election campaign. The UK imposed labour restrictions towards Romania and Bulgaria, in large part as a reaction to the huge influx of immigrants from the 2004 enlargement, Ireland followed suit. The British Conservatives have profited from the immigration issue, they made it a central (if at best partially successful) component in the run-up to the 2005 election. More recently Gordon Brown has also included the immigration issue in Labour's agenda. The Dutch have significantly altered their position towards enlargement and the EU, as the economic consequences of enlargement and immigration fears have spurred a vocal domestic debate. The rejection of the Constitutional Treaty by both Dutch and French voters has been attributed in part to the unease of voters towards further enlargement. More recently, Italy has challenged the free movement of people within the Union on security concerns and has repatriated Romanian citizens on these grounds. Radical right parties have increased their presence in parliaments throughout Europe, leading to right-wing shifts in political parties on issues such as immigration.

Table 10.1: In favour of the EU enlargement with regard to the Eastern enlargement candidate countries in per cent. **Source:** Author's analysis based on Eurobarometer data (1996 to 2002).

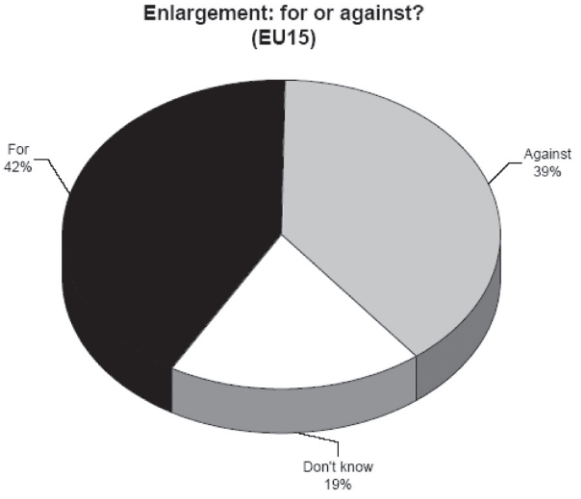
Country	EB44.2bis	EB47.1	EB48.0	EB49	EB50.0	EB51.0	EB52.0	EB53	EB54.1	EB56.2	EB57	EB58
	Jan.	Apr.	Nov.	May.	Nov.	Apr.	Nov.	Jun.	Jan.	Nov.	May.	Nov.
	1996	1997	1997	1998	1998	1999	1999	2000	2001	2001	2002	2002
Malta	50	49	n/a	n/a	52	49	49	50	48	51	47	52
Hungary	51	49	47	53	50	46	47	46	46	50	48	52
Poland	48	46	43	49	47	43	44	44	44	47	44	48
Czech R	44	43	41	48	45	40	42	41	42	45	43	46
Cyprus	43	40	40	46	45	42	43	44	42	46	43	41
Slovakia	37	36	36	43	39	35	37	37	38	40	38	41
Estonia	37	36	35	41	39	35	36	36	37	40	37	41
Latvia	38	36	35	41	39	35	36	35	37	39	37	41
Lithuania	37	35	35	41	38	35	36	35	36	39	36	40
Slovenia	34	34	32	39	36	32	34	34	35	37	35	38

the exception of Cyprus[26]) this approval (or lack of it) is remarkably stable and has remained so over time. This is shown in figure (10.3) and table (10.1). Separate data for each candidate country is only available until 2002.

Figure 10.3 shows that support towards particular countries in the years preceding the 2004 enlargement was remarkably stable both in absolute and relative terms (the exact figures are shown in table 10.1). Thus, variations in overall support have affected all countries equally (with the aforementioned exception of Cyprus). [27]

While the data for each one of the candidate countries was not published in the Eurobarometer reports after November 2002, the Eurobarometer 61 of spring 2004 (the last before enlargement took place) recorded a loss of support for enlargement. Overall support fell to 42 per cent (figure 10.4). See also figure (10.6) which looks at the support in each of the EU-15 MS.

Figure 10.4: In favour of or against EU enlargement. **Source:** Eurobarometer, no 61, Fieldwork (February-March 2004).

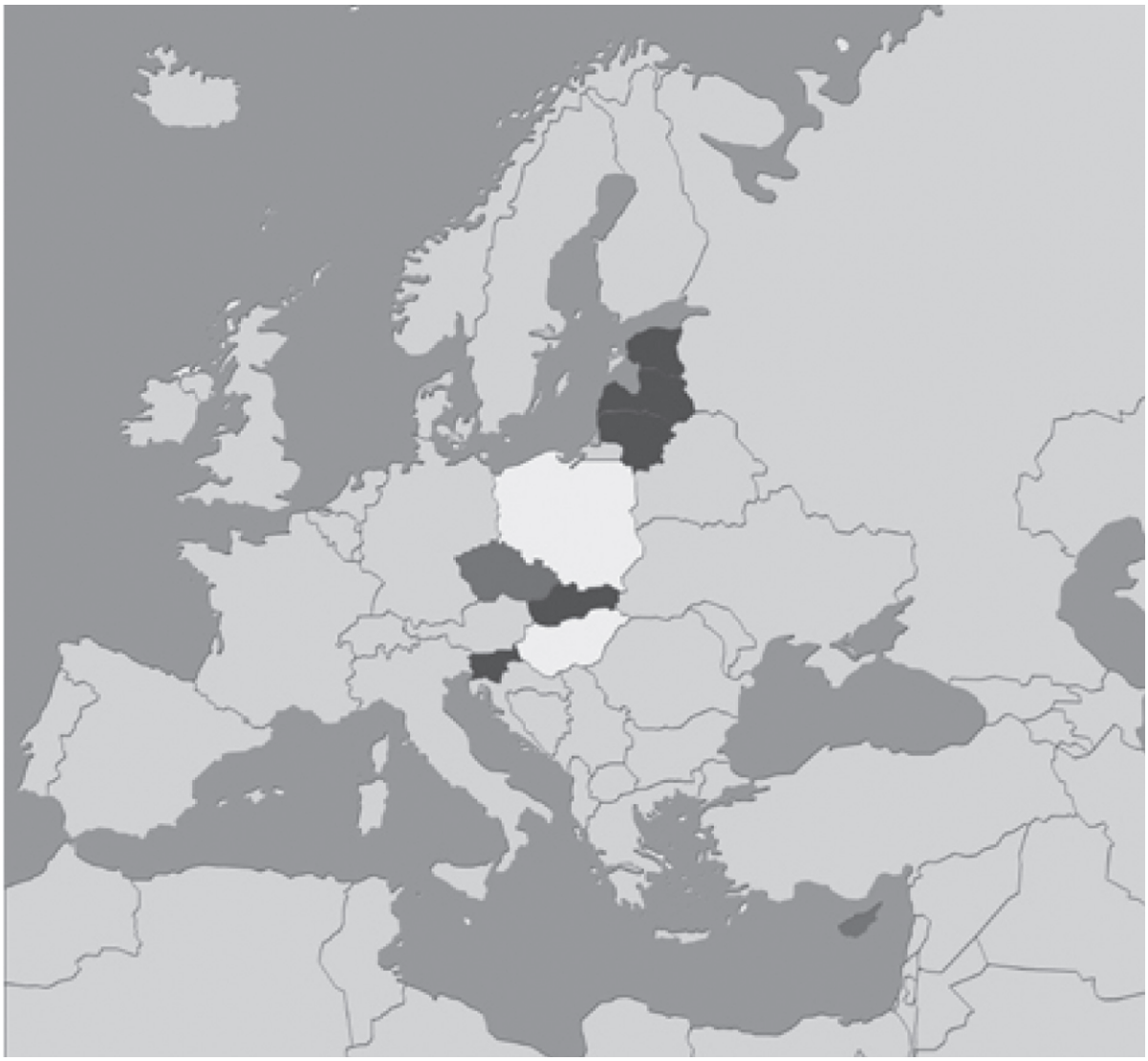


As table 10.1 showed, and this is also reflected in figure 10.5, the states where the lure of enlargement was most important in achieving democratic consolidation – or regional stabilization – were also the countries towards which public support was at its lowest.

26 Its public support decreased as the 2004 enlargement approached. This, nevertheless, seems explainable considering the position taken by the Greek-Cypriot government towards the 'Annan Referendum' supported by the EU and aimed at the island's re-unification. Turkish-Cypriots strongly supported this plan, but it was rejected by the Greek-Cypriots to a large extend given the vocal opposition of its government to the plan. This suggests that public preferences react in a rational way, which goes against one of the main claims of the 'Almond-Lippmann Consensus' (see next section) which is that public opinion is volatile and irrational.

27 It could be conceived that the wider support for some countries was a result of their earlier engagement in the accession process. After all, Helmut Kohl had early on promised and set a date for Polish accession, and with it Hungarian and Czech as well (O'Brennan 2006). However, if this were the case one would expect relative changes in public support over time. That support was overall stable and that the differences in support among the different candidate countries were remarkably constant suggests otherwise.

Figure 10.5: In favour of the enlargement towards Eastern European countries 2004. **Source:** Author's elaboration based on Eurobarometer data (1996 to 2002).



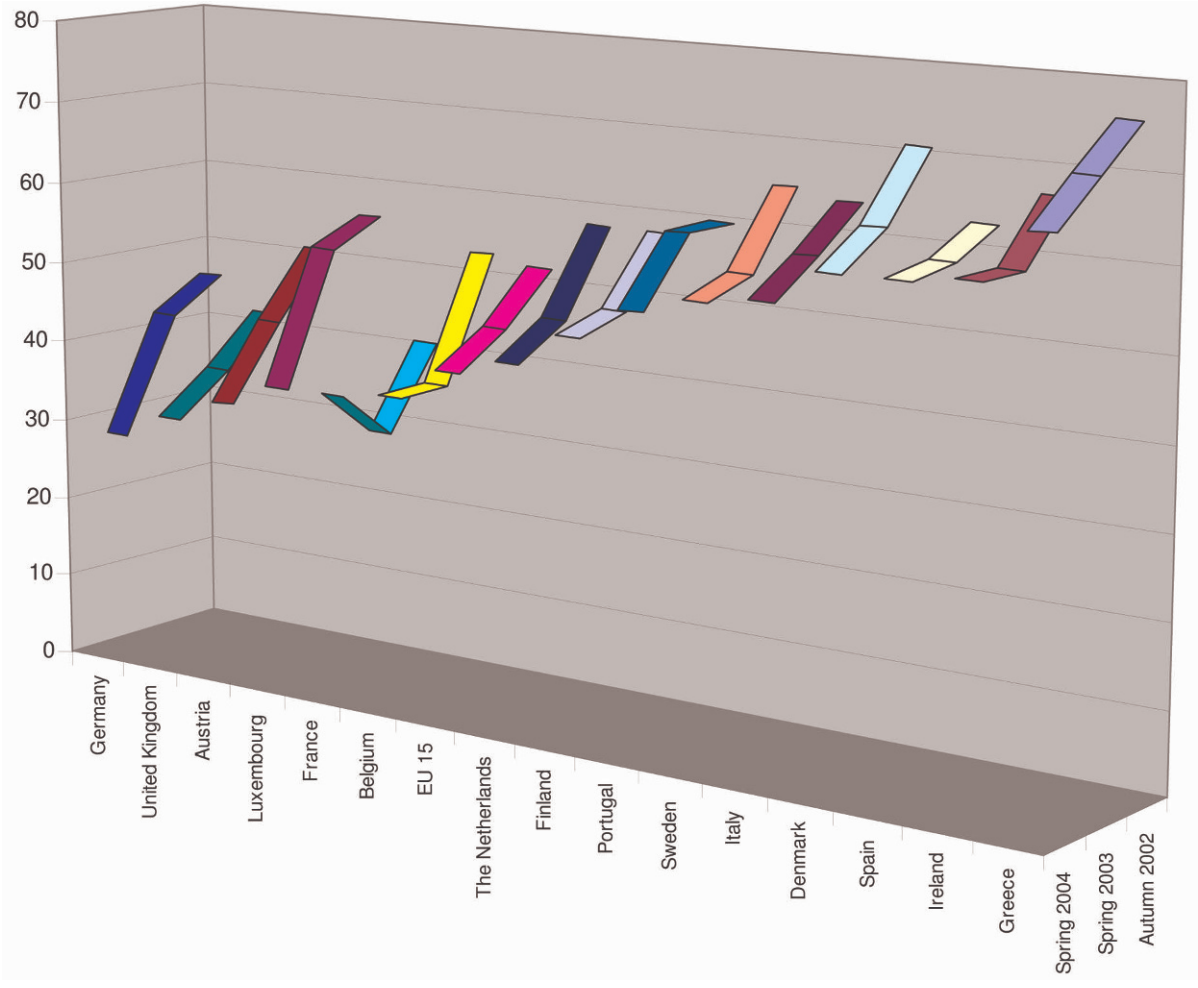
Schimmelfennig and Sedelmeier (2004: 669) argue that the effectiveness of the EU's strategy depended crucially on initial conditions. Thus, both for completely undemocratic countries or for the 'democratic frontrunners' (e.g. Czech Republic, Hungary, and Poland where conditionality was *unnecessary* for democratization and democratic consolidation) EU external governance was ineffective. The democratic frontrunners are amongst those who enjoyed the strongest support in public preferences. On the other hand, public support was at its furthest for those countries which were particularly relevant in the EU's security aims and where success was most evident (i.e. Slovenia, Lithuania, Latvia, Estonia, and Slovakia).[28] Public attitudes towards these countries tended to oppose membership. That the differences in support were stable throughout the whole period covered (both in absolute and relative terms) repeats for the next wave of prospective or new member states (table 10.2).

28 As was mentioned in part 10.2, the Baltic countries had important minority issues to resolve, whereas EU accession was relevant in bringing about the democratic consolidation in Slovakia. Slovenia was the first country in the Balkans to be admitted and consequently a first step in the EU's aim of eventually integrating and ensuring the democratization and stability of other former Yugoslav states.

Table 10.2: In favour of EU enlargement for possible candidate countries between January 1996 (EB44.2) and November 2001 (EB56.2); in percentage. **Source:** Author's elaboration based on *Eurobarometer* data (1996 to 2002).

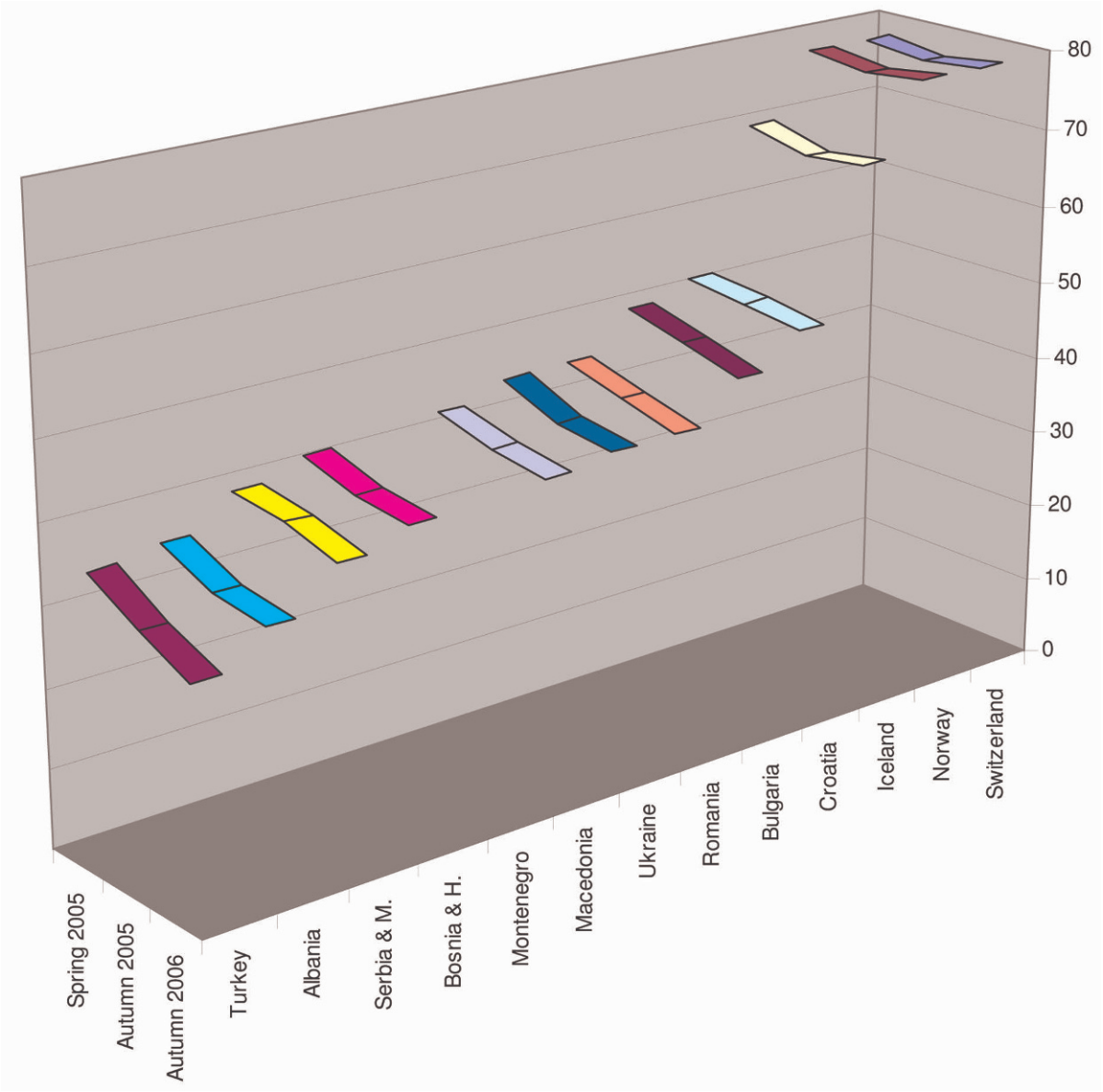
Country	EB44.2bis Jan. 1996	EB47.1 Apr. 1997	EB48.0 Nov. 1997	EB49 May. 1998	EB50.0 Nov. 1998	EB51.0 Apr. 1999	EB52.0 Nov. 1999	EB53 Jun. 2000	EB54.1 Jan. 2001	EB56.2 Nov. 2001
Bulgaria	37	37	36	42	39	35	36	36	35	38
Romania	38	35	33	39	37	33	34	33	33	36
Turkey	36	32	n/a	n/a	n/a	29	30	30	30	34
Croatia	31	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	33
Bos.-H	29	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30
FYROM	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	29
Albania	26	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	27

Figure 10.6: In favour of the Eastern enlargement (EU-15 countries). **Source:** Author's elaboration based on Eurobarometer data (2002 to 2004).



There is another important aspect to be considered, namely the existing differences amongst EU members themselves towards enlargement. Figure 10.6 looks at these differences before the 2004 enlargement. What the figure shows is that, even when these differences

Figure 10.7: In favour of the enlargement towards possible new member states. **Source:** Author's elaboration based on Eurobarometer data (2005 to 2006).

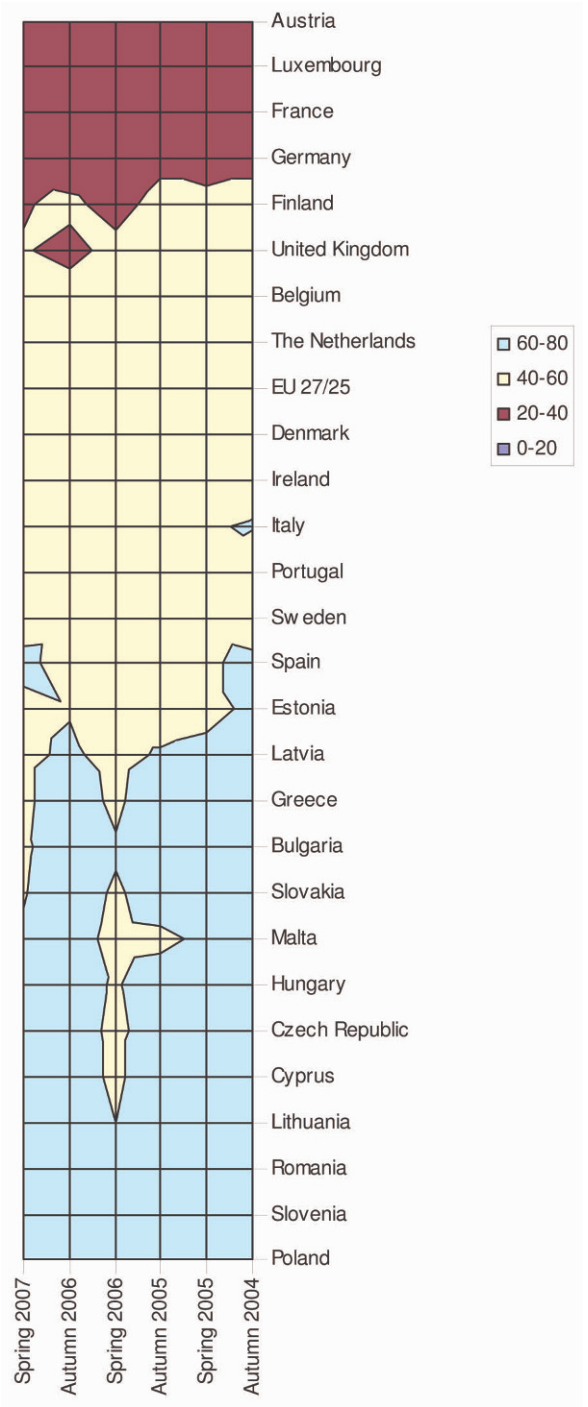


exist, they tend to follow similar patterns (with the exception of France).

The analysis of the current candidate countries (and of Bulgaria and Romania which joined in 2007) shows another big difference amongst on the one hand Croatia and on the other the rest of the West Balkans and Turkey. Figure 10.7 follows patterns similar to the 2004 enlargement.

As with the 2004 enlargement, important differences exist amongst existing MS. In the EU-25 (or EU-27), however, these differences have become more pronounced. It is interesting to note (figures 10.8, 10.9) that there are groups of countries where public opinion towards enlargement reacts in similar ways; particularly in some of the new MS (Lithuania, Cyprus, Czech Republic, Hungary, and Malta). Moreover, there is a clear difference amongst older and newer MS. Public opinion in the former is much more reticent to further enlargement. There is, however, an overall tendency towards opposing enlargement as can be seen by the evolution from 2004 to 2007 (figure 10.8).

Figure 10.8: In favour of further enlargement (EU-25 and EU-27). **Source:** Author's elaboration based on Eurobarometer data (2004 to 2007).



How can one account for the effects of such differences? The next section proposes a framework for doing so.

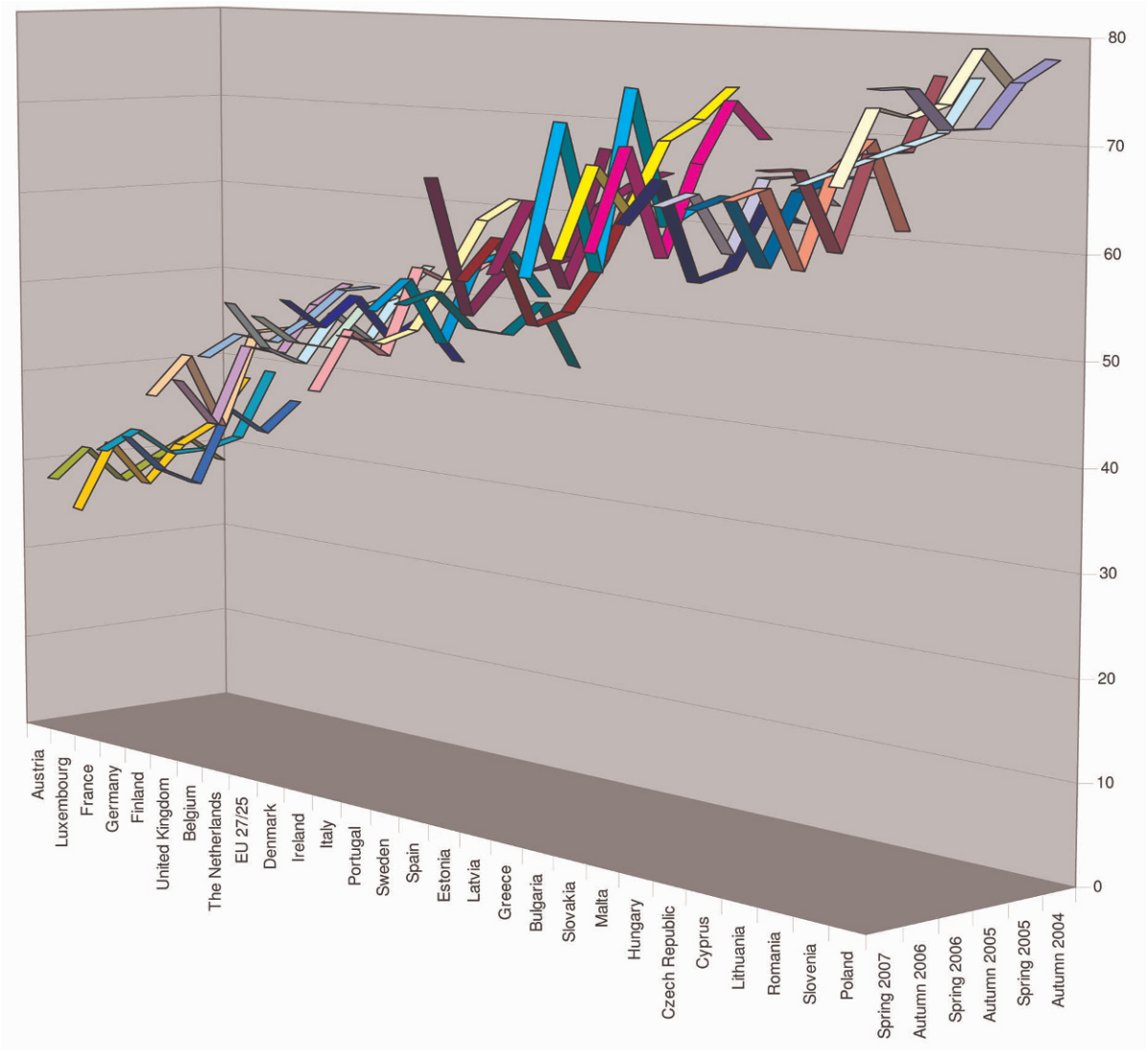
10.5 Domestic Pressures and EFP: A Framework for Analysis

The alleged mismatch amongst policy-makers and public opinion is only relevant inasmuch as domestic political processes have an impact on shaping foreign policy. There is growing interest in the literature on the importance of public opinion in foreign policy-making. These studies have proliferated on American foreign policy, but its insights are equally applicable to the European case. Given its steady evolution (of which the Lisbon Treaty is the most recent example) EFP is subject to increased attention. When developing an analytical framework that captures the influence of domestic politics in European foreign policy it is useful to consider previous studies on the field of IR and comparative politics.

On the wider question of state-society relations a significant body of literature exists. It has been mainly developed by the comparative politics school, the political economy field, and more broadly by the liberal tradition of international relations. A main concern in some of these contributions has been dismissing earlier claims that denied the existence of a link between public opinion, domestic politics, and foreign policy. Holsti (1992) has made a scrupulous revision and critique of the so-called 'Almond-Lippmann consensus'.[29] He does so through an evaluation of academic publications over the last two decades, finding strong evidence against the idea that public opinion exerts little influence on foreign policy and that it is unstructured and volatile.[30] Moreover, when assessing the complexity of the issues involved in foreign policy, which has been argued is a reason for the lack of interest and influence of public opinion; Holsti contends that 'even in the absence of much factual knowledge, members of the public use simple – perhaps even simplistic – heuristics in order to make sense of an increasingly complex world' (Holsti 1992: 450). The Eurobarometer data (parts of which have been examined in the previous section) supports the claims made against the 'Almond-Lippmann consensus'. Preferences have been stable, and where changes occurred (as with Cyprus) these respond to explicable and rational phenomena.

29 A main source for scholars claiming the lack of influence of domestic pressures in foreign policy, its main assumptions are: the volatility of public opinion, the lack in structure of public attitudes, and the limited impact of the later on foreign policy.

Figure 10.9: In favour of further enlargement (EU-25 and EU-27). **Source:** Author's elaboration based on Eurobarometer data (2004 to 2007).



In order to gain insight into the precise mechanism whereby domestic preferences translate into policies, both structure and agency ought to be considered. In this sense, the comparative politics school has long abandoned the strict constitutional and institutional approaches, and has adopted broader conceptions of politics and the political processes (Peters/Doughtie/McCulloch 1977). These look at the input side of the political system: political parties, pressure groups, electoral behaviour, and mass attitudinal configurations. This already suggests the kind of variables which might be useful to consider. Anderson (1998), for example, argues that political parties are the ones who give cues to citizens in their attitudes towards European integration. He finds that the most powerful determinants for support of membership in the EU are system and establishment party support. Hobolt (2006) when looking at integration referendums found a similar result, arguing that parties are in a privileged position to influence voters. Political parties are not, however, the only actors likely to influence public opinion. The development and generation of public opinion as Glyn, Herbst, O'Keefe, and Shapiro (1999) argue, requires active communication processes that involve mass and interpersonal communications as well as third-person effects from the media. These entail complex psychological processes. The media plays a relevant role in this process through agenda-setting and its effects in the informed public.

Institutional factors are also relevant. That is, the output side (or the conversion functions of the political system) which consists of governmental and institutional configurations (Peters/Doughtie/McCulloch 1977). Tsebelis (1995) develops a useful typology to include existing institutional approaches. These approaches comprise three dimensions: presidentialism vs. parliamentarism, bicameralism vs. unicameralism, and two-party vs. multi-party systems.[31] These pairwise structures are compared on the basis of their capacity for policy change (or what Tsebelis calls the presence and number of veto players). His main finding is that as the number of veto players increases, their congruence decreases, their cohesion increases, and so does policy stability. Evaluating the number of veto players can be a useful way of accounting for institutional variation.

Another structural element that seems to be of relevance is the degree of autonomy of the executive. As Klaus Dieter Wolf (1999) argues in his collusive delegation thesis, some institutional configurations offer policy-makers incentives to seek integration in supranational organizations. The main reason for this is to escape from domestic parliamentary control. This occurs, for example, by selling an unpopular policy as part of a package deal which cannot be modified. Enlargement is clearly the case of such a policy.

Koenig-Archibugi (2004) has tested this collusive delegation thesis in the European case. His approach rests on the three main propositions. The first is that initiative (agenda-setting), domestic institutions, information and ideas (ideological justifications) shift due to international cooperation. The second argues that this redistribution of domestic political resources generally favours national executives who are central players in foreign policy. Finally, the third proposition contends that since this cooperation takes the form of intergovernmental bargaining, this increases the incentives for governments to reach an agreement. Thus, weak executives have incentives to promote supranational integration. When testing this thesis on the positions taken by MS in treaty negotiations related to CFSP; Koenig-Archibugi finds that the balance of power between parliaments and executives affects the preferences of executives as to the depth of institutional cooperation in CFSP. Weaker executives are as expected more favourable to integration.

In political economy explanations, on the other hand, a major emphasis has been on the balance amongst domestic and external sectors of the economy (or importers and exporters). For example, it is assumed that individuals who are employed or who invest in export industries are the ones who benefit most from trade whilst those related to import-competing industries are most disadvantaged. This is known as the 'specific factors model' (Hiscox 2005). Given that enlargement has relevant distributional consequences, it is likely to bring about the opposition from those sectors affected.[32] Furthermore, firm advocacy (lobbying) is well documented (Dagger/Kambeck 2007). Firm advocacy occurs both at the national and supranational level to reap the gains of economic integration through enlargement. This is yet another domestic influence which needs to be considered.

Political parties, the national media, decision-makers, public opinion, lobby-groups, and relevant structural elements (both economic and institutional) have been suggested. These are examples of variables which might play a relevant role in determining national preferences. Thence, they might be pertinent

30 Mueller (cited in Holsti 1992: 446) analyses changes in public opinion towards both the Korean and Vietnam Wars and finds these occurred in ways that seemed explicable and rational, rather than random and mindless. Page and Shapiro (cited in Holsti 1992: 446) develop a massive data-set on questions posed by major polling organizations since the 1930's to find that mass opinion was characterized by a great deal of stability. They also find that changes in PO were neither random nor abrupt and that they move in directions which make sense in terms of events. Furthermore, they find that even if the general public is rather poorly informed about foreign affairs, its attitudes are structured in at least moderately coherent ways; and that a single isolationist-internationalist dimension inadequately describes the main dimensions of public opinion on international affairs.

31 Arguments on presidentialism contend that the latter has advantages over parliamentarism because it secures the accountability of elected officials, the identifiably of likely winners, provides checks and balances, and an arbiter. However, presidentialism suffers from temporal rigidities, majoritarian tendencies, and dual democratic legitimacies. Arguments on bicameralism as opposed to unicameralism follow similar lines to those of presidentialism/parliamentarism. Bicameralism is seen as providing more checks and balances. Finally, the debate on two-party and multi-party systems contends that two-party systems provide moderation of the parties, stable executives, and clear majorities, which Lijphart (cited in Tsebelis 1995) has systematically discarded.

32 Debates on the negative consequences on employment due to a relocation of firms towards Eastern Europe abound in most 'old' EU MS.

when considering a domestic perspective, how they interact, and hence their exact relevance in constraining or furthering European foreign policies is suggested as an area for further research.

At the same time it is important to understand how the enlargement process works. There is a complex relationship between the national governments, their permanent representations in Brussels, and the Commission. Thus, whilst domestic political processes determine a particular agenda for national governments, this agenda needs to be discussed and negotiated with the other MS and the Commission in various fora such as the Enlargement Working Group. This interaction also spurs socialization processes (which is the main reason for policy-makers in the permanent representations to be rotated). This has been covered extensively in the Europeanization literature and hence has not been emphasized here. A domestic approach does not deny the relevance of these forces. It merely suggests more attention is to be paid to the formation of preferences within MS themselves.

10.6 Conclusion

The tension amongst policy-makers and voters concerning EU integration (of which foreign policy is an integral part) has been much touted. In what has essentially been an elite project, largely dependent on leadership, public opinion has come to play a relevant role. The end of the 'permissive consensus' and the political earthquake caused by the rejection of the Constitutional treaty highlight the influence of domestic concerns. As Europe moves towards the ratification of the Lisbon Treaty (without national referendums to avoid the risk of derailing a decade-long sought institutional reform) voter sensitivities remain all too present.[33] The more important since some of the most crucial reforms in the treaty are related to foreign policy (a de facto EU foreign minister and the creation of an EU diplomatic service).

This chapter has aimed at showing how enlargement (but also neighbourhood policies) are affected by public concerns and domestic political processes. These domestic dynamics have so far hardly been studied and might have a significant effect on the shaping of future European foreign policies. As the situation in Kosovo threatens to renew instability in the Balkans, and Turkish membership continues to be a crucial geopolitical aim for many MS, EU leaders and policy-makers will have to carefully balance external and domestic aims. Indeed, this seems to be happening already as the EU pays more emphasis on societal concerns such as unemployment and immigration. A better understanding of domestic political debates – alongside the negotiation processes amongst the 27 MS – will go a long way in helping to clarify the workings and direction of EU foreign policies in the near future.

33 The Irish rejection of the Lisbon Treaty in the only referendum that has taken place has caused much consternation and delayed the implementation of crucial reforms in the foreign policy field. This is a further example of the relevance of domestic politics for the overall European foreign policy.

11 Language Games on Security in Finland: Towards Changing Concepts of the State and National Survival

Vilho Harle and Sami Moisio

11.1 Introduction

'Security' is a contested concept covering an expanding area through conceptual widening (up to climate change, unemployment, poverty, etc.), conceptual deepening (from state-centred to common international and human security), and conceptual expansion to various sectors of social and economic life (energy, water, health, food, etc.). The so-called Copenhagen School opened up the concept of security by introducing ideas such as 'societal security' and 'securitization' as a particular type of 'speech act' (Austin 1975), suggesting that the logic of security may be introduced and accepted in many issue areas beyond military matters (Buzan 1991; Buzan/Wæver/de Wilde 1998; Williams 2003). A conventional approach following these lines in the case of Finland would describe this widening, deepening and sectorialization of security by rejecting state-centric discussions of traditional military security connected to state sovereignty and giving key attention to human security or 'societal security' in its stead. We are not, however, following such a line in our case study of Finland.[1]

Instead, our message is that the traditional, official documents of Finnish defence and security policy have expanded 'security' to a meaningless *word* encompassing all unpleasant things, from natural disasters to large-scale accidents. Scholars, especially those interested in critical security studies, have contributed to this process by suggesting alternatives to the traditional military, state-centric security (e.g. Kaski 1981; Laitinen 2007; Nokkala 2001). While the latter group has been critical towards the traditionalists' attempts to militarize human security, the problem is that issues of human security have further expanded the scope of 'security' and indirectly supported the traditionalists' arguments. In spite of opposing motivations, the expansion of 'security' to new problems and risks relocates them above political deliberation and, in the worst case, to a matter for security organizations of the state (Buzan/Wæver/de Wilde 1998).

In this chapter, we consider what *consequences* the expanding conception of security may have through the growing fear experienced by human beings in the *securitized* life world and their consequent need for a strong state (Rosenau 1990: 449–451). We suggest that, in the case of Finland, one of the major consequences has been the growing power and role of the state over civil society. Therefore, politics of security must be discussed in the context of the transformation of the state as a political community (Cerny 2003; Sørensen 2003). This does not imply a 'state-centric analysis' but rather criticism of the role of the state in security and society in general. We suggest that in the case of Finland, both the traditional military version of security conceptions and those put forward by critical security scholars have increased the power of the state. In other words, the employment of various conceptions of security has contributed to the transformation of Finland towards an 'insecurity state'. This transformation has not been caused, in the case of Finland, by external changes in the security environment or the 'war on terror', but rather by internal factors including the politics of security specialists (military and administrative), scholars and activists; by their power games through securitization of all potential issues. This has not served the security interests of citizens but rather the interests of security institutions and complexes ranging from the military to the private and economic – as well as the interests of scholars working in security studies (see e.g. Tunander 2008; Salonius-Pasternak 2007).

In order to document our claims in the case of Finland, we wish to turn attention from the concept of security to politics (of security). Our thesis is that three major factors contribute – both independently

1 The first paragraph is adapted from a referee statement on this chapter; we thank for making us think through and clarify what we were attempting to do and why.

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and inherently interwoven – to the increasing role of defence experts and institutions in expanding security affairs and to the transformation of the state and the concept of national competitiveness and even of national survival. These factors are the political application of: a) a 'Russian (military) threat'; b) a comprehensive list of new security threats; and c) an economic understanding of national survival.

By the suggested 'political application' we refer to politics of security: rhetorical campaigns and manoeuvres where the term 'security' is applied as the major asset to 'win the game' of power. Our conception of politics and the political is thus aspectual (the political can be found in any instance of social activity) not sectoral (where politics is what politicians do in traditional political institutions). Our conceptualization of the 'political use of security' thus includes activities of politicians, security experts and planners, but also critical security scholars and peace and environmental activists, journalists and the like. Of course, a comprehensive analysis of all potential data is impossible here. We therefore restrict our attention to a few documents most relevant in the politics of security. This inevitably leads us to concentrate on documents and statements that openly participate in the relevant political 'struggle for security/power'. Unfortunately, in rejecting 'state-centric' approaches, 'non-state-centric' scholars often locate themselves outside the political campaign, thereby contributing to the increasing power of defence experts and state institutions operating with state-centric conceptualizations.

Even though we share the idea of speech acts (Austin 1975) and securitization in the sense of the Copenhagen School (Wæver 1995), we nonetheless maintain that one can not capture the real role and meaning of such speech acts only through conceptual academic analyses. We are especially interested in what a 'political' actor does in arguing with the help of a security conception.[2] This requires a detailed study of cases, here the case of Finland. We apply the new rhetoric (Perelman 1982) to read the selected texts politically (Palonen 2003: 11; see also Palonen 1988, 1993 and 2006). In order to avoid technical and detailed application of the new rhetoric, we apply the concept of 'language game'[3] as a shorthand for the full rhetorical analysis.

We also share a critical and emancipatory approach typical to the Wales' school of security studies (Wyn Jones 1999). However, we suggest that critical security scholars also contribute and are partly responsible for the increasing power of defence experts and the state. We claim that critical security scholars and activists often act against their own deep needs and will submitting themselves to the power of the state by contributing[4] to the transformation of the state towards the insecurity state by de-politicizing security and reinventing the state as the key actor in security issues, and so removing 'security' outside or above 'normal politics'. One may argue that the increasing application of the concept of security in political argumentation has been an integral part of the current transformation of the state from a civic organization into an enterprise organization (Cerny 2003).

Our argument proceeds in four sections. *First*, we will scrutinize the representation and use of the *Russian threat* in the language games of Finnish security politics. We shall point out that the Russian threat still forms a notable part of Finnish security reasoning among the political elites (and even more likely among the majority of the population). We therefore regard the Russian threat as a latent security element, an ontological condition of possibility for the Finnish security debate concerning military affairs and military security (11.2).

Second, we will claim that the *comprehensive estimation of security challenges,* based on extended conceptions of security does not change the suggested picture (11.2), but instead both directly and indirectly strengthens the threat images implied by the case of

2 Just like anything can be politicized (Schmitt 1976: 26–28, 37), anything can be securitized, too. But while 'politicization' moves something into politics, 'securitization' puts the securitized above and outside politics, securitization is a de-politicising move, an instance of 'politicking' (Palonen 2003).

3 Wittgenstein's idea of 'language game' is here adapted from Aaltola (2003, 2002). In our use (following Kari Palonen 1993: 13–14, 101, 130–135), 'language game' implies an analogy between team games (e.g. soccer) and politics. In a game (e.g. soccer) where rules are given and strictly followed, in politics players try to win each other by politicizing and de-politicizing issues according to their political strategies in winning support for their policies. That is, in politics, players try to change both the field and the rules in order to maximize their influence and minimize that of their opponents; yet still, success in politics demands an ability to 'read the game' as it does, for example, in soccer.

4 Our criticism of 'critical' security studies is based on Brian Fay's (1987: 120) idea of critical social science and his argument that "power must involve the activity of those being led or commanded as much as those leading or commanding."

the Russian threat. We claim that the comprehensive approach is a way of discussing the Russian threat indirectly, through silence. Furthermore, even if 'comprehensive' lists of new security threats really are unconnected to the Russian threat, they only add an important strengthening element to the risks demanding 'help' from the state and its security institutions, thereby strengthening their role (11.3).

Third, we will maintain that both the language games of the Russian threat and the comprehensive approach to security have contributed to the increasing and unique role of a *security political mindset* (Laitinen 2005) in Finnish foreign and security politics and in Finnish society in general. In this process, the issue of the 'survival of the Finnish state' has been changing from the old conception of the military understanding of survival towards a reasoning where economic competitiveness is becoming increasingly visible. We propose that this process concerns a fundamental transformation in the meanings of both the survival of and the state itself. Furthermore, we argue that the current transformation of the state towards a competitive economic unit makes it important to go beyond perceptions and rhetoric security challenges to a more fundamental discussion concerning the nature of the agency that 'constitutes' official perceptions and rhetoric. Our conclusion is that the uniqueness of the Finnish case stands in the shift of foreign political power, within the strong administrative state of Finland, from the Ministry of Foreign Affairs to the Ministry of Defence. (11.4).

Finally, we will discuss if the suggested picture[5] ignores elements and features that deviate from it; if our approach exclusively pays all attention to the dominant, traditional, military discourse of security and ignores its challengers. We will find that there are alternatives. However, their existence does not prove our approach biased in its 'state-centrism', but indicates that resistance to the present power of insecurity and the strong administrative state must arise from within the 'system' where 'security' is made a political issue and an element of power games (11.5).

11.2 The 'Russian Threat' in the Language Game of Finnish Security Politics

Finland is a weak state in military capabilities, and has remained outside wars since 1944. Finland experienced three crises in its relations with the *Soviet Union* (SU) between 1948 and 1961 (Väyrynen 1972), and the SU had a campaign against Finnish neutrality from the end of the 1960's up until the mid-1980's. However, since the collapse of the SU in 1991 and Finland's EU membership in 1995, Russia has become a minor issue in Finnish foreign and security politics (Rytövuori-Apunen 2007: 32). Finland has emphasized EU-Russian relations instead of its bilateral dialogue with Russia. This change has been coupled with the fact that Finland has become a rather marginal area in Russian foreign policy. The other neighbours of Finland, from the Baltic States through Germany to the Nordic States, are politically and culturally close to Finland and do not represent any type of security challenges to Finland. Neither does Finland have any serious domestic sources of conflicts.

On this basis, one might expect that 'security' has disappeared from the Finnish political vocabulary. That Finland is removing economic resources from the military sector to human security, including developmental aid to the poor of the world and to the Finnish health sector, education, and welfare of old people.

Such an implication and expectation is totally incorrect. According to a widely shared reasoning[6], Finland still needs a strong army, and must take care of its defence and be prepared for a major military attack against its integrity. The majority of Finns are unanimous that the defence efforts should not be decreased, rather on the contrary: for instance, those who reject NATO membership are willing to allocate increasing resources to the defence forces in order to maintain a credible national defence.

Indeed, what makes the Finnish case unique is that there are contending public perceptions of security challenges. For instance, in September 2007 Prime Minister Matti Vanhanen declared "There are *no* threats towards Finland from any direction" (Vanhanen 2007a). But no later than in December of the same year the Ministry of Foreign Affairs published its memorandum on "potential NATO membership" de-

5 While this is a case study attempting to delineate unique features in Finnish language and power games of 'security', our contribution also represents theory (of the role of the security discourse in the transformation of the Finnish state) in the sense of the grounded theory (Glaser 2001; Seale/Gobo/Gubrium/Silverman 2007).

6 Concerning the public opinion, we refer to regular surveys by The *Advisory Board for Defence Information* (ABDI); at: <http://www.defmin.fi/index.phtml?l=en&s=179>; and e.g. ABDI Survey (2008).

claring that "NATO membership may have an important pre-emptive influence on threats towards Finland" (Sierla 2007; Salonius-Pasternak 2007; Tiilikainen 2008). We argue in this section that these opposing 'perceptions' of threat are not in conflict with each other but rather represent the unique language game, whereby both the speakers and the audience know what the speaker is speaking about and why. This section aims to open up this complex logic of security rhetoric in the Finnish political discourse.

In reading the official White Books of Finnish Security and Defence Policy[7] it appears that official Finnish perceptions of external security challenges are based on the (neo)realist theory of an anarchic international system (Waltz 1979) and Schmitt's (1996) concept of the political as a distinction between the friend and the enemy, or a Hobbesian anarchy between states (Wendt 1999: 259–60). In this interpretation of the nature of inter-state relations, state survival is about excluding the enemy; maintaining territorial integrity and the boundaries of the state; increasing the homogeneity of a nation; and increasing military capability (Moisio 2008a). In such a view, states are potential enemies to each other, and the enemy represents the issue of life and death. In this image, the threat exists, whatever the states do and say. Therefore this existential threat always represents a fundamental danger to the life of the state and its people. It is maintained that states can live in peace, but it is always possible that some of them will attack another state(s). In the Hobbesian anarchy, therefore, survival of the state demands the capacity and willingness to struggle at any time as required for the very existence of the political community, its people and its way of life. Finland, too, must prepare itself for the case of such an attack. The lesson of history is, according to this view, that it will be too late to do something when an attack actually takes place.[8]

Obviously, this reasoning is articulated as a *general theory* of potential enmity between *all states*. Our point is, however, that the Finnish security political rhetoric applies the suggested general theory rather *selectively*. Not all states, but *Russia* exclusively, are concerned. For Finns, Russia is the only state that represents any potential threat: Russia can remain peaceful for a while but it never looses its basic expansionist nature. The Finnish version of Hobbesian realism considers the potentiality of Russian expansionism as an unquestionable universal truth. However, the point is that this is not usually presented in open terms but concealed in the rhetoric of security debates.

In the first White Book of Finnish Defence Policy in 1926 (PR 1926), the SU was openly represented as the single threat to Finland. After the Winter War (1939–40) and the Continuation War (1941–44), the second White Book (PRK 1949) did not mention any hostile states that would have posed a direct security challenge against Finland. The Soviet-dominated Allied Control Commission in Helsinki, and the Soviet military base in Porkkala close to Helsinki, did not allow an explicit discussion of external threats. The Finns, therefore, began to apply a unique language game, where the potential threat of the SU was explicitly denied but simultaneously implicitly considered within the same texts. In other words, the SU became an ontological condition of possibility for the Finnish security rhetoric, a sort of latent factor that was widely shared among political circles. In official foreign policy, the language game was carried out by Presidents Paasikivi and Kekkonen through the ideas of friendship and neutrality. In defence policy, the language game of security was hidden in complex threat estimations. The Committee of 1949 and the Finnish Defence Ministry had to find indirect and undeclared justifications for the existence and improvement of the Finnish armed forces.[9]

7 Puolustusrevisioni 1923–26 (hereafter PR 1923–26; Puolustusrevisionikomitea 1949 (PRK 1949); Parlamentaarisen puolustuskomitean mietintö 1971 (PPK 1971); Kolmannen parlamentaarisen puolustuskomitean mietintö 1981 (KPPK 1981); Puolustus- ja turvallisuuspoliittnen selonteko (PTPS 2004).

8 This is a typical pro-NATO membership argument often presented in the current debate.

9 This section, especially parts related to political history before the White Book (PTPS 2004), does not make detailed references to 'sources' for two reasons. First, it is based on shared knowledge, not demanding detailed references, expressed in easily accessible text-books of Finnish political history since the war (e.g. Häikiö 1992; Singleton 1998). Second, the section presents an original interpretation by the authors based on personal experience of the senior author, for instance, on the *Advisory Board for Defence Information* (ABDI) during 1976–1984 and in researching and writing two books on various aspects of Finnish defence affairs (Harle/Joenniemi 1977; Harle 1978), as well as the exchange of opinions between the two authors for over a decade on issues of Finnish identity politics. The scientific value of experience is usually rejected by (as feminists put it) 'malestream' scholars, but in this case experience and intuition are invaluable. The reader can compare our interpretation with Raumolin (1978), Nokkala (2004; 2008; 2009), and Raitasalo (2008), which are all based on interviews and systematic documentation.

This justification was found in the Finnish-Soviet treaty on friendship, cooperation, and mutual assistance of 1948. The justification was derived from the Treaty's article concerning military cooperation in the case of threat of military attack by Germany and its allies towards the SU through Finland. More precisely, the Treaty ordered Finland to defend its area against such an attack either alone or in cooperation with the SU. In the case that there would be an imminent threat (defined and perceived as such by the SU), Finland had to start consultations about the need of military cooperation between Finland the SU (Singleton 1998: Appendix C; Raumolin 1978). In Finland, it was received wisdom that such consultations and cooperation had to be prevented at all costs.[10]

Finnish political elites did not believe in the attack by Germany or any other Western power against the SU through Finland. The real threat, as suggested above, consisted of the possibility of Russian demands for military cooperation with, and even occupation of, Finland. The task, therefore, was to make such Russian rhetoric invalid by suggesting that the Finnish army is, or should be, strong enough to prevent any attack alone or at least to fight against it long enough to make last resort assistance from the SU possible. In other words, the military vacuum of Finland was represented as a threat to the SU; it was implied that such a vacuum was likely to pull Western powers to attack the SU through Finland. Finland was successful in finally getting permission to maintain and develop military forces. As a great practical achievement, the first Russian Mig fighters and French earth-to-air missiles were bought by Finland at the end of the 1950's (Raumolin 1978; Harle 1978; Harle/Joenniemi 1977).

The SU accepted the rules of the language game due to its respect for the Finnish earlier survival campaigns; and even more importantly, the SU chose to soften its pressures towards Finland also due to its strategy to maintain political influence within Finland. Its supporters – the Communist Party and partly also the Agrarian League – might have lost their power if the SU had broken the rules of the game.

The language game developed to its highest stage during three crises in Finnish-Soviet relations during 1949–1961. It was later (around 1968–1984) tested when the SU suggested common military exercises and attempted to downgrade the Finnish neutrality in many other ways too. The peculiar language game has not disappeared after the Cold War or following EU membership in 1995. Indeed, it can still be perceived in the conflicting statements quoted earlier in this section.

According to the rules of the game, to be called in general terms the culture of silence, the Russian threat is not usually referred to in security policy rhetoric. Rather the idea that Russia represents a potential military threat is often implicitly expressed in political argumentation which seeks to point out that the future of Russian politics is full of uncertainties concerning the development of democracy, power structures, and society in general (PTPS 2004: 27, 65–66). In other words, it is not the enmity of Russia as such but rather the uncertainty of Russian politics and development that is perceived to pose security challenges for Finland.

In Finland, the political development of Russia is seen as proceeding in vicious cycles: a positive development is always followed by a negative one. This point also helps us to understand the ongoing need of the Finns to constantly make diagnoses about Russian political development. Today, a commonly accepted understanding that Russia is in a process of transition is in fact a major stimulus behind such diagnoses. More often than not, these diagnoses evaluate whether Russia is becoming a 'normal state' which accepts the basic rules of 'Western' free democracy, human rights and a free market economy – and which refuses autocratic political culture, the use of political force against its neighbours and a state-controlled economy. Signs of the latter option are usually taken seriously in Finland as they are understood to authenticate the historical fact that Russia is again selecting its own track which may cause harm to its neighbours.

Certainly, Finnish business and political circles often perceive Russia as a possibility, especially in economic terms. However, it is among these very same circles in which Russia is also considered as posing a security challenge towards Finland, be the Russian state weak or strong. If Russia is perceived as a weak state, its domestic crises are argued to have some 'reflections' in Finland. For example, weaknesses in economy, politics and technology may cause accidents in nuclear power plants or enable the expansion of Russian criminal gangs into Finland. In the case

10 In autumn 1939, Finland rejected Stalin's proposals which, in the final analysis, demanded Finland to make an unpopular identity political choice of joining the SU against Germany (the 'West'). Such proposals cause a sort of panic in Finland, and even still at the end of 2008 Russian proposals (Serdjukov 2008: 19) to have 'common exercises' for potential common crisis management and anti-terrorist operations were ignored by total silence.

where Russia becomes stronger, it is perceived to use, for example, energy exports into Finland as political weapons in the case of political disagreements. Therefore, it is often argued that Finland should not become too dependent on Russian oil, natural gas, or nuclear fuel.[11]

Concerning more explicit references to the traditional Russian threat, Finnish politicians are usually rather clever in using indirect, non-provocative vocabulary. This flexible rhetoric is sufficient exactly because of the strong discursive structures of Finnish security politics: the Finnish audience is capable of understanding the specific position of Russia in Finnish security reasoning. For example, Johannes Virolainen – the then Speaker of Parliament – explained in 1978 that the National Coalition Party was not taken into the Government due to 'general reasons'. The general reasons – indirectly and silently – referred to the SU's influence on Finnish politics and President Kekkonen as the major vehicle of this influence. A more recent Speaker of Parliament and former Prime Minister of two successive governments, Paavo Lipponen, once rationalized NATO-membership by referring to the "historical reasons known to all Finns."[12]

Applying the complex logic of the language game, the pro-EU political decision-makers did not usually mention military security issues at all during the heated debate preceding the EU referendum in 1994. Instead, they often denied the interpretation of EU membership in security political terms. However, afterwards President Koivisto (1995) claimed that he had considered the membership primarily as a security political issue; he even made the membership his greatest achievement in Finnish *security* politics. This can be understood in the context of cultural-geographical imagination and identity politics (Harle/Moisio 2000).

One crucial element of Finnish security politics – and its language game – is that Finland is understood to represent a Western cultural-political tradition which the country inherited already under Swedish rule (Lipponen 2008). Indeed, the logic of cultural-geographical belonging was at the core of the pro-EU campaigning, especially when the decisive moments of the EU struggle took place (Moisio 2006). More precisely, the pro-EU elites wholeheartedly argued that EU membership was a tool to relocate Finland within the political map of Europe. They suggested that the relocation would mean two interrelated things. First, it would bring Finland back into a group of Western states to which Finland naturally belonged even though it had practiced the politics of friendship with the Soviets for the past fifty years. Second, they proclaimed that EU membership would distance Finland from the sphere of Russia as it would demonstrate to both Russians and Western Europeans that Finland belongs to the Western world. In other words, the security of the state was in EU campaigning connected to the question of the political recognition of Finland as a state that does not belong to the Russian sphere of culture and political power. Similar logic of cultural-geographical belonging is also present in the NATO debates. The recent comments by the chairperson of the Finnish Business and Policy Forum, Risto E.J. Penttilä, nicely reveal that logic. According to Penttilä (2008), by joining NATO Finland would finally assert that it is an integral part of 'Europe' and the 'Western camp', not a 'geopolitical exception'.

In the White Book of Finnish Security and Defence policy 2004 (PTPS 2004)[13], the estimations of the Russian threats are made by applying general, universal truths in neutral words. When Russian military power is mentioned, it is often emphasized that it is not directed towards Finland. It remains up to the reader to understand the message. According to the White Book (PTPS 2004: 102; official translation; italics added; see also pp. 68, 66) the evaluation of the security environment is based on three scenarios:

> The Defence Forces must be prepared to prevent and, if necessary, to repel any use of military force against Finland. The crisis and threat scenarios used in defence planning are: a *regional crisis* that may have effects on Finland; political, economic and military pressure, which may include a threat of using military force and its restricted use; and *use of military force* in the form of a strategic strike or an attack beginning with a strategic strike aimed at seizing territory.

By reading the text carefully one might suggest that the first scenario touches upon the global environ-

11 E.g. by the Green Party during the Parliamentary election campaign in 2007.

12 The 'Bomb of Mid-Summer's Day', i.e. Kekkonen's strong hostile attack on Virolainen's statement, soon became a widely used idiom in the Finnish political vocabulary. An item on Lipponen's statement, given passingly in a TV interview, is included in the archives of the senior author without a date.

13 The While Book '2008' was to be published in July 2008; however, publication was postponed first to October 2008, and later until February 2009 and it was not yet available in January 2009 when this chapter was finalized.

ment but the two other scenarios can refer to Russia only. Looking more carefully, all three references are made to Russia. Regional crises, it is argued, "can emerge far away from Finland, but they may have repercussions in Finland either gradually or sometimes very rapidly" (Vanhanen 2007b; PTPS 2004: 99). It is obvious that regional crises, while originally perhaps taking place outside Russia, can escalate and draw Russia along. Therefore, it is again the Russian threat, not 'regional crises' as such, which counts in the first scenario too.

The security political language game, the culture of silence, was the dominating trend in Finnish foreign and security political rhetoric until September 2007. Then the Minister of Defence, Jyri Häkämies (2007), gave his speech at the Center for Strategic and International Studies (CSIS) in Washington. Häkämies told his audience that Finland has "three main security challenges: Russia, Russia and Russia!"

This unique speech act seems to be a path-breaking deviance from the suggested language game. In the final analysis, however, it is not. The speech represents nothing more than a different type of case in the continuing tradition of the complexity of Finnish security political rhetoric, its pervasiveness and its continuity.

Häkämies argued that Finland's security interests form three concentric circles. The first circle consists of "common [Western] values." Finland pursues cooperation with those states that support the common values. Cooperation takes place, especially, in UN peace-keeping and humanitarian operations. The second circle, Häkämies goes on, consists of security threats "affecting [Western] Europe." In order to struggle against such threats, Finland participates both in EU and NATO-led operations.

According to Häkämies, within the third circle, "our national interest reigns supreme." In the case of Finnish security and territory, the question is not about abstract security challenges: "such core issues as national independence, security and well-being of the Finnish citizens, and, ultimately, even the very survival of the nation, are at stake." In Häkämies' speech, this is further explicated by references to the Finnish regional defence system, the conscription army, and large reserves of manpower consisting of 350,000 soldiers at the moment of the speech, and 250,000 still in the coming decade.

Häkämies emphasized that Finland cannot participate in extensive NATO operations far away from its own geographical area: Finland must take care of its defence in the Finnish and neighbouring areas. In other words, Finland must be able to struggle against any Russian attack at least so long as other (Western) countries will come to assist the Finnish troops. Indeed, Häkämies suggests that the Russian triple-challenge concerns not only Finland but "all of us" – most likely the EU and NATO countries. In other words, Häkämies not only expects the others to understand the Finnish position but he also expects the others to give support to Finnish efforts to cope with the Russian challenges within the innermost circle.

Häkämies argued that Finland is, in many ways, willing and ready to cooperate with NATO, but Finland must keep its 'powder dry' within its own security area. That is, according to Häkämies, "a country like mine might produce the necessary tools in a different way from the others, but the end result is similar" to "all of us: ... We are ready to stand up to protect our common values, to produce security and stability, and even to defend our national territory, whenever and wherever such threats emerge."

In his speech, Häkämies explicitly applies a geopolitical approach and analysis. More precisely, his rhetoric is partly connected to the post-war security vocabulary in which it was often highlighted that Finland cannot escape 'history and geopolitics': it is a historical and geopolitical fact that Russia is Finland's Eastern neighbour. According to Häkämies, it is exactly the geopolitical location of Finland which produces the suggested three security political 'challenges' for Finland. Indeed, as he reminds us, "geopolitics is back, and it is back with force." It is important to notice that in Häkämies's language the term 'geopolitics' replaces the term 'threat'.

Public comments from the President and the Prime Minister were slightly critical about the connection between the forum of the speech and its content. The speech was declared a 'private' opinion of the Defence Minister, and the President[14] emphasized that the Defence Minister is not among the key figures in Finnish foreign policy. The Prime Minister, for his part, declared that Finland prefers a "comprehensive approach" in speaking of security challenges (Vanhanen 2007a). But neither of them actually suggested that Häkämies was wrong in his analysis of the Finnish security environment.

As for newspaper editorials, almost all important newspapers[15] shared the view that Russia is the only potential threat to Finland. On many occasions, it was maintained that the Russian military threat towards

14 In a TV interview, a note in the archives of the senior author without a date.

Finland is the only reason for the existence of Finnish military forces. Häkämies was represented as the figure who boldly expressed the undeniable historical truth of the Russian threat. Many editorials, however, were also sceptical about the wisdom of speaking the truth; the old traditional language game of the culture of silence was preferred instead. One editor-in-chief demanded Häkämies to resign, not because of the content of the speech, but because of its openness!

One may claim that Häkämies' speech represented the end to the culture of silence. However, this positively was not the case. The language game soon returned to its original form whereby the Russian threat is still disguised in complex indirect rhetoric of security. Häkämies himself contributed to that 'correcting move' already in his very speech.

Häkämies actually continued the old language game where Russian enmity is denied in explicit terms. After shouting his 'triple-challenge' Häkämies added in the terms of the old language game: "It would be [a] foolish – and mistaken – conclusion to draw that the new Russia will threaten Finland's security." Furthermore, Häkämies suggested a conceptual distinction between 'challenge' and 'threat'; this terminological 'clarification' was shared by other important speakers and soon accepted in public debates. All the revealing elements of his speech – words like 'dry powder', 'geopolitics' and 'regional defence needs', and 'Finnish military reserve forces' – were pushed under the carpet of the traditional culture of silence.

11.3 The Language Game of the Comprehensive Approach to Threat Estimations

Instead of 'silenced' Russian military security challenges, a comprehensive survey of all types of threats is given the open key role in security estimations in contemporary Finland. The military dimension is still the basic issue of these security perceptions; the comprehensive approach is introduced in order to strengthen the truth and continuity of military, especially Russian, security threats in an indirect way. The comprehensible list does not replace the military threat challenges but adds new causes of fears concerning the threatening world, justifying the increasing role of the state as the exclusive security agent and of military-oriented measures to manage the dangers.

The list of comprehensive threats also includes military ones: "The threat of weapons of mass destruction, threats targeted at information systems, information warfare and terrorism are challenges for which the defence establishment is prepared" (PTPS 2004: 9; official translation). Surely, weapons of mass destruction are a 'universal' category of threats, but one cannot read the quoted text fully ignoring the specific case of Russia. Threats against information systems and information war in general can, and actually must, be understood with Russia in mind.

The White Book 2004 (PTPS 2004) speaks of terrorism in general and universal terms. It does not suggest that Finland might be a target for terrorists, but that Finland may become a potential sanctuary for terrorists when they prepare for new attacks against their real targets (PTPS 2004: 22). No distinctions are officially made between various terrorists. However, 'terrorism' actually refers exclusively to the Islamist al-Qaida version of it (PTPS 2004: 21). The White Book is silent in the case of terrorists, who struggle against the Russian state and its political leadership.

Less official sources are more explicit by distinguishing between anti-American and anti-Russian terrorism. The Chechnyan terrorist attacks are often suggested to be justified as part of the Chechnyan campaign for independency. For example, a systematic analysis (Normio 2007; see also Pietiläinen 2005) of two large newspapers (*Helsingin Sanomat*; *Aamulehti)* documented this convincingly. The newspapers were somewhat critical of both the American and Russian leadership and the foreign policies of the two countries but the two major terrorists attacks were represented in opposite ways in the newspapers. The September 2001 attack was strongly judged as a planned and unjustified attack against innocent people by al-Qaida. The Beslan school massacre in 2004 was suggested as being caused by Russia and Putin; that is, the badly planned and executed Russian operation was condemned, but the terrorists' attack on the school was not.

Concerning 'non-military' new threats, those delineated by the comprehensive approach are still perceived in the context of the state and its territory. The official representation of threats does not list any country as the source of a military threat towards Finland: neither Russia nor rogue states. But revealingly, most new threats are located outside the Finnish ter-

15 All leading national and regional newspapers were checked for two days after the speech, all of them publishing at least one editor's comment. Only one of the newspapers, *Hämeen Sanomat*, did not share the reality of the Russian threat.

ritory in Russia and the near-by area (PTPS 2004: 28–29, 137).

It must be noted that not the comprehensive but rather the selective approach is typical to this current, post-Cold War, rhetoric. However, this is not easy to recognize; the comprehensive approach to security seems to produce a long list of threats ranging from military to environmental, and from external to domestic. Instead, the White Book lists all threatening or unpleasant things from terrorism to local crises and natural disasters and climate turbulence (PTPS 2004: 5, 27, 138). In short, the world has turned into a completely dangerous place: "In the modern world there are more and more possibilities to get involved in unexpected crisis situations caused by new threats" (Vanhanen 2007b). But, looking more carefully, the estimation of threats is much less comprehensive than the name suggests. Some security challenges and risks are ignored altogether.

The Finnish White Books purposefully never discuss threats for which Finnish military resources are insufficient. For example, neither limited nor full-scale nuclear wars are taken into consideration. Another case of the selective approach can be found in the case of non-military disasters. Climate change is given much attention, and even tsunamis and tornadoes are predicted to hit Finnish soil (Vanhanen 2008). This is a rather imaginary prediction attempting to conceal the fact that more likely domestic disasters are not discussed at all. Not a single word is given to the risk of disasters in Finnish nuclear power plants, which are all located in the most populated Southern area of the country. According to a rather general wisdom such disasters, however, can take place in Russia and in the Baltic.

11.4 The Transformation of the State on the Basis of New National Survival

Considering the insecurity state (Chernus 2006), we can find some signs of it, for example, in the White Book (PTPS 2004) where terrorism is increasingly connected to immigrants and non-Finnish foreign minorities dwelling in Finland or, in some cases, where the state restricts or controls the movement or the freedom of expression of citizens. However, it must be claimed that it is not issues concerning US-like homeland security but instead more traditional military threats that are key factors in the Finnish case. Military security and willingness to defend the country in the case of attack are typical Finnish ways of speaking about security (e.g. ABDI Survey 2008). An extended security conception is not replacing but rather supporting this traditional mode of security thinking.

Still, we might speak of the insecurity state also in the case of Finland, but in a peculiar sense only. Both the traditional way of thinking of state security and the more critical orientation of security studies have contributed to the same goal of making security the key term in the current discourse. Both the traditional thinking and the critical school share the view that this is all about nothing else than security. There is no alternative thinking or approaches that would suggest that the long lists of security threats and challenges include issues that should be called other names. Things like unemployment, and health or environmental problems, are spoken in terms of security challenges. In listing such fears a journalist suggested, rather 'logically', that Finland cannot stay alone in front of such 'threats' as poverty, unemployment and climate change; "Finland must enter into an *alliance*!" (Vasama 2007).

However, this is not just a simple securitization process in which more and more issues are given a (military) security meaning. We would alternatively like to argue that the key issue here is that the very idea of national survival is currently getting a fundamentally social and economic meaning. Consequently, the traditional Weberian state monopoly of violence is changing towards a more fundamental state monopoly of social and economic development. In other words, the state's security function is extending from military security to daily, social and economic activities. The state decides upon not only the use of military force but the development and use of all social energy throughout civil society.

This particular security logic has been very visible in the current debate on the 'international competitiveness' of Finland. In this ongoing debate, issues such as national survival, national success and national security are discussed in market terms, and political actors increasingly conceptualize national interests in terms of the market rather than in terms of political community. In this debate nations are understood to compete with one another in the same way as corporations compete with one another. We may therefore ask whether the fact that in political action the 'national interests' are increasingly expressed in terms of market metaphors, reflects a significant paradigm shift in Finnish security culture. The practice of referring to nations and states as companies is in fact

typical to this security rhetoric whereby the issues of world and domestic politics are articulated with recourse to market metaphors (Moisio 2008b; Kettunen 2008).

The new security monopoly of the Finnish state can be explained by three factors. First, it is based on the perceptions of external (Russian) military threats. The public opinion both sustains official security and defence policy and demands the careful consideration of the Russian dimension, so demanding strong national, independent defence arrangements. Second, the comprehensive approach and extended security conceptions lead to an increasing support for the role of the state in all types of threat/security issues including natural catastrophes, terrorism, immigrants, and the like. Third, the state's increasing role is justified by the need to make the Finnish nation more competitive in the globalizing world markets.

Our point is that in the Finnish case the security political mindset has found its major application, in addition to the traditional defence sector, within the economic sector. In Finland the Hobbesian notion of anarchy has given space to the Lockean conception of anarchy (Wendt 1999: 279), according to which the relationships between states and their very survival are based on economic not military competition. One may, therefore, argue that this partly leads to the securitization of economic issues, for example in the case of Nokia. Discourse concerning Nokia became (in the 1990's and up to recent years) rather security political, with terminology of family resemblance with that related to external and internal security challenges (Salomäki 2004, 2007).

This economic competitiveness is not just a simple *security* issue: it is currently argued as the key to and basis of national *survival* and the future of the nation.[16] If the question of national survival was earlier defined in military terms, as the ability and willingness to defend the country's territory, societal order and independence, now the basic independence and survival struggle is carried out within the economic sector as a question of competitiveness. The earlier national survival was something for foreign and security policy to take care of, now this responsibility belongs to private firms and the state supporting their competitiveness. Surely, the old conception of national survival (Apunen/Rytövuori 1982) and the new one do not exclude but rather complement each other, yet even so, the new conception is taking the upper hand in processes of the reasoning of national survival and national security.

This step towards a competition state and the consequent increase in the role of the state has not taken long. The earlier welfare state was based much on the central role of the state. The state was a powerful actor because only the state was able to maintain the distribution of incomes demanded for the maintenance of the welfare systems throughout the territory. Therefore, the role of the state is not the basic issue here: it is rather the content of the state's policy that counts. In the welfare state the leading ideas were based on equality, social (re)distribution, social compromise and humanity – the importance of giving equal opportunities to all to develop themselves as members of the Finnish society – that is, a sort of 'human security'. Of course, these welfare state principles sought to increase the power of the state apparatus and the legitimacy of its power throughout the territory and across social classes. In the welfare state, security was defined in social terms and especially in the terms of mutual solidarity. In the competition state, individualism, competition and material values are increasingly becoming the measure of happiness.

The politics of competitiveness means especially the development of practices (typical to the global market-place model) through which the Finnish state tries to attract transnational footloose capital as well as the international 'creative class'. Moreover, when the state is required to build the basis for national competitiveness in order to maintain the survival of the nation, the state's policy in all sectors, from the economy to education and culture, becomes a new type of security policy. Security and insecurity obtain a totally new meaning, whereby the welfare state takes its last step towards the insecurity state in this new sense.

This chapter has claimed that traditional perceptions of military security challenges, with emphasis on the Russia threat, still govern the Finnish security political discourse. Related to this, the comprehensive approach in the estimation of old and new security challenges led to the situation where security and security challenges govern the Finnish mindset more than ever before. As the last step, the insecurity state has obtained the meaning of the competition state where the question of national survival has received a strongly economic connotation. In other words, the ways through which the relations between states are currently perceived in Finland include both the Hobbesian and Lockean understanding of anarchy.

16 The step from 'security' to 'survival' represents a unique 'deepening' of security in the Finnish case.

One key factor or consequence of making security a national issue that controls the behaviour of all serious politicians and excludes all non-military alternatives and ways of thinking, can be found in the fact that security political debate and opinion formation has become a sort of monopoly of the Defence Ministry. Earlier, up to the end of the 1980's, 'foreign policy' was the leading sector in Finland's external relations. This was challenged already in the 1970's by the military establishment and also politicians and individuals emphasising the traditional Finnish duty to defend the Motherland against the external enemy (Russia). They introduced the concept of 'foreign and security policy'. Originally, the concept implied that foreign policy and defence policy are equals in the foreign affairs of the country. Later on, the Ministry of Defence won the struggle, and emphasis went towards 'security policy', suggesting that foreign policy was included as its *sub-section*. For several years now, it seems that 'security and defence policy' has replaced the earlier terms. Indeed, the White Book to which we have referred to above (PTPS 2004) is a four-year plan for *security and defence policy* – and arms procurement. However, it is presented under the auspices of the Government, and also otherwise reads as a sort of White Book of *Finnish Foreign Policy*.

Originally, the parliamentary defence committees, of which the first one presented its report in 1971 (PPK 1971; see also KPPK 1981) as the modern successor of the defence revisions of 1926 (PR 1926) and 1949 (PRK 1949), aimed at raising defence issues above or outside party politics. The idea was to avoid 'political' passions in the matter vitally important to the country. The debates of the committee were carried out behind closed doors, where the representatives of the defence establishment were able to negotiate with responsible politicians. In practice, both parties and the Parliament gave their power in defence planning to the parliamentary committee. The committee suggested its report as a sort of agreement, and therefore it was followed without long debates, at least as far as defence funding was concerned.

This open aim to close or prevent political debates on security and defence issues made the estimations of security challenges rather narrow and technical. Through this process, the defence administration has taken the major role. Planning staff are located in the Ministry of Defence, and also the representatives of the military establishment have a strong influence on the committee. The representatives of the political parties have been selected, by definition, from those politicians who are interested in the defence of the country and are openly in favour of the Finnish military forces and military defence. Furthermore, the role and influence of the Ministry of Foreign Affairs is excluded from the committee by its very name. Formally, the White Book on Security and Defence Policy does not appear to deal with the foreign policy of the country. In practice, it certainly does.

The process was made easier by the culture of silence typical to Finnish foreign politics. Open debate did not belong to post-war foreign politics: power was purposefully given to the President, who according to the Constitution was alone responsible for foreign policy. Foreign political discussion was allowed as an educational process, where the President took the role of educator. His task was to make the citizens learn what the correct truth was. The Ministry of Foreign Affairs supported the President in this effort, always willing to point out what was wise and unwise. As suggested above, the culture of silence in Finnish foreign politics became the dominating art of wisdom, leading to rhetoric that was accessible to the 'high priests' of foreign politics only. This culture of silence has strongly favoured the (re)militarization of security. Gradual steps towards military 'crisis management' are sold as continuity rather than change in Finnish foreign policy. The more the foreign policy changes, the more loudly it is presented as continuity. For example, when Finland decided to join the NATO Response Forces in March 2008, it was emphasized loud and clear that this participation was limited and that the decision did not constitute a step towards NATO membership.

The increasing role of the Ministry of Defence and the emphasis given to technical issues of security and defence politics is not a single case where political debate and political decision making is put aside in Finnish politics. Finland can be called a strong administrative state, where administration, not politics, is leading the country.[17] This can be found, for example, in issues like nuclear power. Nuclear power is defined in technical and legal, not political terms. This has increased the role of the administrative staff of

17 The term 'strong administrative state' is adapted from Säynässalo (2009) who speaks of the case of nuclear power. However, the role and power of administrative staff and experts is typical to all areas of Finnish politics and public administration, including security and defence affairs. In our case, what is interesting is the movement of administrative power from the Ministry of Foreign Affairs to the Ministry of Defence in the case of 'security threats'.

the Ministry of Trade and Industry, which has recently become (partly removing the Ministry of Finance side) the most powerful political agency of the country, not only in nuclear power but in the economy in general. Indeed, due to its role in the area of the competitiveness of the national economy, this ministry is having increasing power in Finnish security policy as well.

11.5 Discussion

The suggested picture – the impact of the perceptions of a Russian threat; the comprehensive estimation of threats; and the changing conception of national survival with the increasing power and transformation of the state – obviously looks rather 'state-centric'. We have, however, discussed the reasons behind this orientation. It is not our choice of academic preference, but is fully dependent on the phenomenon under investigation. Therefore, our orientation is critical towards the observed development. We tend to think that the more broad and comprehensive 'security' is made, the greater the power that is given to the state.

Certainly, the story here is written as a sort of dominant discourse. This may look unfair to those who seriously work in favour of human security, and who wish to oppose the development towards an insecurity/strong administrative state. We do not wish to nullify such efforts; we only call attention to the fact that those efforts must not be based on expanding 'security' to all possible issues. Instead, 'security' should be returned back to where it has come from. Only then, as the traditional military threat, can it be estimated realistically both at the regional (Russian) and global level. And only then can alternatives to military efforts to build security be discussed and developed in open political deliberations.

We suggest that Finnish public opinion (against NATO membership) reveals that Finns are able to estimate military threats and to avoid measures that would increase, not decrease, such threats (ABDI Survey 2008; Rahkonen 2004), and that they are able to discuss such issues as poverty, unemployment and healthcare problems as normal social – not security – problems in the society. Both the security political elite and (critical) security scholars would win by taking this public opinion seriously. Not fear towards all imaginable threats but instead pragmatic measures to deal with practical problems are demanded.

While we have not discussed rivalling discourses as alternatives to the dominant one, we must say that there have been and still are alternatives to the suggested development. The question is: where and how to find them? Considering that this is an issue of the role of and power over the state ('who moves the strong administrative state?'), one must look at the alternative discourse(s) not in the margins but in the foreign and security political elites of the country. Indeed, one might claim that we have introduced not the 'dominant' discourse but rather a minority discourse of security political elites; and even that of its minority. We confess that this point is correct at least partly. We have concentrated on the issues and problems of expanding 'security' and the consequences of this expansion on the growing power of the state apparatus. This development does not serve the interests of the majority of the population or the elite, but the interests of those who wish to raise (military) security above democratic deliberations. Similarly, as economic issues are increasingly represented as national security issues, this type of action potentially increases the power of the economic circles within the state.

The history of Finnish *foreign policy* after the Continuation War (1944) is not based on the language game suggested above, only perceptions of and dealing with the Russian and new comprehensive threats are. President Kekkonen (1956–81) spoke for good relations between the former arch-enemies (Finland and the SU), and maintained that "security implies not building fences but opening doors."[18] Furthermore, the use of expanding, non-military and non-state centric security conceptions did not, originally, serve only military interests. For example, President Koivisto (1982–1994) declared in 1985 that:

> The UN has taught all nations to understand that there cannot be national security without international security. The understanding of this dependency is not limited just to nuclear weapons and military threats. Security implies more than the prevention of war and the abolishment of fear of military attack. Security is needed in everyday life in order to guarantee the satisfaction of the needs of all human beings and fulfilment of human rights. This demands continuous and increasing efforts to support and advance universal justice (Koivisto 1992: 51).

This line of argumentation has found comprehensive applications in President Halonen's (2000-) thinking and speeches (Halonen 2000-).[19] Indeed, her under-

18 Quoted in Koivisto (1992: 48); references to Koivisto's statements are to Koivisto (1992: 7–12, 15–22); and for Halonen see her home page at: <http://www.tpk.fi>.

standing of international cooperation, common security and human well-being and principles of equality and human (including women's) rights are widely supported by the population. Halonen (e.g. 2005) is sceptical towards NATO membership, as is the majority of the population (where pro-membership share has remained around 25 per cent for several years).

While the president is still the most powerful political institution in Finland, and while the current Prime Minister (Vanhanen, holding his second term since 2007) shares the fundamental ideas of the president, the current political struggle in the field of security perceptions and politics of security takes place between the pro-NATO fraction of the elite and the president. The president has a sort of idealist reputation, but the media does not pay much attention to her views. The two most favoured candidates[20] to become her successor come from the party that strongly supports NATO-membership, and those candidates declare their preferences in open terms. Martti Ahtisaari (President 1994–1999 and Nobel Peace Prize laureate of 2008) joins the pro-NATO orientation on the basis of identity policy; Ahtisaari maintains that Finland should join its friends who represent the same values as Finland does, so symbolizing the alliance between the traditional military understanding of security and that of security of identity (e.g. Ahtisaari 2005, 2008), a basic feature in the perception of the Russian threat (see 11.2).

So, in this constellation, 'security' is not the essence of 'security challenges': the political struggle for power is.

19 See Harle (1995) on Koivisto's and Harle (2000) on Ahtisaari's rhetoric. A study on Halonen's rhetoric is under progress, but it can be claimed that Halonen is a unique case among the Finnish presidents in emphasizing the positive values of human security and the related values and norms.

20 The Speaker of Parliament, Sauli Niinistö, and the current Minister of Foreign Affairs, Alexander Stubb.

12 Security Threats, Challenges, Vulnerabilities and Risks in US National Security Documents (1990–2010)

Hans Günter Brauch

12.1 Introduction

Since the end of WWII and since the adoption of the US National Security Act of 1947 (Czempiel 1966; Brauch 1976; Yergin 1977) issues of defence were framed, formulated and legitimated as issues of US national security. Thus, issues of international and regional (hemispheric, European, Asian and Middle East) security were perceived through the perspective of United States national security reflecting US national military, political and economic interests. In most official documents the specific meaning of 'national security' remains undefined or was defined to serve the specific purposes of the respective organization. During the Cold War, the former US Secretary of Defense Harald Brown suggested this definition:

> National security ... is the ability to preserve the nation's physical integrity and territory; to maintain its economic relations with the rest of the world on reasonable terms; to protect its nature, institutions and governance from disruption from outside, and to control its borders (Brown 1983: 4).

Ernest R. May (1992: 94) in his review of "national security in American history", defined national security as "preserving the United States as a free nation, with its fundamental institutions and values intact", where the values and institutions have changed significantly. In their annual messages to the Congress, the US presidents since George Washington used instead of the 'new concept of national security', terms of 'safety', 'tranquillity', 'insecurity', 'danger', 'threat' or 'peril'. May argued that "American ideas about national security evolved in four stages" referring to: 1) the safety of borders and the preservation of the union of states (from the 1790's to the 1870's), 2) to hemispheric independence (Monroe doctrine, 1823) and social order (from the 1880's to WWII), 3) to a free world independence with prosperity at home (from WWII to the 1960's), and 4) to stability and economic growth (from the 1960's to the 1980's). May (1992: 104-) concluded from his analysis that 1) US national security interests always combined external and domestic components, 2) that it "identified its security with the security of other states" including their traditional interests.

This narrow definition of national security that referred to the three features of national sovereignty (of the territory, people, and system of rule) has been gradually widened, deepened and increasingly also sectorialized in official national policy declarations of many countries and in the pronouncements of international organizations since the end of the Cold War in 1989.

After a brief overview of the different perspectives and worldviews of strategic thinkers and foreign policy specialists on the role of the United States in the post-Cold War world (12.2) this chapter reviews the 'speech acts' (Wæver 1995, 1997, 2008) of key US institutions as 'securitizing actors' that are responsible for defining the policy goals, developing policy guidance with a set of policy documents (quadrennial defence review, national security strategy, as well as military and defence strategy and nuclear defence posture statements) and overseeing and controlling their implementation. Thus, this chapter addresses these questions:

- How have the concepts of security, and especially the references to key security dangers and concerns as *threats*, *challenges*, *vulnerabilities* and *risks* been defined in the major US national security documents in the US Administrations from George Bush (1989–1993) to William J. Clinton (1993–2001), George W. Bush (2001–2009) and Barack Obama (since 2009)?
- How has the perception of US national security threats, challenges, vulnerabilities and risks changed since the end of the Cold War (1989), in the aftermath of 11 September 2001 and since the Administration of Barack Obama?

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- Did international factors or internal interests (technological impetus, strategic rationales) contribute to a change in the perception and definition of the security dangers and concerns?
- Did the dominant 'worldview' of the civilian and military strategists and the 'mindset' of the national security policy-makers prevent a redefinition of the security dangers and concerns facing the USA since the end of the Cold War?

The basis of the empirical analysis will be a) the *National Security Strategies* (1991, 1994, 1996, 1998, 2000, 2002, 2006) of the US President, b) the *Quadrennial Defence Review* (1997, 2001, 2006, 2010), and c) the *Nuclear Posture Reviews* (1994, 2001, 2010) of the Secretary of Defense, as well as d) selected other documents such as the US National Military Strategy (1995, 1997, 2004) of the Joint Chiefs of Staff, and the National Defense Strategy of the US Department of Defense (2005, 2008).

It will first introduce the legal basis and the specific political objective of these documents that are addressed both to the domestic audience to 'assure' the people and to 'guide' the national security establishment but also to the international audience both to 'reassure' its allies and to 'warn' and to 'deter' its opponents (12.3.). It will then analyse and assess as to how the four key concepts of security threats, challenges, vulnerabilities and risks for the *US National Security Strategy* (12.4), the *Quadrennial Defence Review* (12.5), c) the *Nuclear Posture Reviews* (12.6.) and other key military and defence documents (12.7.).

In the conclusions this chapter will discuss the above research questions both with regard to the 'worldviews' of academic writers and policy analysts and the 'mindsets', roles and interests of the representatives of major institutions that formulate and implement US national security policies with a specific focus on elements of change and continuity in these major official US documents. However, the chapter will not assess how these policy goals have been implemented in the framework of US global diplomacy and its national and international defence policy.

12.2 Contrasting Worldviews and Mindsets

This survey of the major official pronouncements of the US national security strategy since the Cold War by the major 'securitizing actors' (President, Secretary of Defense) refer to different 'mindsets' on the US global role represented by the conservative realists of the Administration of George Bush (1989–1993), the multilateral liberal vision of the Clinton Administration (1993–2001), the self-centred neo-conservative perspective of the Administration of George W. Bush (2001–2009), as well as the pragmatic internationalist vision of the Obama Administration.

Binnendijk and Kugler (2006: 6) distinguished between two different ideal type worldviews in the policy-oriented US literature on "the US role in global security" (between 1990 and 2005) they categorized as Neo-Kantian and Neo-Hobbessian "each offering different interpretations of contemporary trends" that referred to two different political philosophies "whereas Hobbes sought solutions through state power, Kant sought them through moral conduct and law" (table 12.1).[1]

In discussing "US national security goals and constraints" Binnendijk and Kugler (2006: 161–216) distinguished with regard to the motivation and preferred instruments of power among: a) assertive interventionists (Mead 2004; Ferguson 2004; Lieber 2005); b) progressive multilateralists (Brzezinski 1997, 2004; Nye 2004); c) traditional conservatives (Kissinger 1994; Haass 2005); and d) offshore balancers

1 These dichotomic categorizations of basic trends in thinking on world affairs have been widely used in the major US dominated debates among international relations specialists since the end of World War II that started in the 1940's with the attack of the so-called 'realists', many of them being refugees from Europe (Morgenthau 1948, 1951; Herz 1959, Kissinger 1994) on the Wilsonian 'idealists' (Maghroory/Ramberg 1982). The so-called British school of Martin Wight (1991) and Hedley Bull (1977) distinguished among three schools of thought represented by the adherents of Machiavelli and Hobbes (realists), of Kant (revolutionists) and Grotius (rationalists or pragmatists). During the George W. Bush Administration, Kagan (2003) contrasted the US thinking with Mars and the European thought with that of Venus. Following this tradition, in a book addressed to students of America's war colleges, Binnendijk and Kugler (2006) contrasted the foreign and defence thinking by civilian specialists during the Administrations of Clinton (1993–2001) and George W. Bush (since 2001) in the context of the two opposite intellectual traditions of Hobbes and Kant. Since the early 1990's, this author has used the trilogy of the English school and has contextualized his own thinking on security in the tradition of the Grotian or rationalist school (Brauch 1995, 2002, 2005, 2005a), where cooperation matters, and with regard to the environment as that of an equity-oriented pragmatist where multilateral cooperation will be able to solve most of the environmental security dangers and concerns.

Table 12.1: Key Postulates of Neo-Kantian and Neo-Hobbesian worldviews on the US role in global security. **Source:** Binnendijk and Kugler (2006: 11). Permission for reproduction was granted by the authors.

	Neo-Kantian[a)]	Neo-Hobbesian[b)]
Modern world affairs are driven mainly by:	Democratization and economic growth	Stressful security affairs
The primary instrument is:	Democratic institutions and economic instruments	Military power
The geographic focus is on:	Europe, Asia, Latin America	Greater Middle East
The main goals of foreign policy should be:	Democracy and economic growth	Stable security affairs
The future is:	Optimistic	Pessimistic
Treaties, alliances, and inter-national institutions merit:	Strong support	Less faith
Interdependence creates	Opportunities for cooperation	Vulnerabilities
Best chance of success in world affairs comes from:	Liberal democracies working together multilaterally	United States often acting unilaterally as a Leviathan

a) Binnendijk and Kugler (2006: 15-57) attributed the label 'Neokantian' to the following authors and books: Fukuyama (1992); Huntington (1991); Lipson (2003); Friedman (1999); Garten (1992); Asmus (2002); Kegley/Raymond (1994), Yergin/Stanislaw (1998); Gilpin (2000); Keohane (2002); Slaughter (2004).
b) Binnendijk and Kugler (2006: 59-104) labelled the following authors and books as 'Neohobbessian': Brzezinski (1993); Huntington (1996); Mearsheimer (2001); Terrill (2003); Greenfeld (1992); Moynihan (1993); Pfaff (1993); Kaplan (2000); Power (2002); Lewis (2003); Pollack (2004).

(Kennedy 1987; Daalder/Lindsay 2003, 2005; Huntington 2004; Kagan 2003, 2004; Walt 2005; Zakaria 2004).

In their reading of the US literature on the American role in the post-Cold War world Binnendijk and Kugler (2006: 164) synthesized the premises of the different philosophies and 'worldviews' on national security strategy that were partly reflected in the 'mindsets' of policy-makers and their advisers that drafted the *national security strategy* documents and the military strategy papers of the Pentagon (table 12.2).

This categorization of the different 'worldviews' (Krell 2000)[2] of strategic thinkers is only partially reflected in the 'mindsets' (Booth 1979, 1987, 1991, 1998, 2007) of policy-makers and the roles and interests of big institutions that interpret world trends, developments and events in light of their past experience, their often crude images of the world, but also reflecting their present role and the specific interests of their organization (White House, National Security Council, Department of Defense, Department of State, etc.). By securitizing policy topics, the 'securitizing actors' have stressed that these objects are of 'utmost importance' and 'require extraordinary measures' (Wæver 1995, 1997, 2008) and also substantial financial resources to address these new security dangers, concerns and issues. Thus, in the USA 'securitizing moves' have become major policy instruments for legitimating political preferences and for the allocation of resources.

Thus, key strategic policy documents represent 'speech acts' that aim to convince both the audience at home whose support must be maintained and regained, and the international audience that must be deterred, persuaded and reassured. Thus, these 'speech acts' as reflected in the political notions associated with security threats, challenges, vulnerabilities and risks perform multiple political functions beyond the effort to describe and assess aspects of political reality. While strategic thinkers and policy analysts may be influenced by or promote different 'political philosophies' (macro theories) or develop and test their 'academic theories', institutions have strong bureaucratic or institutional interests which are reflected in the specific roles policy-makers play as representatives of these institutions. Thus, the 'terms' they use may not be interpreted as 'concepts' as they have been developed by different scientific communities to frame specific scientific issue areas (Brauch chap. 2).

2 See the definitions of the concepts of 'worldview' and 'mindset' and their use in international relations in chap. 95 by Oswald Spring and Brauch.

Table 12.2: Premises of philosophies on U.S. national security strategy. **Source:** Binnendijk and Kugler (2006: 164). Permission for reproduction was granted by the authors.

	Traditional Conservatives	Progressive Multilaterialism	Assertive Interventionism	Offshore Balancers
Kant vs. Hobbes	Mostly Hobbes	Mostly Kant, some Hobbes	Mostly Hobbes, some Kant	Mostly Hobbes, some Kant
Nature of major threat	Unstable big power relations	Chaotic southern arc, terrorism	Chaotic southern arc, terrorism	American Overstretch
Role of alliances	Important	Very Important	Less Important	Very Important
Instruments of power	Hard military power and diplomacy	Soft power and diplomacy	Hard military and economic power	Soft power and diplomacy
Mechanisms of success	Power balancing and major-power equilibrium	Persuasion and coalition building	Suppression of threats and promotion of democratization	Balancing and using regional powers
US leadership style	Architect of big power concert	Consensual leader of multilateral alliances	Path-setting leader of ad hoc coalitions	Less engagement
Attention to Limits of US Power	Moderate emphasis	Major emphasis	Little emphasis	Strongest emphasis
Also called	Realists	Liberals, idealists	Neoconservatives	Neoisolationists

12.3 National Security Strategy, Quadrennial Defence Reviews and Nuclear Posture Statements

The selected official documents of the *national security strategies*, *quadrennial defence reviews*, *nuclear posture statements* and other *national military* and *defence strategies* are the most representative official and public pronouncements of American national interests in its diplomacy and military policy (table 12.3).

12.3.1 National Security Strategy Documents

The *National Security Strategy* (NSS) *of the United States of America* (USA) has been prepared since 1986 by the executive branch and released by the US President for the US Congress. It outlines the major US national security dangers and concerns and how the Administration plans to deal with them (Kugler 2000; Newman 2003; Korb 2003; Flanagan/Schear 2008). In contrast with the *National Military Strategy* (NMS) its implementation relies on elaborating guidance in supporting documents. Since the end of the Cold War nine national security strategy documents were released by President George Bush (1991), William J. Clinton (1994, 1996, 1998, 2000), George W. Bush (2002 and 2006) and by Barack H. Obama in May 2010.

During the Cold War the milestone US strategic documents have been the Truman Doctrine and the Marshall Plan (1947); NSC-68 (1950) that outlined the military component of the US Grand Strategy of Containment, NSC 162/2 with the New Look of the Eisenhower Administration (1953) and its implementation in NATO's MC 48 and its strategy of flexible response (1957) that resulted in NATO's MC 14/3 (1967) with its dual diplomatic and military goals. President Kennedy's nuclear strategy of *Mutual Assured Destruction* (MAD) of 1963 was complemented by the Nixon Doctrine (1969) and developed further by the Reagan Doctrine (1982).

Since the end of the Cold War, Richard Betts (2004) referred to the *Draft Defense Planning Guidance* (1992) calling for a strategy for primacy, President Clinton's first NSS (1994) that proposed "Engagement and Enlargement" aiming at primacy and world order and the first NSS (17 September 2002) of George W. Bush as major strategic milestones that called after 11 September 2001 for a strategy of 'preemption' with the goal of a strategic primacy. This NSS (2002) contains the notion of 'military preeminence' that was first suggested in the *Draft Defense Planning Guidance* (1992) by its two principal authors, Paul Wolfowitz and I. Lewis Libby, who were working for then Secretary of Defense Richard Cheney. The Bush doctrine (NSS 2002) had moved from the doctrine of deterrence to a proactive attempt to adjust policy to the realities of the current

Table 12.3: Overview of major US strategic documents (1989-2010). **Source:** The author.

Administration	US Quadrennial Defense Reviews (DoD)	US National Security Strategy (President)	US Nuclear Posture Review (DoD)	National Military/ Defense Strategy (JCS, DoD)
George Bush (1989-1993)		NSS (1991)		*Draft Defense Planning Guidance* (1992)
William J. Clinton (1993-1997)		NSS (1994) NSS (1996)	NPR (1994)	*National Military Strategy* (1995)
William J. Clinton (1997-2001)	1997 (William C. Cohen)	NSS (1997) NSS (1998) NSS (2000)		*National Military Strategy* (1997)
George W. Bush (2001-2005)	30 September 2001 (Donald Rumsfeld)	NSS (2002)		*National Military Strategy* (2004)
George W. Bush (2001-2005)	February 2006 (Donald Rumsfeld)	NSS (2006)	NPR (2001)	*National Defense Strategy* (2005) *National Defense Strategy* (2008)
Barack H. Obama (2009-	1 February 2010 (Robert Gates)	NSS (2010)	NPR (April 2010)	*Quadrennial Homeland Security Review Report* (2010)

situation where the threat was coming both from terrorist groups and from nation states. However, his second NSS of 16 March 2006 returned to a more multilateral approach by restating America's commitment to support democracies and defeat terrorism by discussing the challenges of globalization.

12.3.2 Quadrennial Defence Reviews

In 1996, the US Congress requested that "the Secretary of Defense, in consultation with the Chairman of the Joint Chiefs of Staff, shall complete in 1997 a review of the defense program of the United States intended to satisfy the requirements for a Quadrennial Defense Review" that should "include a comprehensive examination of the defense strategy, force structure, force modernization plans, infrastructure, budget plan, and other elements of the defense program and policies with a view toward determining and expressing the defense strategy of the United States and establishing a revised defense program through the year 2005". So far four such documents have been released by the Clinton (1997), the George W. Bush (2001, 2006) and the Obama (1 February 2010) Administrations.

12.3.3 US Nuclear Posture Reviews

Since the end of the Cold War, the US Department of Defense (DoD) completed three *Nuclear Posture Reviews* (NPRs)[3] in 1994, 2001, and in April 2010 that offer

> the framework for US nuclear policy for the following five to 10 years. The purpose of the reviews is to determine the role of nuclear weapons in the broader context of US security policy. In order to determine this role, the DoD and several appointed commissions assess nuclear policy in light of the global strategic environment, and then provide a collective recommendation to senior DoD staff, the president, and Congress. The NPR then becomes a guide for the operation and budget of the nuclear weapons community.

In the post-Cold War era the primary US concern was to downsize and to legitimate its large nuclear forces in its strategic arsenal trying to incorporate nuclear forces into a new geostrategic situation. The 1994 NPR of the Clinton Administration "reaffirmed the centrality and legitimacy of strategic deterrence, which is based on the threat of retaliation with nuclear weapons in the event that the United States is attacked by another state with nuclear weapons". It

3 This section relies on an analysis on "Nuclear Posture Reviews" by the Monterey Institute's James Martin Center for Nonproliferation Studies; at: <http://www.nti.org/f_wmd411/f2c.html> (17 April 2010).

focused on Russia as the primary nuclear threat to the US and called for maintaining the existing nuclear triad of bombers, submarines, and land-based ballistic missiles. This NPR affirmed US commitments to arms control agreements (*Non-Proliferation Treaty* (NPT), *Cooperative Threat Reduction* (CTR) Program, START I) and emphasized US commitments to the *Comprehensive Test Ban Treaty* (CTBT). The NPR of 2001 by the Administration of George W. Bush

> underscored the importance of nuclear weapons in war fighting. It also reiterated the importance of the US-Russian relationship and noted that Russia retained the ability to destroy the United States with its immense nuclear arsenal. In addition to Russia, the United States named six countries that could present a threat and therefore might warrant a nuclear strike: North Korea, Iran, Iraq, Syria, Libya, and China. Finally, the 2001 NPR asserted the need for military flexibility through a 'capabilities-based' defense system as opposed to a 'threat-based' system.

The NPR 2001 downgraded arms control by withdrawing from the ABM and opposing the CTBT and called for "a new strategic nuclear triad that incorporated conventional weapons as well as a stronger role for missile defense". It supported "the development and deployment of ... bunker busters and low-yield nuclear weapons ..., which would serve the primary role of destroying underground nuclear facilities".

The NPR of 6 April 2010 by the Obama Administration reflected recommendations of the *Congressional Commission on the Strategic Posture of the United States* made in its Final Report (May 2009) that had recommended "that a step-by-step approach should be taken with Russia to establish a follow-on agreement to START I" but it also stressed the "need to improve nuclear infrastructure; pursue missile defense, so long as it does not cause heightened threats from Russia and China; and increase the safety, security and reliability of warheads permissible" (Perry 2009). The release of NPR 2010 was delayed because President Obama opposed draft versions "resembling too closely the status quo" and the nuclear policy of his predecessor. Its five key objectives include: "1) preventing nuclear proliferation and nuclear terrorism; 2) reducing the role of US nuclear weapons in US national security strategy; 3) maintaining strategic deterrence and stability at lower nuclear force levels; 4) strengthening regional deterrence and reassuring US allies and partners; and 5) sustaining a safe, secure, and effective nuclear arsenal". NPR 2010 stressed

> that the security environment is significantly different since the Cold War ended, which requires an alteration in the US nuclear posture. The report states that ... the reduction of nuclear arms will help to persuade other NPT members to collaborate in the fight against nuclear proliferation and terrorism. The NPR also indicates that any state, terrorist organization or non-state actor pursuing the use of WMD will be held fully accountable. Additionally, the review also advocates for the successful negotiation of a *Fissile Material Cut-off Treaty*.

While most Democrats in the US Congress support the measured approach of NPR 2010, several Republicans were concerned "over a few key provisions, among them being uncertainty over the extent of reliance on conventional capabilities and further reductions to the US nuclear arsenal".

12.3.4 Other US National Security Documents

Many other official US documents have specified the very general policy guidelines in the NSS documents of the American President and in the QDRs and the NPRs by the US Department of Defense. Among them is the US *National Military Strategy* (NMS) by the *Chairman of the Joint Chiefs of Staff* that outlines the strategic aims of the armed forces, which the JCS must submit each second year to the *Senate* and the *House Committee on Armed Services* with "a comprehensive examination of the national military strategy". The NMS

> must provide a description of the strategic environment and the opportunities and challenges that affect United States national interests and United States national security. The Report must describe the most significant regional threats to US national interests and security as well as the international threats posed by terrorism, weapons of mass destruction, and asymmetric challenges.

In February 2010, the Obama Administration also released its *Quadrennial Homeland Security Review Report* that reviewed its assessment and guidance for domestic security.

12.4 Threats, Challenges, Vulnerabilities and Risks in US National Security Strategy Documents (1991-2010)

Between 1991 and 2010, nine *National Security Strategy* (NSS) documents were released by President Georg Bush (1991), William J. Clinton (1994/1995, 1996, 1997, 1998, 2000), George W. Bush (2002,

2006), and by Barack Obama in May 2010. Have there been any clear differences in the use of the four terms of security threats, challenges, vulnerabilities and risks or have they been used as synonyms for describing major security dangers and concerns for the USA in the post-Cold War era?

12.4.1 References to US National Security 'Threats'

The nine NSS documents have offered many different definitions and references to US national security threats since the end of the Cold War.

12.4.1.1 Threats in the NSS of the Administration of George Bush

The first NSS document of August 1991 pointed to the key goal of "the survival of the United States as a free and independent nation, with its fundamental values intact and its institutions and people secure". It referred to a "reduced *Soviet threat*" [emphasis added by the author also in the citations below] but also claimed that the SU's "conventional forces west of the Urals ... could still pose a *potent threat* to a single flank or region". NSS 1991 noted "*threats of power vacuums* and regional instabilities", and the *threats of drug trafficking, of international terrorism*, to combat "*threats to democratic institutions* from aggression, coercion, insurgencies, subversion, terrorism and illicit drug trafficking". In the context of economic and security assistance NSS 1991 added to the list of threats "AIDS and environmental degradation". The security concerns include besides illicit drugs, protection of the oil supplies, *varied threats to stability, ballistic missile proliferation and weapons of mass destruction*, and it claimed "regional crises are the *predominant military threat* we will face in the future". Thus, the term 'threat' was widened from military to non-military security dangers and also the referent object (security for whom?) was deepened by the Bush Administration.

12.4.1.2 Threats in the NSS of the Clinton Administration

The first NSS 1994/1995 of the Clinton Administration on "Engagement and Enlargement" used the term 'threat' 25 times with a wide range of connotations. It stated with regard to the US historical experience: "After World War II, ... in the face of a new *totalitarian threat* this great nation did not walk away from the *challenge* of the moment" and it noted that "the *threat of communist expansion* – is gone" and that "the *threat of a war* among great powers and the specter of nuclear annihilation have receded dramatically" and that the US support "market reforms in Russia (and the other newly independent states)" and thus "help turn a *former threat* into a region of *valued diplomatic and economic partners*". NSS 1994/1995 claimed that "the unitary threat that dominated our engagement during the Cold War has been replaced by a complex set of challenges".

NSS 1994/1995 pointed to several remaining military threats, such as another "*Iraqi threat* to Kuwait", and that "the continuing *tensions on the Korean Peninsula* remain the principal *threat* to the peace and stability of the Asian region". But it also considered it "essential that *China not become a security threat to the region*", and that "in Southwest Asia, the United States remains focused on *deterring threats to regional stability*, particularly from *Iraq and Iran* as long as those states *pose a threat* to US interests, to other states in the region, and to their own citizens". The object of the threat is not only 'US interests' but also 'other states in the region' and 'their citizens'.

With regard to the conflict in the post Yugoslav space NSS 1994/1995 claimed that "the *threat of NATO air power* was judged real", but it was clear that "allied or friendly governments" should "ultimately, defeat aggression should it occur, we must prepare our forces to *confront this scale of threat*, preferably in concert with our allies and friends, but unilaterally if necessary", acknowledging that this "does not pose a *direct threat* to our security or warrant unilateral US involvement".

The Clinton Administration used the term 'threat' for various non-military dangers such as "the *threat of intrusions to our military and commercial information systems*", and that the US has "the political will to confront the *narcotics threat*" and that it will "address the *growing threat from high-purity heroin* entering this country" as well as "seek to eliminate the scourge of drug trafficking, which poses a *serious threat to democracy and security*". NSS 1994/1995 goes beyond the state as the sole source and points to dangers posed by non-state actors: "*Terrorism* involving weapons of mass destruction represents a particularly *dangerous potential threat* that must be countered." With regard to the "Nunn-Lugar *Cooperative Threat Reduction* effort and other denuclearization initiatives", the NSS 1994/1995 stated that the USA "are working with our Allies to develop a policy framework to consider how to reinforce ongoing prevention efforts and to reduce the *proliferation threat*

and protect against it", and it announced to "develop security countermeasures based on *sound threat analysis* and risk management practices".

The Clinton Administration's second *National Security Strategy of Engagement and Enlargement* (February 1996) used the term 'threat' and 'threaten' more than 100 times both with regard to military and non-military security problems, many of them were also cited in the previous document. It refers to a key scientific debate that "democratic states are less likely to *threaten* our interests and more likely to cooperate with the United States to meet security *threats* and promote free trade and sustainable development". It also notes that "the boundaries between *threats* that start outside our borders and the *challenges* from within are diminishing". NSS 1996 uses the term 'threat' both for military and non-military dangers but nearly exclusively with regard to the USA and its allies but also to "US enterprises" and "threats to democracy", posed by states and transnational threats (drugs, organized crime), thus reflecting a widening with a limited deepening.

In May 1997 in the early second Clinton Administration *A National Security Strategy for A New Century* was released that refers 89 times to the term 'threat' noting in the preface that

> the dangers we face are unprecedented in their complexity. Ethnic conflict and outlaw states *threaten* regional stability; terrorism, drugs, organized crime and proliferation of weapons of mass destruction are global concerns that transcend national borders; and environmental damage and rapid population growth undermine economic prosperity and political stability in many countries.

These new dangers require to "increase cooperation in confronting *new security threats* that defy borders and unilateral solutions". It specifically lists as "*threats to US interests* ... [that] are generally grouped into three, often intertwined, categories:

- *Regional or State-centered Threats*: A number of states still have the capabilities and the desire to *threaten* our vital interests, through either coercion or cross border aggression. In many cases, these states are also actively improving their offensive capabilities, including efforts to obtain nuclear, biological or chemical weapons. In other cases, unstable nations, internal conflicts or failed states may threaten to further destabilize regions where we have clear interests.
- *Transnational Threats*: Some *threats transcend national borders*. These *transnational threats*, such as terrorism, the illegal drug trade, illicit arms trafficking, international organized crime, uncontrolled refugee migrations, and environmental damage threaten American interests and citizens, both directly and indirectly. *Not all of these are new threats*, but advances in technology have, in some cases, made these threats more potent.
- *Threats from Weapons of Mass Destruction*: Weapons of mass destruction pose the *greatest potential threat to global security*. We must continue to reduce the *threat* posed by existing arsenals of such weaponry as well as work to stop the proliferation of advanced technologies that place these destructive capabilities in the hands of parties hostile to US and global security interests. Danger exists from outlaw states opposed to regional and global security efforts and transnational actors, such as terrorists or international crime organizations, potentially employing nuclear, chemical or biological weapons against unprotected peoples and governments.

NSS 1997 contains a clear commitment to multilateralism when it states that "No one nation can defeat these threats alone. Accordingly, a central thrust of our strategy is to adapt our security relationships with key nations around the world to *combat these threats* to *common interests*" by using diplomacy, international assistance, and military activities as major tools and it notes with regard to "*transnational threats*" that

> Today, American diplomats, law enforcement officials, military personnel and others are called upon to respond to *assorted transnational threats* that have moved to center stage with the Cold War's end. Combating these dangers which range from terrorism, international crime, and trafficking in drugs and illegal arms, to environmental damage and intrusions in our critical information infrastructures requires far-reaching cooperation among the agencies of our government as well as with other nations.

Among the transnational threats NSS 1997 refers besides drug trafficking and organized crime also to "environmental and security concerns" by stating:

> *Environmental threats* do not heed national borders and can pose long-term dangers to our security and well-being. Natural resource scarcities often trigger and exacerbate conflict. *Environmental threats* such as climate change, ozone depletion and the transnational movement of dangerous chemicals directly *threaten the health of US citizens*. We must work closely with other countries to respond aggressively to *these and other environmental threats*.
>
> Decisions today regarding the environment and natural resources can affect our security for generations; consequently, our national security planning is incorporating environmental analyses as never before. In addition, we have a full diplomatic agenda, working unilaterally, regionally and multilaterally to forge agreements to protect the global environment.

This statement clearly reflects the arguments of the first two phases of the policy and scientific debates on environmental security (Brauch 2008, 2009; chap. 1 in this vol.). NSS 1997 pointed to "promoting sustainable development abroad" as a key US national security goal:

> Sustainable development improves the prospects for democracy in developing countries and expands the demand for US exports. It alleviates pressure on the global environment, reduces the attraction of the illegal drug trade and improves health and economic productivity. ... New diseases, such as AIDS, and other epidemics that can spread through environmental damage, *threaten* to overwhelm the health facilities of developing countries, disrupt societies and stop economic growth. ... The Global Environmental Facility provides a source of financial assistance to the developing world for climate change, biodiversity and oceans initiatives that will benefit all the world's citizens.
>
> Environmental and natural resource issues can impede sustainable development efforts and promote regional instability. ... Environmental damage in countries of the NIS and Central and Eastern Europe continues to impede their ability to emerge as prosperous, independent countries. In addition, the effects of climate change and ozone depletion know no borders and can pose grave dangers to our nation and the world. We seek to accomplish the following:
>
> - forge an international consensus to address the challenge of global climate change, as evidenced by *threats such as rising sea levels*, the spread of tropical disease and more frequent and severe storms;
> - achieve increased compliance with the Montreal Protocol through domestic and multilateral efforts aimed at curbing illegal trade in ozone depleting substances;
> - implement the UN Straddling Stocks Agreement, ratify the Law of the Sea Convention and help to promote sustainable management of fisheries worldwide;
> - implement the Program of Action on population growth developed at the 1994 Cairo Conference;
> - expand bilateral forest assistance programs and promote sustainable management of tropical forests;
> - focus technical assistance and encourage non-governmental environmental groups to provide expertise to the NIS and Central and Eastern European nations ...;
> - achieve Senate ratification of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes;
> - lead a renewed global effort to address population problems and promote international consensus for stabilizing world population growth; and
> - achieve Senate ratification of the Biodiversity Convention and take steps to slow or stop biodiversity loss. ...

Thus, with NSS 1997 the Clinton Administration clearly responded to the emerging policy (Mathews 1989, Myers 1989) and scientific (Homer-Dixon 1991, 1994, 1995) debate on environmental security that had started in the USA in 1989 and illustrates the progressing official securitization of the environmental dimension of US national security.

NSS 1998 used the term 'threat' 32 times by referring to the threat to US national security, to global instability, posed by existing weapons and from foreign intelligence services and by "traditional human, technical and signals intelligence activities". It pointed to Clinton's Presidential Decision Directive 62 of May 1998 that "creates a new and more systematic approach to fighting the *terrorist threat* of the next century". NSS 1998 mentions the "*serious and potent threat to the American people at home and abroad*" posed by international crime, where this "*growing threat* to our security from *transnational crime* makes international law enforcement cooperation vital".

The Clinton Administration submitted its last *National Security Strategy For A Global Age* in December 2000 just before leaving office, where the term 'threat' was employed 34 times referring to new international health security issues, where the US "leadership in the international fight against infectious diseases, especially HIV/AIDS, is critical to defeat a *threat that kills massively*, crosses frontiers and destabilizes whole regions", because such international cooperation on health issues "*reduces the threat of diseases to Americans*, and because global international economic development, democratization, and political stability are predicated in part on the health of populations worldwide". The threat concept is widely used with regard to BMD and WMD but also for the drug issue and international crime. However, the indication to go it alone was a tendency that became more pronounced during the Administration of George W. Bush.

12.4.1.3 Threats in the NSS of the Administration of George W. Bush

In the first *National Security Strategy* (NSS 2002) of President George W. Bush of September 2002 there were 18 references to the term 'threat' that pointed to a shift from states to non-state actors as the cause of insecurity: "Enemies in the past needed great armies and great industrial capabilities to endanger America. Now, shadowy networks of individuals can bring great chaos and suffering to our shores for less than it costs to purchase a single tank. Terrorists are organized to penetrate open societies and to turn the power

of modern technologies against us." NSS 2002 notes that once this threat is localized the USA "will help ensure the state has the military, law enforcement, political, and financial tools necessary to finish the task". It stressed the task of "defending the United States, the American people, and our interests at home and abroad by *identifying and destroying the threat* before it reaches our borders". With regard to the danger of proliferation of WMD the US "comprehensive strategy to combat WMD includes: a) Proactive counterproliferation efforts. We must deter and defend against the threat before it is unleashed". Against this new threat posed by

> rogue states and terrorists, the United States can no longer solely rely on a reactive posture as we have in the past. The inability to deter a potential attacker, the immediacy of *today's threats*, and the magnitude of potential harm that could be caused by our adversaries' choice of weapons, do not permit that option. We cannot let our enemies strike first. ... But deterrence based only upon the *threat of retaliation* is less likely to work against leaders of rogue states more willing to take risks, gambling with the lives of their people, and the wealth of their nations. ... For centuries, international law recognized that nations need not suffer an attack before they can lawfully take action to defend themselves against forces that present an imminent danger of attack. Legal scholars and international jurists often conditioned the legitimacy of pre-emption on the existence of an *imminent threat* – most often a visible mobilization of armies, navies, and air forces preparing to attack.

The NSS 2002 of the Administration of George W. Bush proposed to "adapt the concept of *imminent threat* to the capabilities and objectives of today's adversaries" and it legitimated pre-emptive action: "to counter a *sufficient threat to our national security*. The *greater the threat*, the greater is the risk of inaction – and the more compelling the case for taking anticipatory action to defend ourselves, even if uncertainty remains as to the time and place of the enemy's attack. To forestall or prevent such hostile acts by our adversaries, the United States will, if necessary, act pre-emptively". NSS 2002 suggested to "strengthen intelligence warning and analysis to provide *integrated threat assessments for national and homeland security*. Since the *threats inspired by foreign governments and groups* may be conducted inside the United States, we must also ensure the proper fusion of information between intelligence and law enforcement". This use of the threat concept is limited to military but also domestic security dangers posed by so-called 'rogue states' and 'terrorists' where all references to non-military soft security dangers and concerns had disappeared.

The second *National Security Strategy* (NSS 2006) of President George W. Bush of March 2006 used the term 'threat' 14 times, noting that "some conflicts pose such a *grave threat to our broader interests and values* that conflict intervention may be needed to restore peace and stability" and that "the *proliferation of nuclear weapons* poses the *greatest threat* to our national security". NSS 2006 focused primarily to threats posed by biological, chemical and nuclear weapons with a special reference to the claimed threats of the WMD of Iraq that were later rejected by the Silverman Commission set up by President George W. Bush. However, it also applied the threat concept as well to a new non-military danger to human health: "To confront the *threat of a possible pandemic*, the Administration took the lead in creating the International Partnership on Avian and Pandemic Influenza, a new global partnership of states committed to effective surveillance and preparedness that will help to detect and respond quickly to any outbreaks of the disease." Contrary to the Clinton Administration the 'threat' concept of George W. Bush stressed nearly exclusively hard security dangers and concerns and there was no more reference to 'environmental threats'.

12.4.1.4 Threats in the NSS of the Administration of Barack H. Obama

The first *National Security Strategy* of the Obama Administration of May 2010 (NSS 2010) has significantly changed the foreign and security strategy of the United States. President Barak H. Obama stressed in his introduction that the national security strategy "begins with the steps we take at home". As goals he lists economic growth, reduction of the deficit, education "of our children to compete in an age where knowledge is capital". The US Armed Forces as the cornerstone of US national security must be complemented by the diplomats. He argued that "America's greatest asset is its people" and he believed that the USA "must foster even deeper connections among Americans and peoples around the globe". While NSS 2010 does not use the concept of 'human security', it acknowledges however that "The freedom that America stands for includes freedom from want."

NSS 2010 is structured in four parts referring (I.) to an Overview of National Security Strategy; (II.) providing an outline of the Strategic Approach referring to "the world we seek" that builds on the foundations of the USA, pursues a comprehensive engagement

and promotes a just and sustainable international order; (III.) a strategy for advancing US interests of security, prosperity, values and international order; and a brief concluding section.

The strategic shift of the declared NSS from the Administration of George W. Bush can be described from a 'capability-based' towards a value oriented strategy. Among the key security goals NSS 2010 lists: "strengthen security and resilience at home", "disrupt, dismantle and defeat Al Qa'ida and its violent extremist affiliates in Afghanistan, Pakistan, and around the world", ... "revise the spread of nuclear and biological weapons and secure nuclear materials", "advance peace, security, and opportunity in the Greater Middle East", "invest in the capacity of strong and capable partners", and to "secure cyberspace".

With regard to the value basis, NSS 2010 emphasizes to "strengthen the power of our example", "promote democracy and human rights abroad" and to "promote dignity by meeting basic needs". On international order, NSS 2010 stresses to "ensure strong alliances", to "build cooperation with other 21st century centers of influence", to "strengthen institutions and mechanisms for cooperation" and to "sustain broad cooperation on key global challenges".

NSS 2010 used the term 'security' 251 times, with the qualifiers of *national, state, homeland, internal, regional, European, African, international, global, transnational, mutual, common, collective, broader, shared, nuclear, proliferation, maritime, positive and negative, food, energy, cyber, aviation, physical, health, transition, lasting, true, responsible, civilian, border, future, America's, Israel's, Afghanistan's and Iraqi* security but it did not use the terms of 'human', 'environmental', 'ecological' and 'social' or 'societal security'.

NSS 2010 used 17 and 55 times the term threat(s), 8 times challenge(s), 3 times vulnerability(ies) and 13 times risk(s). Besides the "immediate threat" in the aftermath of the events of 11 September 2001, NSS 2010 pointed to the American engagement

> on strengthening international institutions and galvanizing the collective action that can serve common interests such as combating violent extremism; stopping the spread of nuclear weapons and securing nuclear materials; achieving balanced and sustainable economic growth; and forging cooperative solutions to the *threat of climate change, armed conflict, and pandemic disease*.

NSS 2010 notes that there "is *no greater threat to the American people than weapons of mass destruction*, particularly the danger posed by the pursuit of nuclear weapons by violent extremists and their proliferation to additional states". Instead of the "*ideological, economic, and military threat* from communism" during the Cold War, now "we must once again position the United States to champion mutual interests among nations and peoples". With regard to homeland security the new US approach "relies on our *shared efforts to identify and interdict threat*s; deny hostile actors the ability to operate within our borders; maintain effective control of our physical borders; safeguard lawful trade and travel into and out of the United States; disrupt and dismantle transnational terrorist, and criminal organizations; and ensure our national resilience in the face of the threat and hazards". But NSS 2010 also notes that it will not be able "to *deter or prevent every single threat*" but that the USA is "committed to fighting here and abroad have *underscored the threat* to the United States and our interests *posed by individuals radicalized at home*" but also that the "best *defenses against this threat* are well informed and equipped families, local communities, and institutions" and that "the Federal Government will invest in intelligence to understand this threat and expand community engagement and development programs to empower local communities".

Internationally, NSS 2010 refers to "Al Qa'ida's core in Pakistan" and the "*growing threat from the group's allies* worldwide" and that the USA is working with the government of Pakistan "to address the *local, regional, and global threat from violent extremists*". NSS 2010 also discusses "global *financial threats*" resulting from globalization. NSS 2010 points specifically to non-state actors "that *pose a threat to our national security* – terrorists, proliferators, narcotics traffickers, corrupt officials, and others". Therefore the USA should expedite "the lawful and legitimate flow of people and goods while *interdicting transnational threat that threaten our open societies*".

Besides environmental security dangers, NSS 2010 argues that "the *threat of contagious disease* transcends political boundaries, and the ability to prevent, quickly detect and contain outbreaks with pandemic potential has never been so important". Thus, "addressing these transnational risks requires advance preparation, extensive collaboration with the global community, and the development of a resilient population at home". This requires to "improve global surveillance and early warning capabilities and quickly enact control and containment measures against the next pandemic threat" and "to mitigate other problem areas, including limited global vaccine production capacity, and the threat of emergent and reemergent dis-

ease in poorly governed states". The 55 references to 'threats' are linked to 'new', 'evolving' and 'asymmetric' threats as well as vital, military, intelligence, transnational, terrorist, biological, external, cybersecurity, financial, health, criminal and maritime threats. From the Administration of George W. Bush to that of Barak H. Obama, the scope of the threat has widened and become increasingly of a non-military nature against which non-military counter strategies, policies, measures and means are needed.

12.4.2 Changing Perceptions of US National Security Challenges

12.4.2.1 Challenges in the NSS of the George Bush Administration

The NSS 1991 used the term 'challenge' much less than 'threat', primarily with a non-military or 'soft security' meaning in the following contexts [emphasis added by the author]: "We face *new challenges* not only to our security, but to our ways of thinking about security;" or by referring to "a new agenda of *political challenges*", or "the *security challenges* of a new era" or to "The upheavals of this era are also giving rise to human migrations on an unprecedented scale, raising a host of *social, economic, political and moral challenges* to the world's nations." NSS 1991 listed among its goals, to "achieve cooperative international solutions to key *environmental challenges*, assuring the sustainability and environmental security of the planet as well as growth and opportunity for all". Migration and refugees are also described as "an unprecedented *challenge* to the new Europe". But it also referred to China and the Soviet Union as posing "a complex *challenge* as it proceeds inexorably toward major systemic change", and it listed as top issues "for international cooperation ... the *global challenges* posed by illegal drugs, terrorism and degradation of the environment". NSS 1991 also stated:

> We will focus our efforts and resources on five *major challenges*:
>
> - Promoting and consolidating democratic values ....
> - Promoting market principles: ...
> - Promoting peace: ...
> - Protecting against transnational threats: International terrorism, narcotics, AIDS and environmental degradation threaten all peaceful nations....
> - Meeting urgent human needs. We will respond quickly and substantially to the suffering caused by natural or man-made disasters.

The term challenges was also used as "*economic challenges*" by referring to "the ability and willingness of all countries to rise to the *challenges of a new world order* and will require compromise on all sides" and as "*environmental challenges*" that are "already contributing to political conflict". But it also notes that "the *specific challenges facing our military* in the 1990's and beyond will be different from those that have dominated our thinking for the past 40 years", and it argues that the new US strategy will "also guide our restructuring so that our remaining forces are appropriate to the *challenges of a new era*" and that with regard to crisis response the USA "must be prepared for our interests to be challenged with force, often with little or no warning". But with regard to the solution NSS 1991 reflects a technological imperative when it argues "we must *challenge our technology* to develop forces that are lethal but more readily deployable" and "another *challenge* will be to maintain our edge in defense technology, even as we reduce our forces" following this principle of "reducing our defense burden as appropriate, while restructuring our *forces for new challenges*". The concept of 'security challenges' was extensively used in the NSS 1991 by the Bush Administration reflecting a wider meaning of security including the economic, environmental and technological dimensions where the state remains the primary reference object.

12.4.2.2 Challenges in the NSS of the Clinton Administration

NSS 1994/1995 of the Clinton Administration used the term 'challenge' seven times sometimes as a synonym for threat but mostly with regard to new non-military security dangers. For Haiti after the coup, "our *challenge* now is to help the Haitian people consolidate their hard-won democracy and rebuild their country" and it noted on the financial crisis in Mexico in December 1994 that "the United States took the lead in marshaling international support to assist the country in meeting this *challenge*". For the "Middle East and elsewhere" the USA shared its concerns "for the *enormous challenge* of stemming the proliferation of such weapons".

The Clinton Administration's second *National Security Strategy of Engagement and Enlargement* (February 1996) used the term 'challenge' 36 times for both hard and soft security issues, arguing that with the end of the past primary security imperative of "containing communist expansion while preventing nuclear war", the US is now "confronted [with] a complex array of *new and old security challenges*". It points to the new dangers posed by globalization that "makes possible for the violence of terrorism, organ-

ized crime and drug trafficking to challenge the security of *our borders* and that of our *citizens* in new ways". With regard to Africa, different security dimensions are linked as "*economic, political, social, ethnic and environmental challenges*" that could lead to "Afro-pessimism" but if the USA "can simultaneously *address these challenges*, we create a synergy that can stimulate development, resurrect societies and build hope". NSS 1996 has often combined threats and challenges in the same sentence and often contrasted challenges and opportunities.

NSS 1997 referred 48 times to the term 'challenge' with the connotations of the previous strategy statements of the Clinton Administration. It refers to "joint action on *common security challenges*" in Europe contributing "to a democratic Russia's active participation in the post-Cold War European security system" and to various environmental goals "to close the hole in the ozone layer, reducing the greenhouse gases that challenge our health as they change our climate". However, NSS 1997 used the term challenge more for military and regional security issues than for environmental dangers.

NSS 1998 employed the term 'challenge' 15 times pointing to globalization that "enables other states, terrorists, criminals, drug traffickers and others to challenge the safety of our citizens and the security of our borders in new ways". A special focus was on macroeconomic issues, such as the Asian financial crisis.

NSS 2000 referred to the term 'challenge' six times in connotation with "international drug syndicates based abroad *challenge* us", but also with "*ethnic conflict [that] represents a great challenge to our values and our security*" and democracy and human rights where the USA announced to "promote responsible indigenous moves toward increasing political participation and enhancing the quality of governance, and we will continue to *challenge governments* in the region to improve their human rights records". These five national security strategy papers of the Clinton Administration have used the term 'challenge' with a wide variety of referents with both a wider and a more constrained meaning (widening), with both the states but also the American and other peoples as referent objects (deepening) but only a few pointed to sectorialized security concepts. However, there have been no clear borderlines between the use of the terms 'threat' and challenge'.

12.4.2.3 Challenges in the NSS of the Administration of George W. Bush

NSS 2002 by George W. Bush employed the term 'challenge' 13 times referring to the other non-military dimensions of security for which it would "deliver greater development assistance through the *New Millennium Challenge Account* to nations that govern justly, invest in their people, and encourage economic freedom" and that the USA "will also continue to lead the world in efforts to reduce the terrible toll of HIV/AIDS and other infectious diseases". It also announced "*to challenge Israeli leaders* to take concrete steps to support the emergence of a viable, credible Palestinian state" and with regard to Colombia, the US "recognize the link between terrorist and extremist groups that *challenge the security of the state* and drug trafficking activities that help finance the operations of such groups". It emphasized that the US would only "aid countries that have *met the challenge of national reform*" and that its "*Millennium Challenge Account* will reward countries that have demonstrated real policy change and *challenge those that have not* to implement reforms." Both "share health and environmental threats, such as the spread of HIV/AIDS, *challenge us to promote jointly the welfare of our citizens*" but also "addressing these transnational threats will *challenge China* to become more open with information, promote the development of civil society, and enhance individual human rights".

NSS 2006 employed the term 'challenge' six times by referring with regard to terrorism to "sub-cultures of conspiracy and misinformation" that "keep alive grievances and filter out facts that would *challenge popular prejudices* and self-serving propaganda". NSS 2006 also points to the great "challenge" the USA is facing from Iran and to the "serious *nuclear proliferation challenge*" from the North Korean regime. The two NSS documents of the Administration of G.W. Bush used the term 'challenge' for both hard and soft security problems.

12.4.2.4 Challenges in the NSS of the Administration of Barack H. Obama

NSS 2010 used the term 'challenge' 8 times, three times as a noun and five times as a verb. The plural of 'challenges' was used 64 times, most particularly in connotation with 'new', 'emerging', 'shared', 'major', 'tough', 'difficult', 'enormous', 'global', 'common', 'civilian', 'transnational', 'economic' and 'development' issues. Under the heading of "sustain broad cooperation on key global challenges", NSS 2010 returns to a

broad global multilateral and cooperative approach of the Clinton Administration as being "necessary to meet 21st century challenges".

Among the key new challenges "requiring broad global cooperation", NSS 2010 refers to climate change, peacekeeping and armed conflict, pandemics and infectious disease, transnational criminal threats and threats to governance and safeguarding the global commons. With regard to climate change, NSS 2010 stated:

> The danger from climate change is real, urgent, and severe. The change wrought by a warming planet will lead to new conflicts over refugees and resources; new suffering from drought and famine; catastrophic natural disasters; and the degradation of land across the globe. The United States will therefore confront climate change based upon clear guidance from the science, and in cooperation with all nations—for there is no effective solution to climate change that does not depend upon all nations taking responsibility for their own actions and for the planet we will leave behind.
>
> *Home*: Our effort begins with the steps that we are taking at home. We will stimulate our energy economy at home, reinvigorate the U.S. domestic nuclear industry, increase our efficiency standards, invest in renewable energy, and provide the incentives that make clean energy the profitable kind of energy. This will allow us to make deep cuts in emissions—in the range of 17 percent by 2020 and more than 80 percent by 2050. This will depend in part upon comprehensive legislation and its effective implementation.
>
> *Abroad*: Regionally, we will build on efforts in Asia, the Americas, and Africa to forge new clean energy partnerships. Globally, we will seek to implement and build on the Copenhagen Accord, and ensure a response to climate change that draws upon decisive action by all nations. Our goal is an effective, international effort in which all major economies commit to ambitious national action to reduce their emissions, nations meet their commitments in a transparent manner, and the necessary financing is mobilized so that developing countries can adapt to climate change, mitigate its impacts, conserve forests, and invest in clean energy technologies. We will pursue this global cooperation through multiple avenues, with a focus on advancing cooperation that works. We accept the principle of common but differentiated responses and respective capabilities, but will insist that any approach draws upon each nation taking responsibility for its own actions.

With regard to peacekeeping and armed conflict, NSS 2010 calls for preventing genocide and mass atrocities and international justice. For pandemics and infectious disease, NSS 2010 states that "addressing these transnational risks requires advance preparation, extensive collaboration with the global community, and the development of a resilient population at home". Internationally, the USA "are enhancing international collaboration and strengthening multilateral institutions in order to improve global surveillance and early warning capabilities and quickly enact control and containment measures against the next pandemic threat". With regard to "transnational criminal threats" NSS 2010 supports a "multidimensional strategy that safeguards citizens, breaks the financial strength of criminal and terrorist networks, disrupts illicit trafficking networks, defeats transnational criminal organizations, fights government corruption, strengthens the rule of law, bolsters judicial systems, and improves transparency". Finally for safeguarding the global commons, NSS 2010 stresses that the US "must work in concert with allies and partners to optimize the use of shared sea, air, and space domains", and it notes that "these efforts require strong multilateral cooperation, enhanced domain awareness and monitoring, and the strengthening of international norms and standards". Whether these new value-based goals will be implemented in the years ahead also partly depends on the rather interest-driven and short-time focused U.S. Congress.

12.4.3 US National Security Vulnerabilities

In the NSS statement of 1991 there is only one reference to the term 'vulnerability' that is used solely in the context of *energy security*: "Our use of oil is the key source of our *vulnerability* to world oil supply disruption. To reduce this *vulnerability*, we must work to both reduce oil consumption and to use oil more efficiently."

In NSS 1994/1995 of the Clinton Administration there was again only one reference to 'vulnerability' that referred to the goal "to minimize the *vulnerability of our forces* abroad to weapons of mass destruction". The single reference to 'vulnerability' in NSS 1996 is used for protecting US "forces abroad to weapons of mass destruction" why the USA "are placing a high priority on improving our ability to locate, identify and disable arsenals of weapons of mass destruction, production and storage facilities for such weapons and their delivery systems".

NSS 1997 used the term 'vulnerability' twice with regard to the *information infrastructure* and major theatre warfare. While for the first "concepts and technologies are being developed and employed to protect and defend against these *vulnerabilities*; we must fully implement them to ensure the future secu-

rity of not only our national information infrastructures, but our nation as well", for the second it concludes that the US "must plan and prepare to fight and win under conditions where an adversary may use asymmetric means against us, unconventional approaches that avoid or undermine our strengths while exploiting our *vulnerabilities*". NSS 1998 and NSS 2000 did not use the vulnerability term at all, nor did NSS 2002 of the Administration of George W. Bush. The NSS 2006 has one reference to 'vulnerability' with regard to the "Department of Homeland Security" that "is focused on three national security priorities: preventing terrorist attacks within the United States; reducing America's *vulnerability* to terrorism; and minimizing the damage and facilitating the recovery from attacks that do occur". However, contrary to the use of 'vulnerability' during the Cold War referring to its nuclear forces no similar solely technical use could be documented for the post-Cold War period.

12.4.3.1 Vulnerabilities in the NSS of the Administration of Barack H. Obama

NSS 2010 has used the term 'vulnerability' only once in the context of natural hazards for improving "resilience through increased public-private partnerships" where the private sector as the owner and operator of the critical infrastructure "lays a vital role in preparing for and recovering from disasters". With a strengthened "public-private partnerships" new structures and systems are to be designed

> that can withstand disruptions and mitigate associated consequences, ensure redundant systems where necessary to maintain the ability to operate, decentralize critical operations to reduce our *vulnerability* to single points of disruption, develop and test continuity plans to ensure the ability to restore critical capabilities, and invest in improvements and maintenance of existing infrastructure.

The plural of 'vulnerabilities' was used twice in NSS 2010 in the context of enhancing security at home that "relies on our shared efforts to prevent and deter attacks by identifying and interdicting *threats*, denying hostile actors the ability to operate within our borders, protecting the nation's critical infrastructure and key resources, and securing cyberspace. That is why we are pursuing initiatives to *protect and reduce vulnerabilities in critical infrastructure, at our borders, ports, and airports, and to enhance overall air, maritime, transportation, and space and cyber security*".

Other new security dangers are 'cybersecurity threats' that "represent one of the most serious national security, public safety, and economic challenges we face as a nation". However, the US "public safety depend[s] on power and electric grids, but *potential adversaries could use cyber vulnerabilities* to disrupt them on a massive scale". The term vulnerability is not used any more with a purely military meaning as during the Cold War but with various non-military connotations.

12.4.4 Perceptions of US National Security Risks

12.4.4.1 Risks in the NSS of the George Bush Administration

In NSS 1991 the term 'risk' was used four times in the following political contexts: "American leadership must include mobilizing the world community to share the danger and *risk*." In a different context NSS 1991 stresses that "nonstrategic nuclear weapons remain integral to our strategy of deterrence" and suggests that "as the principal means by which Alliance members share nuclear *risk*s and burdens, these aircraft and their weapons must be based in Europe". It points to the goal "to maintain our edge in defense technology, even as we reduce our forces. Technology has historically been a comparative advantage for American forces, and we have often relied on it to overcome numerical disparities and to reduce the *risk* to American lives". And it notes with regard to resource competition, our "emphasis on technology development ... may mean accepting some continued *risk* in the near term. But accepting such *risk* may well be prudent in a period of reduced East-West tensions".

12.4.4.2 Risks in the NSS of the Clinton Administration

In NSS 1994/1995 of the Clinton Administration the term 'risk' was used eight times arguing that the external and internal "threat of intrusions to our military and commercial information systems poses a significant *risk to national security*". It also noted that regarding the US humanitarian interests that "the *risk to American troops* is minimal". With regard to the conclusions of the NPR 1994, NSS 1994/1995 stated that the USA "will continue to maintain nuclear forces of sufficient size and capability to *hold at risk* a broad range of assets valued by such political and military leaders" and with regard to nuclear arms control it noted that the USA "will also explore strategic confidence building measures and mutual understandings that reduce the *risk of accidental war*". It further an-

nounced that the USA would "develop security countermeasures based on sound threat analysis and *risk management practices*".

With regard to the environment and sustainable development NSS 1994/1995 reflected the concerns of the Clinton Administration with regard to environmental security (Matthew/McDonald 2009) by noting that the "increasing competition for the dwindling reserves of uncontaminated air, arable land, fisheries and other food sources, and water, once considered 'free' goods, is already a very *real risk to regional stability around the world*". And with regard to NATO's involvement in the Balkans, NSS 1994 argues that this would promote US interests "by reducing *the risk of instability or conflict in Europe's eastern half*".

NSS 1996 used the term 'risk' 22 times, referring to the US soldiers that "put their *lives at risk*" and it repeatedly notes that "US security, prosperity and freedom are neither cost- nor *risk-free*", why "resources must be spent and casualties may be incurred", and that the USA faces "*security risks* that are not solely military in nature". It acknowledges the positive cost-benefit analysis of humanitarian missions when "only the military has the ability to jump-start the longer-term response to the disaster; when the response requires resources unique to the military; and when the *risk to American troops is minimal*". NSS 1996 also asks about "the *environment of risk*" the USA is entering. It interprets *limiting risks* also as a major diplomatic task where "the G-7 leaders [are] committed to intensify cooperation among financial authorities to *limit systemic risk* and pledged to develop and enhance safeguards, standards, transparency and systems to reduce *risk*".

NSS 1997 employed the term 'risk' 17 times, by referring to preventive mission of US policy as "an unrelenting force for peace – from the Middle East to Haiti, from Northern Ireland to Central Africa. Taking *reasonable risks for peace* keeps us from being drawn into far more costly conflicts", and it claims that "the more America leads, the more willing others are to share the *risks and responsibilities* of forging our futures". It also stresses

> the requirement to invest in selected research and prototype systems while monitoring trends in likely future threats. These prudent steps provide insurance against the possibility that some of our efforts to shape the international environment in ways favorable to US interests do not succeed. Although such insurance is certainly not free, it is a relatively inexpensive way to *manage risk in an uncertain, resource-constrained environment* – that is, *the risk of being unprepared to meet a new threat*, the *risk of developing the wrong capabilities*, and the *risk of producing a capability too early* and having it become obsolete by the time it is needed.

NSS 1997 employed the term 'risk' 15 times, including with regard to environmental issues: "A deteriorating environment not only threatens public health, it impedes economic growth and can generate tensions that threaten international stability. To the extent that other nations believe they must engage in non-sustainable exploitation of natural resources, *our long-term prosperity and security are at risk*." Such international cooperation could "also help to prevent threats from arising that *place at risk American lives and property at home*". With regard to the potential danger of biological weapons, NSS 1998 noted "we must have the medicines and vaccines needed to treat those who fall sick or prevent *those at risk from falling ill* because of a biological weapons attack".

NSS 2000 employed the term 'risk' nine times by referring to putting "*US forces at risk*" primarily with regard to military contingencies that by failing "to defeat initial enemy advances rapidly ... could undermine US credibility and *increase the risk of conflict* elsewhere", but that the USA must "accept a *degree of risk* associated with withdrawing from contingency operations and engagement activities in order to *reduce the greater risk* incurred if we failed to respond adequately to major theater wars". It further used the risk concept with regard to the war against Yugoslavia that "prevented the *real risk* that violence in Kosovo would create turmoil throughout the region, undermining its new, fragile democracies and reversing our progress in Bosnia and Herzegovina", and for its dialogue to encourage with India and Pakistan "to take steps to prevent further proliferation, *reduce the risk of conflict*, and exercise restraint in their nuclear and missile programs". Again in these five national security statements of the Clinton Administration between 1994/1995 and 2000 there was no consistency in the use of the term risk that was often used synonymously with threats and challenges.

12.4.4.3 Risks in the US NSS of the Administration of G.W. Bush

NSS 2002 used the term 'risk' only three times with different connotations by focusing on international efforts and resources against terrorism "on *areas most at risk*" and that the US faced after the Cuban Missile Crisis (1963) "a generally status quo, *risk-averse adversary*" and in the context of the legitimating pre-emptive action it stressed "The greater the threat, *the greater is the risk of inaction* – and the more compel-

ling the case for taking anticipatory action to defend ourselves, even if uncertainty remains as to the time and place of the enemy's attack."

NSS 2006 used the term risk three times with regard to the "great *personal risk*" of Muslims that are "a target of this ideology of terror" and with regard to international trade where "protectionist impulses in many countries *put at risk* the benefits of open markets and impede the expansion of free and fair trade and economic growth". This use does not reflect any of the suggested definitions in the highly sophisticated scientific debates on risk.

12.4.4.4 Risks in the NSS of the Administration of Barack H. Obama

NSS 2010 used the term 'risk' 9 times and 'risks' four more times in several contexts. With regard to engaging "with communities and citizens" NSS 2010 announces: "We will emphasize individual and community preparedness and resilience through frequent engagement that provides clear and *reliable risk and emergency information* to the public." On the danger of terrorism, NSS 2010 claims to "deny safe havens and strengthen *at-risk states*", ... "pursue sustainable and responsible security systems in *at-risk states*", and that the USA "must improve its capability to strengthen the security of *states at risk* of conflict and violence. We will undertake long-term, sustained efforts to strengthen the capacity of security forces to guarantee internal security, defend against external threats, and promote regional security and respect for human rights and the rule of law". Furthermore, NSS 2010 states that "the *increased risk of terrorism* necessitates a capacity to detain and interrogate suspected violent extremists, but that framework must align with our laws to be effective and sustainable" and that the USA "will place renewed emphasis on deterrence and prevention by mobilizing diplomatic action, and use development and security sector assistance to *build the capacity of at-risk nations and reduce the appeal of violent extremism*".

NSS 2010 sees the USA more threatened "by proliferation that could lead to a nuclear exchange. Indeed, since the end of the Cold War, the *risk of a nuclear attack* has increased." Further, the USA "must continue to work at home with first responders and health officials to reduce the *risk associated with unintentional or deliberate outbreaks of infectious disease* and to strengthen our resilience across the spectrum of high-consequence biological threats". On the prevention of "the emergence of conflict", NSS 2010 notes that the USA "have already begun to reorient and strengthen our development agenda; to take stock of and enhance our capabilities; and to forge new and more effective means of applying the skills of our military, diplomats, and development experts. These kinds of measures will help us *diminish military risk*, act before crises and conflicts erupt, and ensure that governments are better able to serve their people".

With regard to the use of force, NSS 2010 argues that the USA "will exhaust other options before war whenever we can, and carefully weigh the *costs and risks of action* against the *costs and risks of inaction*". On countering biological threats, the USA promotes global health security and aims at "obtaining timely and accurate insight on *current and emerging risks*". Regarding pandemics, NSS 2010 notes that "addressing these *transnational risks* requires advance preparation, extensive collaboration with the global community, and the development of a resilient population at home".

12.5 Threats, Challenges, Vulnerabilities and Risks in the US Quadrennial Defense Reviews

12.5.1 Security Threats in the QDRs

The first *Quadrennial Defense Review* (QDR 1997) was a six-month analysis of the threats, risks and opportunities for US national security which reviewed US defence strategy and programmes, including force structure, infrastructure, readiness, intelligence, modernization and people. Its task was to delineate a national defence strategy consistent with the most recent National Security Strategy by defining force structure, modernization plans, and a budget plan allowing the military to successfully execute the full range of missions within that strategy.

Secretary of Defense William C. Cohen in his preface to the first QDR of May 1997 referred to new "*threats and dangers* - harder to define and more difficult to track" which have made it necessary that "America's policy makers ... *comprehend the nature of these threats* and devise appropriate strategies and programmes to defuse or defeat them" and to "be better able to respond to a variety of smaller-scale contingencies and asymmetric threats ... ranging from nuclear, biological, and chemical weapons to attacks via information warfare and terrorism".

With regard to the "global security environment", the QDR 1997 noted that "the *threat of global war*

has receded" but that *new threats of "coercion and large-scale, cross-border aggression against US allies and friends* in key regions by hostile states with significant military power" remain, and that "both *Iraq and Iran continue to pose threats* to their neighbors and to the free flow of oil from the region", and that in "the Middle East, the potential for conflict will remain until there is a just and lasting peace in the region and security for Israel" while "*North Korea continues to pose a highly unpredictable threat*". QDR 1997 noted that

> US interests will continue to be challenged by a variety of transnational dangers, and the lives of US citizens will often be placed at risk, directly and indirectly. Increasingly capable and violent terrorists will continue to directly *threaten the lives of American citizens* and try to undermine US policies and alliances. The illegal drug trade and international organized crime will continue to ignore our borders, attack our society, and threaten our personal liberty and well-being. Uncontrolled flows of migrants will sporadically destabilize regions of the world and *threaten American interests and citizens*.

Besides the threats posed by WMD, "*information warfare* (attacks on our infrastructure through computer-based information networks) *is a growing threat*". Besides the projected trends of

> continued regional dangers, the proliferation of advanced weapons and technologies, transnational dangers, and the increased danger of asymmetric attacks, there are a number of 'wild card' scenarios that could seriously challenge US interests both at home and abroad. Such scenarios range from the *unanticipated emergence of new technological threats*, to the loss of US access to critical facilities and lines of communication in key regions, to the takeover of friendly regimes by hostile parties. Taken individually, these scenarios are unlikely. But taken together, it is more likely that one or more wild cards *will* occur than it is that *none* will occur. ... while the probability of individual wild cards may be low, their consequences may be disproportionately high. Therefore, the United States must maintain military capabilities sufficient to deal with such events.

QDR 1997 saw "the dominant challenge ... [in] the possible emergence, after 2010–2015, of a regional great power or global peer competitor, as well as more *stressing combinations of asymmetric threats*". QDR 1997 defines as the goal "to ensure the long-term dominance of US forces by preparing now for the emergence of *more challenging threats* in the future while accepting reductions in our capabilities to meet near-term demands". Contrary to the NSS of the Clinton Administration the QDR referred solely to hard security and regional military threats as well as to the uncertainty related to asymmetric threats and 'wild cards'.

The first QDR of the Administration of George W. Bush was released on 30 September 2001 by Secretary of Defense Donald Rumsfeld shortly after the third attack on the US territory of 11 September (after 1812 by Britain and 1941 by Japan). It referred 16 times to the concept of 'threat' that point to a fundamental change in defence planning from

> a '*threat-based*' model that has dominated thinking in the past to a 'capabilities-based' model for the future. This capabilities-based model focuses more on how an adversary might fight rather than specifically whom the adversary might be or where a war might occur. It recognizes that it is not enough to plan for large conventional wars in distant theaters. Instead, the United States must identify the capabilities required to deter and defeat adversaries who will rely on surprise, deception, and asymmetric warfare to achieve their objectives.

The QDR 2001 distinguished between "*threat of major war to the faceless threat of terror*". For the QDR 2001 Russia "does not pose a large-scale *conventional military threat to NATO*" but "It shares some important security concerns with the United States, including the problem of vulnerability to attack by ballistic missiles from regional aggressors, the danger of accidental or unauthorized launches of strategic weapons, and *the threat of international terrorism*." But "in several regions, the inability of some states to govern their societies, safeguard their military armaments, and prevent their territories from serving as sanctuary to terrorists and criminal organizations can also pose a *threat to stability* and place demands on US forces". This was a clear reference to Afghanistan that became an objective of a US led intervention a few weeks later responding to the attack of 11 September 2001.

QDR 2001 identified elements of a new US defence strategy "for deterring conflict and conducting military operations" but it also noted that "*future challenges risk not only addresses possible future threats*, but also the ability to meet critical transformational challenges. For example, the decision not to pursue a new technology due to the lack of a current threat entails risk: introducing it early provides a military advantage for a time, and it may dissuade any potential adversary from pursuing similar capabilities." However, the shift towards a capability-based strategy decouples defence planning from specific 'threats' and legitimates the technological imperative as a major driver of future defence spending on military R&D.

The second QDR of the Administration of G.W. Bush was released on 6 February 2006 and referred 19

times to the term 'threat' in the context of a wider defence transformation from "*threat-based*" to "*capabilities based planning*", whose essence is "to identify capabilities that adversaries could employ and capabilities that could be available to the United States, then evaluate their interaction, rather than over-optimize the joint force for a *limited set of threat scenarios*". Among the specific threats and countermeasures the QDR 2006 announced "to develop broad-spectrum medical countermeasures against the *threat of genetically engineered bio-terror agents*" as part of the DoD's countermeasures against the "*threat of biological terrorism*". It also notes that in many countries "*terrorist networks pose a greater threat than external threats*" but that "the *threat to the US homeland, however, is broader than that posed by terrorists*". While QDR 2006 considered it unlikely that Russia poses "*a military threat to the United States or its allies* on the same scale", it stresses with regard to China the US goal "to encourage China to choose a path of peaceful economic growth and political liberalization, *rather than military threat and intimidation*". While some states "do not pose a *direct military threat to the United States*, these states may *threaten* the United States or its allies indirectly by transferring weapons or expertise to terrorists". It also points to the threat that "nuclear weapons, sophisticated and/or bioengineered biological agents, and non-traditional chemical agents – once the sole purview of large, complex state weapons programs – will be within reach of a growing number of actors in the coming decades". Therefore, "national efforts to counter the *threat posed by weapons of mass destruction* must incorporate both preventive and responsive dimensions" and "the future force will be organized, trained, equipped, and resourced to *deal with all aspects of the threat* posed by weapons of mass destruction" with the goal "to better support the warfighter and [that] are appropriate for the *threat environment*".

The QDR of the Administration of Barack H. Obama of 1 February 2010 referred 21 times to the term of 'threat'. It repeated many threats listed in the earlier QDR of 2001 and 2006 posed by

> the proliferation of weapons of mass destruction (WMD) [that] continues to undermine global security, further complicating efforts to sustain peace and prevent harmful arms races. The instability or collapse of a WMD-armed state is among our most troubling concerns. Such an occurrence could lead to rapid proliferation of WMD material, weapons, and technology, and could quickly become a global crisis posing a direct *physical threat to the United States* and all other nations.

QDR 2010 argued that "if deterrence fails and adversaries challenge our interests with the *threat or use of force*, the United States must be prepared to respond in support of US national interests". It also considered WMD and the *terrorist threat in Afghanistan and Pakistan* "posing an *enduring threat to the security of America and its allies and partners*".

12.5.2 Security Challenges in the QDRs

The first QDR 1997 stressed that "the United States likely will face a number of significant *challenges to its security* between now and 2015" and "will continue to confront a variety of regional dangers" and that "more than one aspiring regional power will have both the desire and the means to *challenge US interests militarily*". Synonymously with its reference to threats posed by WMD it points to challenges by the proliferation of "NBC weapons, materials, and technologies" and to challenges "by a variety of transnational dangers" that will place "the lives of US citizens ... placed at risk, directly and indirectly". Further, "dealing with ... *asymmetric challenges* must be an important element of US defense strategy, from fielding new capabilities to adapting how US forces will operate in future contingencies". The term 'challenge' was in most cases used synonymously for the term 'threat' and both were limited solely to military security dangers and concerns.

The second QDR 2001 used the term 'challenge' 13 times stating that "*uncertainty is a key challenge for US defense planning*, certain features and trends of the security environment define not only today's *geopolitical and military-technical challenges* but also highlight critical *operational challenges* that the Nation's armed forces will need to master in the future". Further, "the pervasiveness of proliferation in an era of globalization has increased the availability of technologies and expertise needed to create the *military means to challenge* directly the United States and its allies and friends". QDR 2001 states that "a *fundamental challenge* confronting DoD is ensuring that US forces have the capabilities they need to carry out the new defense strategy and meet the demands of the 21st century". It further notes that "while the United States cannot predict with confidence which adversaries will pose threats in the future, the types of military capabilities that will be used *to challenge US interests and US military forces* can be identified and understood". QDR 2001 concludes that "*mitigating*

future challenge risks [requires] experimentation, R&D, and Selective Procurement. Achieving DoD's strategic goals mandates embarking on the long-term transformation of US military capabilities".

The third QDR 2006 used the term 'challenge' six times with these connotations referring to the challenge posed by Iraq and the challenges facing the USA that differ from the Cold War, "a *challenge so immense* that it requires major shifts in strategic concepts for national security and the role of military power". In his assessment the chairman of the JCS, emphasized that "any attempt to predict the future security environment of 2025 is inherently difficult. ... Given the dynamics of change over time, we must develop a mix of agile and flexible capabilities to mitigate uncertainty".

The fourth QDR 2010 employed ten times the term 'challenge' arguing that "If deterrence fails and *adversaries challenge our interests with the threat or use of force*, the United States must be prepared to respond in support of US national interests." QDR 2010 referred to this "range of *plausible future challenges*" with which the DoD will be required to deal with:

- Defeating Al Qaeda and its allies;
- Supporting a national response to attacks on, or natural disasters in, the United States;
- Defeating aggression by adversary states, including states armed with advanced anti-access capabilities and/or nuclear weapons;
- Locating, securing, or neutralizing weapons of mass destruction, key materials, and related facilities in the context of a loss of control of such weapons or materials, and thwarting the potential for a non-state adversary to acquire them;
- Supporting and stabilizing fragile states facing threats from terrorist and insurgent groups;
- Protecting American citizens in harm's way overseas;
- Conducting effective operations in cyberspace; and
- Preventing human suffering due to mass atrocities or large-scale natural disasters abroad.

The QDR 2010 also "gives solid direction on developing capabilities that counter the proliferation of anti-access and area-denial threats, which present an *increased challenge to our maritime, air, space, and cyber forces*".

12.5.3 Security Vulnerabilities in the QDRs

The first QDR 1997 argued that "US dominance in the conventional military arena may encourage adversaries to use such asymmetric means to attack our forces and interests overseas and Americans at home. That is, they are likely to seek advantage over the United States by using unconventional approaches to *circumvent* or *undermine* our strengths while *exploiting* our *vulnerabilities*". Further, "areas in which the United States has a significant advantage over potential opponents and increasing capabilities (e.g., space-based assets; command, control, communications, and computers; and intelligence, surveillance, and reconnaissance) could also involve inherent *vulnerabilities* that could be exploited by potential opponents (e.g., attacking our reliance on commercial communications) should we fail to account for such challenges", and to "prevent and deter future terrorism and *reduce US vulnerability to terrorist acts* through DoD efforts to enhance intelligence collection capabilities and protect critical infrastructure". The second (QDR 2001), third (QDR 2006), and fourth *Quadrennial Defence Reviews* (QDR 2010) lacked any reference to the term 'vulnerability'.

12.5.4 US National Security Risks in the QDRs

The first QDR 1997 "examined three alternative paths that differed in where they accepted *risks* and emphasized investment over the near term, midterm, and long term" and it argued that in the early post-Cold War period "US interests will continue to be challenged by a variety of transnational dangers, and the *lives of US citizens will often be placed at risk*, directly and indirectly". For primarily humanitarian missions, QDR suggests that "the military mission should be clearly defined, the *risk to American troops* should be minimal, and substantial US military involvement should be confined to the initial period of providing relief until broader international assistance efforts get underway". Furthermore, "US participation in smaller-scale contingency operations must be selective, depending largely on the interests at stake and the *risk of major aggression* elsewhere." The USA should also "insure or hedge against unlikely, but significant, future threats in order to *manage risk in a resource-constrained environment* and better position the Department to respond in a timely and effective manner to new threats as they emerge".

The second QDR 2001 used the term risk 70 times including a whole section on "managing risks" with "a New Risk Framework" with regard to force management, operational, future challenges, and institutional risks and a section on "*mitigating risks across the spectrum*". The QDR 2001 called for a "culture within the military that embraces innovation and *risk-taking*" and states that the DoD "will pursue new de-

terrence tools that not only *hold at risk an adversary's military forces and other valued assets*, but also extend greater protection to allies and friends in crisis through capabilities such as missile defenses, defensive information operations, and counter-terrorist operations" and it suggested that the "DoD must find ways to encourage and *reward innovation and risk-taking among fighting forces* as well as support personnel". The QDR 2001 suggested that the proposed

> *risk framework* is made up of four related dimensions: a) force management - the ability to recruit, retain, train, and equip sufficient numbers of quality personnel and sustain the readiness of the force while accomplishing its many operational tasks; b) operational - the ability to achieve military objectives in a near term conflict or other contingency; c) future challenges - the ability to invest in new capabilities and develop new operational concepts needed to dissuade or defeat mid- to long-term military challenges; and d) institutional - the ability to develop management practices and controls that use resources efficiently and promote the effective operation of the defense establishment.

With regard to "*mitigating operational risks* ... the QDR has developed a broader approach to *operational risk* that involves assessing the Department's ability to perform the following: i) defend the United States; ii) deter forward in critical areas; iii) swiftly defeat aggression in overlapping major conflicts; and iv) conduct a limited number of small-scale contingencies". This proposed new risk framework for the Pentagon's operations was totally detached from the sophisticated debates on risks in the social sciences.

The third QDR 2006 had 12 references to the term 'risk' including the approach to risk assessment it adopted with the QDR 2001. It noted with concern that "the pace and scope of China's military build-up already *puts regional military balances at risk*". QDR 2006 indicated that the DoD "is considering adopting a *risk-based source selection process* in place of the current cost-based approach".

The fourth QDR 2010 used the term 'risk' 83 times, including again a whole section dealing with "a *defence risk management framework*". DoD suggested to balance "*resources and risk* among four priority objectives: prevail in today's wars, prevent and deter conflict, prepare to defeat adversaries and succeed in a wide range of contingencies, and preserve and enhance the All-Volunteer Force". The QDR widened the focus from the narrow military focus of the first three QDR to include the economic and environmental dimensions of security. It noted with regard to the former that "the US export system itself poses a potential national security risk. Its structure is overly complicated, contains too many redundancies, and tries to protect too much". For the first time, the QDR stressed that the "DoD will need to adjust to the impacts of climate change on our facilities and military capabilities", noting that according to an estimate of the National Intelligence Council

> more than *30 US military installations* were already facing e*levated levels of risk* from rising sea levels. DoD's operational readiness hinges on continued access to land, air, and sea training and test space. Consequently, the Department must complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required.

In its risk assessment "for this QDR, the Department used a multidisciplinary approach" that included "updated thinking on best practice" drawing on "quantitative analysis", but also relying "on informed judgments, expert opinions, and the use of scenarios" and DoD "ensured that its *risk assessment was strategy driven*". It also noted that "a failure by the Department to secure its systems in cyberspace would pose a *fundamental risk to our ability to accomplish defense missions* today and in the future", and that "a number of factors related to research and development will, over time, generate *increased risk to America's technological edge*".

Without any reference to the four key terms of security 'threats', 'challenges', 'vulnerabilities' and 'risks', the QDR 2010 referred 19 times to climate change noting that the "rising demand for resources, rapid urbanization of littoral regions, the *effects of climate change*, the emergence of new strains of disease, and profound cultural and demographic tensions in several regions are just some of the trends whose complex interplay may spark or exacerbate future conflicts". The QDR 2010 announced that the DoD would craft "a strategic approach to climate and energy" where "climate change and energy will play significant roles in the future security environment" by "developing policies and plans to manage the effects of climate change on its operating environment, missions, and facilities". The new global challenges of the "rising demand for resources, rapid urbanization of littoral regions, the effects of climate change, the emergence of new strains of disease, and profound cultural and demographic tensions in several regions are just some of the trends whose complex interplay may spark or exacerbate future conflicts". DoD acknowledged that "climate change will shape the operating environment, roles, and missions that we undertake". According to "assessments conducted by the intelligence community indicate that climate change

could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fragile governments. Climate change will contribute to food and water scarcity, will increase the spread of disease, and may spur or exacerbate mass migration". Objecting to any mono-causality, the QDR 2010 stated that

> while climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world. In addition, extreme weather events may lead to increased demands for defense support to civil authorities for humanitarian assistance or disaster response both within the United States and overseas. In some nations, the military is the only institution with the capacity to respond to a large-scale natural disaster. Proactive engagement with these countries can help build their capability to respond to such events.

Furthermore, "DoD will need to adjust to the impacts of climate change on our facilities and military capabilities". Adaptation to climate change would "pose challenges for civil society and DoD alike, particularly in light of the nation's extensive coastal infrastructure". As 30 US military installations may face "elevated levels of risk from rising sea levels, DoD's operational readiness hinges on continued access to land, air, and sea training and test space. Consequently, the Department must complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required". This necessitates that the DoD "must complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required". Further, "as climate science advances, the Department will regularly re-evaluate climate change risks and opportunities in order to develop policies and plans to manage its effects on the Department's operating environment, missions, and facilities. Managing the national security effects of climate change will require DoD to work collaboratively, through a whole-of-government approach, with both traditional allies and new partners". And finally, DoD "is increasing its use of renewable energy supplies and reducing energy demand to improve operational effectiveness, reduce greenhouse gas emissions in support of US climate change initiatives, and protect the Department from energy price fluctuations".

12.6 Threats, Challenges, Vulnerabilities and Risks in the US Nuclear Posture Reviews

At the request of President Clinton Secretary of Defense Les Aspin initiated on 29 October 1993 a comprehensive review of America's nuclear posture that was described as "the first DOD study of its kind to incorporate reviews of policy, doctrine, force structure, operations, safety and security, and arms control in one look". This review focused on: "1. The role of nuclear weapons in US security strategy; 2. US nuclear force structure; 3. US nuclear force operations; 4. Nuclear safety and security; 5. The relationship between US nuclear posture and counterproliferation policy; 6. The relationship between US nuclear posture and threat reduction policy with the former Soviet Union."

The goal was to replace two presidential directives: a) *National Security Decision Directive* (NSDD) 13 on nuclear employment policy (Ronald Reagan, 1981); b) *Presidential Decision* (PD) 48 on ballistic missile submarine commitments to NATO (Jimmy Carter, April 1979).[4] President Clinton approved the *Nuclear Posture Review* (NPR) in September 1994 that

> defines and integrates past and present US policies for nuclear deterrence, arms control, and nonproliferation objectives. The NPR ... provides the DoD policy guidance, force structure and stewardship obligations for the enduring nuclear weapons stockpile. This force structure reflects the reduced role nuclear weapons now play in US security strategy.[5]

The second *Nuclear Posture Review* (NPR) was submitted by Secretary of Defense Donald Rumsfeld on 31 December 2001 to the US Congress to "lay out the direction for American nuclear forces over the next five to ten years". Based on the (QDR 2001) the NPR (2002) implemented a major change in the US approach "to the role of nuclear offensive forces in our deterrent strategy and presents the blueprint for transforming our strategic posture".[6]

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4 This paragraph is based on: The Nautilus Institute, Nuclear Strategy Project: "The 1994 Nuclear Posture Review"; at: <http://www.nautilus.org/archives/nukestrat/USA/Npr/npr94.html> (19 April 2010).

5 See "PDD/NSC-30 Nuclear Posture Review Implementation [September 1994], Text Not Available"; at: <http://www.fas.org/nuke/guide/usa/doctrine/dod/95_npr.htm> (19 April 2010).

6 See "Nuclear Posture Review (Excerpts)"; at: <http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm> (19 April 2010).

The third *Nuclear Posture Review* (NPR) was submitted by Secretary of Defense Robert Gates on 6 April 2010 to the US Congress that "provides a roadmap for President Obama's agenda for reducing nuclear risks to the United States, our allies and partners and the international community".[7] As only the latter review is fully available the use of the four key terms of threats, challenges, vulnerabilities and risks can only be reviewed for the most recent document.

Commenting on the changed international security environment since the end of the Cold War, the NPR 2010, uses 19 times the term 'threat' noting that "The *threat of global nuclear war* has become remote, but the *risk of nuclear attack has increased*", and "Today's other pressing *threat is nuclear proliferation*", but "the *most immediate and extreme threat* today is nuclear terrorism". It claims that "changes in the *nuclear threat environment* have altered the hierarchy of our nuclear concerns and strategic objectives". NPR 2010 announced that the Obama Administration will accelerate "the *Global Threat Reduction Initiative* and the International Nuclear Material Protection and Cooperation Program", and that the US would secure and eliminate WMD "through cooperative *threat reduction programs* at the Departments of Defense, State, and Energy, including the flagship Nunn-Lugar program". It announces with regard to "the catastrophic potential of biological weapons and the rapid pace of bio-technology development" that the USA "reserves the right to make any adjustment in the assurance that may be warranted by the evolution and proliferation of the *biological weapons threat* and US capacities to counter that *threat*". Not surprisingly, in the NPR the use of the term 'threat' has been limited to nuclear issues and to other WMD and their proliferation.

The NPR 2010 refers nine times to the term 'challenge' which was used with these connotations that in facing "increasingly urgent *threats of nuclear terrorism and nuclear proliferation,* the United States must continue to address the more familiar *challenge of ensuring strategic stability with existing nuclear powers* – most notably Russia and China" and that "today, the reassurance mission remains, but the *deterrence challenge is fundamentally different*" as well as that "our most pressing *security challenge* at present is preventing nuclear proliferation and nuclear terrorism, for which a nuclear force of thousands of weapons has little relevance".

With regard to Russia and China NPR 2010 states that "*maintaining strategic stability* with the two countries will be an important *challenge* in the years ahead" and that the USA "must continue to address the more familiar *challenge of ensuring strategic stability* with existing nuclear powers – most notably Russia and China" and that "maintaining strategic stability at reduced force levels will be an *enduring and evolving challenge* for the United States in the years ahead", and "ongoing nuclear and other military modernization efforts by Russia and China compound this *challenge*, making the need for strategic stability dialogues all the more critical", but also "maintaining strategic stability with the two countries will be an *important challenge* in the years ahead". NPR 2010 also states that "the cumulative loss of focus, expertise, and excellence on nuclear matters in the United States remains a *significant challenge*".

The NPR 2010 did not use the term 'vulnerability' but employed the term 'risk' nine times in the following contexts arguing repeatedly that "while *the risk of all-out nuclear war* is much diminished relative to the Cold War" and the "*risk of nuclear attack against NATO* members is at an historic low", nevertheless "the *risk of nuclear attack has increased*", especially as the "nuclear black market, create a serious *risk* that terrorists may acquire what they need to build a nuclear weapon". Therefore, the "verified elimination of all nuclear weapons and minimize risk of cheating and breakout", and new "*technologies will help us manage risk*" with the goal to be "able to detect potential clandestine weapons programs".

In conclusion, in the NPR 2010 – representing a major policy declaration of the Obama Administration or a 'speech act' in the wording of the theory of securitization - the three terms 'threat', 'challenge' and 'risk' that refer to the nature of the 'objective' security dangers, but also 'subjective' security concerns and 'intersubjective' security issues have been used synonymously. However, their use differs significantly from the complex scientific definitions and debates in the security, the global change, the climate change and in the natural hazard communities (chap. 2 by Brauch).

7 See all details on the release of NPR 2010 at: <http://www.defense.gov/npr/>. The full text of the *Nuclear Posture Review Report* (April 2010) is at: <http://www.defense.gov/npr/docs/2010%20Nuclear%20Posture%20Review%20Report.pdf> (19 April 2010).

12.7 Threats, Challenges, Vulnerabilities and Risks in the National Military and Defense Strategy Documents

The moderate *National Security Strategy* of August 1991 by President George Bush was in clear contrast to the *Draft Defense Planning Guidance* of February 1992 under the direction of then Under Secretary of Defense Paul Wolfowitz for the then Secretary of Defense Richard Cheney that "outlined strategy to prevent the rise of 'potential competitors', to discourage advanced countries 'from challenging our leadership', and to extend security commitments to countries that had been Soviet allies only a short time before" (Betts 2004: 24). According to a leaked draft version excerpted by the New York Times this document

> called for massive increases in defense spending, the assertion of lone superpower status, the prevention of the emergence of any regional competitors, the use of preventive—or pre-emptive—force, and the idea of forsaking multilateralism if it did not suit US interests. It called for intervening in disputes throughout the globe, even when the disputes were not directly related to US interests, arguing that the United States should 'retain the preeminent responsibility for addressing selectively those wrongs which threaten not only our interests, but those of our allies or friends, or which could seriously disrupt international relations'. According to the draft DPG, the United States must also 'show the leadership necessary to establish and protect a new order that holds the promise of convincing potential competitors that they need not aspire to a greater role or pursue a more aggressive posture to protect their legitimate interests'.[8]

The *Draft Defense Planning Guidance* further argued,

> Our first objective is to prevent the re-emergence of a new rival. This is a dominant consideration underlying the new regional defense strategy and requires that we endeavor to prevent any hostile power from dominating a region whose resources would, under consolidated control, be sufficient to generate global power. These regions include Western Europe, East Asia, the territory of the former Soviet Union, and Southwest Asia. There are three additional aspects to this objective: First the United States must show the leadership necessary to establish and protect a new order that holds the promise of convincing potential competitors that they need not aspire to a greater role or pursue a more aggressive posture to protect their legitimate interests. Second, in the non-defense areas, we must account sufficiently for the interests of the advanced industrial nations to discourage them from challenging our leadership or seeking to overturn the established political and economic order. Finally, we must maintain the mechanisms for deterring potential competitors from even aspiring to a larger regional or global role."[9]

Thus, the neoconservative defence officials that produced the Guidance wanted to preserve the unique position of American predominance "to protect US territory, citizens, and military forces from attack, to back up security guarantees to allies", and to "preclude any hostile power from dominating a region critical to our interests", and they argued that the USA had to:

- Pursue the 'military-technological revolution' to preserve its superiority in the latest weapons systems (e.g. smart munitions);
- Sustain the 'forward' presence of US ground, air, and naval forces in strategically important areas, to validate commitments, and to provide a capability to respond to crises affecting significant interests, such as freedom of the seas and access to markets and energy supplies;
- Preserve a smaller but diverse 'mix' of survivable nuclear forces to support a global role, validate security guarantees, and deter Russian nuclear forces;
- Field a missile defence system as a shield against accidental missile launches or limited missile strikes by 'international outlaws';
- Maintain a capability to reconstitute military forces in the event that a regional hegemon threatens to become a global threat;
- Find ways to integrate the 'new democracies' of the former Soviet bloc into the US-led system;
- Work with allies in NATO Europe and elsewhere but be ready to act unilaterally or with only a few other nations when multilateral and cooperative action proves too 'sluggish' to protect vital interests.[10]

This draft guidance reflects the 'mindset' of strategists during the Cold War era reflecting a Hobbesian or

8 IPS (Washington, D.C.): "1992 Draft Defense Planning Guidance", at: <http://www.rightweb.irc-online.org/profile/1992_Draft_Defense_Planning_Guidance> [updated 12 March 2008] (16 April 2010).

9 IPS (Washington, D.C.): "1992 Draft Defense Planning Guidance", at: <http://www.rightweb.irc-online.org/profile/1992_Draft_Defense_Planning_Guidance> [updated 12 March 2008] (16 April 2010).

10 For redacted versions of the original draft DPG and supporting documents, see the *National Security Archive*, February 26, 2008: "Declassified Studies from Cheney Pentagon Show Push for US Military Predominance and a Strategy to "Prevent the Reemergence of a New Rival"; at: <http://www.gwu.edu/~nsarchiv/nukevault/ebb245/ index.htm>.

Neohobbesian worldview. It offered a 'rationale' for the policies pursued nine years later by the Administration of George W. Bush, and according to James Mann, the Iraq War "was carried out in pursuit of a larger vision of using America's overwhelming military power to shape the future".[11] An analysis of the threat definitions in this DPG is not possible as the version that was excerpted in the *New York Times* in 7 March 1992 and the version that was declassified in February 2008 differed. But the NSS 1991 prepared by the NSC for President George Bush and the DPG (1992) drafted for the Secretary of Defence Richard Cheney have differed significantly and reflect two different mindsets, of the pragmatic realist and more diplomatic perspective in the White House, the NSC and in the State Department and the Hobbesian worldview of the neoconservatives around Paul Wolfowitz in the US Department of Defense.

During the first Clinton Administration (1993-1997) the perspective of the hawkish neocons was rejected. In the NSS 1994 and NSS 1996, in the NPR 1994 and in the NMS 1995 the term 'threat' was used both for hard and soft security dangers and concerns.

To implement the National Security Strategies of the US presidents and the Quadrennial Defense Reviews as well as the Nuclear Posture Reviews of the US Department of Defense, the Joint Chiefs of Staff have prepared so far three *National Military Strategy* (1995, 1997, 2004) papers and two *National Defense Strategy* (2005, 2008) documents that focus solely on military issues, as do the respective posture papers of the four military services of the US Army, US Navy, US Air Force and of the US National Guard. In addition, the *Quadrennial Homeland Security Review Report* of the Department of Homeland Security (2010) on issues of domestic security as well as the *Diplomatic and Development Reviews* of the Department of State addresses the diplomatic aspects of US national security. These multiple policy reports and declarations all represent additional official 'speech acts' that refer to 'issues of utmost importance' for the well-being and survival of the USA, its territory, people, values and political system that 'require extraordinary measures' to cope with these security dangers, concerns and issues. However, to avoid redundancy and due to space limitations these many additional official documents have not been included in this review.

12.8 A Concluding Assessment

Based on the above review of four qualifiers – threats, challenges, vulnerabilities and risks – of objective security dangers, subjective concerns and intersubjective security issues, this concluding section will return to the four initial questions and offer tentative answers based on the above review of the use of the four key terms of security threats, challenges, vulnerabilities and risks and to which extent their substantial meanings, contexts and connotations have changed in the public utterances but also to which extent a verbal continuity of legitimating efforts could be observed.

With regard to the first question in all documents the US concept of national security has widened with regard to the four qualifiers of *threats*, *challenges*, *vulnerabilities* and *risks* from the narrow political and military dimension of the Cold War, to include the economic and environmental and only marginally also the societal dimension. However, the key referent object has remained the 'nation state' of the USA as well as the other components of US national sovereignty (territory, people, system of rule) and in none of these documents the term or concept of human security was ever mentioned. However, from a US national security perspective many references to global, international and regional security problems were included. Among the sectoral security concepts only energy, health and food security problems were repeatedly discussed while the policy problems of water and soil security were widely ignored.

Environmental security issues were extensively referred to in the NSS 1997 by the Clinton Administration and the nexus between climate change and security was addressed in NSS 2010 of May 2010 and in the QDR document of 1 February 2010 by the Administration of Barack H. Obama. Obviously in both Administrations academic and policy debates were taken up by the NSC and by the DoD while the neoconservative mindset of the policy-makers, advisers and officials of the Administration of George W. Bush ignored these debates (Matthew/McDonald 2009).

While after the end of the Cold War the scope of national security dangers, concerns and issues had significantly widened during the Administrations of George Bush, William J. Clinton and Barack H. Obama, as was documented above with many cita-

11 James Mann: "The True Rationale: It's A Decade Old", in: *The Washington Post*, 7 March 2004; reprinted at: <http://www.gwu.edu/~nsarchiv/nukevault/ebb245/wp_true_rationale.pdf>; see also Mann (2004): 208–215. On the impact of the neocons see: Halper and Clarke (2004), Heilbrunn (2008) and Ehrman (1995).

tions, during the Administration of George W. Bush the main focus was reduced to weapons of mass destruction, so-called rogue states and terrorism.

Thus, both the end of the Cold War and the attack on the USA on 11 September 2001 had a major impact on the framing of national security threats, challenges, vulnerabilities and risks, while only during the Clinton and Obama Administrations policy and scientific debates, e.g. on environmental security and climate change were reflected at least in three of these official 'speech acts' of NSS 1997, NSS 2010 and QDR 2010.

As was reviewed above (12.2) there was no single dominant worldview of the strategists, policy analysts and academic security and foreign policy specialists but a combination of Neokantian and Neohobbesian perspectives, partly influenced by both Wilsonian goals of spreading democracy, and partly stimulated by contemporary conservative philosophers, such as Leo Strauss who had influenced many neoconservative thinkers and whose views had some impact on the mindset of key officials in the Pentagon and NSC during the time of President George W. Bush. As the above official pronouncements of US national strategy goals and means are the outcome of a complex bureaucratic process the result has not been conceptual clarity but rather a reflection of many different political and institutional perspectives and interests.

13 Changes in the Perception of Military Threats, Challenges, Vulnerabilities and Risks in Russia (1991-2009)

Alexander Sergunin

13.1 Introduction

To understand the nature and orientation of Russia's foreign policy it is very important to examine how this state identifies challenges to its security. This is also helpful for explaining how the national security discourse and ideas developed by various foreign policy schools are translated into concrete political initiatives and implemented by practitioners.

In defining its national security doctrine (including threat perceptions) in the 1990's, Russian policy makers and analysts faced numerous problems. One of them was the lack of a point of departure because the old doctrine did not exist (at least in a formal sense). What has been called the Soviet national security doctrine, in reality, was a mixture of ideological dogma and real political considerations, a mixture which had usually been camouflaged by peaceful rhetoric (Kremenyuk 1994: 88). The very notion of 'national interests' or 'national security' was rejected because of the dominance of cosmopolitan ideas. At the same time, the concept of security was interpreted in purely military terms. Other (the so-called 'soft') aspects of security (such as economic, societal, environmental, information and other dimensions) were nearly completely ignored. For the above reasons, the Russian post-Communist theorists and practitioners had to start from scratch.

Drafting of the security concept began in the late Soviet period, but its completion foundered both on rapid changes in the international environment and on the political upheavals - and the related political infighting between competing interest groups - that have been a regular feature of the Russian political scene. The long failure by the country's political elite to reach a consensus on the security concept complicated efforts to draft a series of other documents, including Russia's military and foreign policy doctrines, that in principle needed to follow from the concept.

This chapter examines how Russian military threat perceptions evolved over the last two decades and what factors affected this process. Since elsewhere in this volume some issues of the 'soft' security problematique have been discussed this chapter will examine primarily traditional 'hard' or military aspects of Russian threat perceptions that still play a significant role in Russian strategic thinking. The analysis below focuses primarily on the official Russian documents but informal discussions among Russian strategic experts and academics are also taken into consideration.

The evolution of the Russian post-Soviet military or national security doctrines and strategies evolved in several phases.

- The *first*, formative, period took place in 1991–1993 when the new Russian politico-military elites tried to apprehend new domestic and international realities and formulate the country's national interests and relevant strategies. First national security-related documents were adopted.
- The *second period* (1994–1999) was characterized by attempts to define more precisely Russia's threat perceptions and national security interests (on the one hand) and develop a more coherent and integrative national security strategy (on the other). Particularly, a national security doctrine that integrated previous similar documents was adopted in 1997.
- The *third period* (2000–2006) was related to Russia's efforts to reassess its national security strategy because of the second Chechen war, NATO military intervention in Kosovo, NATO's eastward enlargement and wars in Afghanistan and Iraq. A new set of military and national security doctrines was adopted in 2000 and the military reform that aimed at radical restructuring of the Russian armed forces was speeded up.
- The *fourth period* that started in 2007 and continues so far is famous by Russia's more assertive for-

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eign and security policies both in the 'near' and 'far' abroad, Moscow's growing anti-NATO and especially anti-American sentiments and attempts to restore its former military strength (albeit for different purposes and on a different basis).

13.2 Early Concepts

Immediately after the collapse of the Soviet Union the Yeltsin government surprisingly found itself as the only relevant military successor of the USSR. For the period of several months the Russian leadership simply did not have a coherent and clear vision of its future security strategy. The new Russian government was hesitating between the desire to keep a unified control over the military structures of the *Commonwealth of Independent States* (CIS), especially of its nuclear forces that were based not only in Russia but also in Belarus, Ukraine and Kazakhstan, and plans to create national armed forces.[1]

Initially, the new Russian leadership pushed the idea of creating collective armed forces of the CIS with a command centre in Moscow (without national armies). However, this idea very soon failed because for various reasons (civil or inter-state wars, nationalistic/anti-Russian sentiments among the local elites, etc) CIS member states started to form their national armies. By spring 1992 President Yeltsin had to abandon the idea of keeping a unified CIS military structure and decided to create independent Russian armed forces and develop Russia's national security strategy.

13.2.1 Russia's Law on Security of 1992

On 5 March 1992 President Boris Yeltsin signed "*The Law on Security of the Russian Federation*" which the Supreme Soviet (the then Russian Parliament) had initiated. The Law established some legal and institutional frameworks for Russia's security policy. It was a rather interesting document from both the theoretical and practical points of view. First of all, it defined the very notion of security: "Security is freedom from internal and external threats to vital interests of the individual, society and state" (Yeltsin 1992: 5).[2] In line with the foreign political thought the authors of the document singled out not only state and military security but also economic, social, information, and ecological aspects of security. Contrary to the Soviet legislation, which had focused on state or party interests, the above document declared priority of interests of the individual and society. It also established a national security system of the newly born Russian Federation. Along with already existing bodies such as the Ministry of Foreign Affairs, Ministry of Interior, Ministry of Security, Foreign Intelligence Service, Ministry of Environment, the Law recommended to set up the Security Council, the Ministry of Defence, and several committees including the Border Guards Committee and so on.

However, this document was too abstract and vague to design a coherent national security strategy. It mainly focused on domestic issues and lacked proper legal and conceptual grounds for a number of important areas such as foreign policy and military reform. A special section on threat perceptions was lacking as well. Moreover, in adopting this legislation the leadership of the Supreme Soviet was eager to use it as a tool in the power struggle with the President. With the adoption of the new Russian Constitution in December 1993, which has designed a new system of government, some provisions of the Law became outdated.

13.2.2 Russia's Draft Military Doctrine of 1992

Following the recommendations of the *Law on Security* the armed forces of the Russian Federation have been formed in May 1992. In the same month, the General Staff published its draft of the military doctrine in its journal *Voennaya Mysl* (Military Thought). According to some accounts, some civilian experts

1 On this period of Russia's strategic thinking see Blackwill and Karaganov (1994); Dawisha and Parrott (1994); Dunlop (1993); Razuvayev (1993); Sergunin (1998a: 146–148); Shearman (1995).

2 From the linguistic point of view the Russian word 'security' ('*bezopasnost*') literally means 'the lack of danger', i.e. defines this concept in a negative rather than in positive way. That's why some experts see this word as misleading because it does not explain what will be next when the danger is prevented. Some experts suggest the concepts of 'stability' or 'sustainable development' to provide the notion of security with a more positive content (see, e.g. Makarychev 2001: 15–24). Along with the concept of security, Russian specialists use terms such as 'threat' ('*ugroza*': a clear danger to security of an individual or the state or combination of factors that pose such a danger); 'challenge' ('*vyzov*': less threatening factor than danger but it requires preparedness and some kind of response); 'risk' (the same word in Russian: potential threats and challenges). On the Russian security-related terminology see: Sergunin (2003: 65–75).

(including Andrei Kokoshin, the then First Deputy Defence Minister) also took part in its drafting (Kremenyuk 1994: 91).

In the document, the sources of threat were described as purely external, whereas the possibility of internal threats had been ignored (with the exception of reference to potential conflicts between the members (regions) of the Russian Federation). The draft document underlined that Russia does not regard any state as its enemy. However, while not actually naming the USA and NATO as the enemy, there can be no doubt that its authors meant them when it referred to "some states and coalitions" which wished to dominate the world or particular regions and which continued to regard force as a means of resolving disputes. It was also declared that the violations of rights of Russian citizens and of the population in the ex-Soviet republics might be a major source of conflicts. The text described in detail how Russia intended to cope with such a threat. This particular section of the document evoked most negative comments of foreign analysts who immediately accused Russia of imperialist intentions (Sakwa 1993: 317–318; Tsypkin 1994: 197–198; Ra'anan 1995: 20).

In line with the Soviet tradition it was planned to design the armed forces mainly for high intensity conflict. It made a particular emphasis on the use of nuclear weapons as a political deterrent to nuclear or conventional aggression. Remarkably, the famous Brezhnev's 'no-first-use principle' has been reiterated in the draft. At the same time, the paper stated that conventional attacks on nuclear systems, early warning or C^3 (*command, control, communications*) facilities, or on nuclear or other 'dangerous' installations, could provoke a nuclear retaliation. The draft had also been based on the assumption that the CIS would soon become an integrated and cohesive military mechanism, which could be successfully used to meet security challenges. The document emphasized the need for priority to be given to the military's needs in government spending. It also called for the preservation of the defence industry and on the maintenance of a mass mobilization capability (Ministry of Defence of the Russian Federation 1992: 4–7).[3]

There were also some alternative drafts that stemmed from the officer corps and 'national patriotic forces'. For example, in April 1992 Major-General Aleksandr Vladimirov personally presented to Yeltsin a concept of his own. The document had been based on the principle of reasonable defence sufficiency and called for integration of the CIS military structures into a global security system under the auspices of the United Nations (Vladimirov 1992). Contrary to this liberal doctrine, the Russian National Convention, the leading organization of the 'patriotic movement' at that time, proposed a series of documents, which insisted on the preservation and further development of the defence industrial base and an active arms export policy, which in turn could strengthen Russia's military security and international position (Modestov 1992).

These suggestions, however, did not affect the mainstream of Russian security thinking. According to many experts, at this stage the Russian security discourse had been dominated by traditionalists from the military agencies whose views were rather close to the General Staff's draft (Malcolm/Pravda/Allison/Light 1996: 254–256).

13.2.3 Russia's Foreign Policy Concept of 1993

In early 1993, the Foreign Ministry presented a foreign policy concept of the Russian Federation that was consequently approved by the Supreme Soviet (the then Russian Parliament) and President Boris Yeltsin (Ministry of Foreign Affairs of the Russian Federation 1993: 3–23). For the first time post-Soviet Russia has adopted a systemic foreign policy doctrine. Despite numerous inconsistencies and shortcomings this document clearly described Russian national interests and foreign policy priorities. Its basic premise was that Russia's foreign policy must meet fundamental national interests, primarily the need to preserve the sovereignty, independence and territorial integrity of the country, strengthen its security in every respect, revive Russia as a free, democratic country, provide favourable conditions for the formation of an efficient market economy in keeping with the status of a great power and for the entry of the Russian Federation into the world community.

The document suggested greater emphasis on the economic aspect of foreign policy to mobilize international support for Russian economic reforms, integrate the national economy into world economic relations in competitive forms, ease the burden of military spending, solve the problem of foreign debt, support Russian business, carry out conversion projects. The text called for giving priority to the interests of the individual, to human and minority rights.

3 See also discussions on this draft published in *Voennaya Mysl*, Special Issue, July 1992 (in Russian).

According to the concept, Russia was to exercise its responsibility as a great power to maintain global and regional stability, conflict prevention, and promotion of the democratic principles such as rule of law, human and minority rights protection. The document emphasized Russia's commitment to political and diplomatic methods and negotiation rather than to the use of military force, the admissibility of the limited use of force in strict accordance with international law to ensure national and international security and stability.

The aims of the military strategy had been depicted as follows: a) transformation of the international relations system from a bipolar, bloc-based model to a co-operative one; facilitating the arms control and disarmament process; b) bringing the military potential into line with a new pattern of challenges and threats and in accordance with the principle of reasonable defence sufficiency; c) a military reform should be conducted on the basis of a national security concept and it should take into consideration the economic and social potential of the country.

The concept did not see any serious threats to Russia's security. Even the Baltic states that discriminated Russian-speaking minorities and pushed the Russian Federation to withdraw its armed forces from their territory were seen as promising international partners. The only exception was the Third World that had initially been characterized as a main source of threats to regional and global security. However, in the document's sections dealing with regional issues developing countries were depicted as an important resource for Russia's successful global strategy.

In general, the document can be characterized as liberal and pro-Western in its spirit. This did not come as a surprise because the concept was prepared by the team of the so-called 'Atlanticists' – a group of Russian liberal-minded pro-Western politicians and experts (led by the then Foreign Minister Andrei Kozyrev).

13.2.4 Skokov's Foreign Policy Concept (1993)

In April 1993, a group of conservative politicians and experts who were discontent with Kozyrev's doctrine have tried to develop a foreign policy concept of their own. This document was drafted by an anonymous collective of authors called "groups of experts from the Defence Ministry, the Foreign Intelligence Service, the Ministry of Foreign Economic Relations, the Ministry of Foreign Affairs, as well as the staffers of the Directorate for Strategic Security and other structures of the Security Council" (Orlov 1993: 9). Some accounts suggest that the Council's Inter-Agency Foreign Policy Commission organized the final stages of discussion and preparation of this concept (*Diplomaticheskiy Vestnik* 1993, 7–8: 67–68; Malcolm/Pravda/Allison/Light 1996: 114). It has been classified as 'not for press' and never been published, albeit Vladislav Chernov, Deputy Head of the Security Council's Directorate on Strategic Security, quoted extensively from the document in his article in *Nezavisimaya Gazeta* published on 29 April 1993.

The new document, entitled "Guidelines of the Foreign Policy Concept of the Russian Federation", had been prepared under supervision of Yuri Skokov, the Security Council's Secretary. The paper both listed external threats to Russian security and defined Russia's military-related national interests. From the theoretical point of view, it represented a mixture of various approaches. Contrary to some interpretations, it was not extreme, and with some adaptation, it could suit the radical democrats, the national patriots, political scientists and officials from the foreign policy and national security agencies. However, in some respects it was closer to the hard-liners' position than to the liberal one. It used rather strong language regarding the Russian minorities in the Baltic states, the nuclear ambitions of Ukraine and admitted rivalry with the United States (Orlov 1993: 9). The document claimed that Russia should be responsible not only for the creation of a new world order but, in particular, for building a new security system in the post-Soviet space and assume the role of a guarantor of Eurasian stability.

The authors of the document underlined that in contrast with the previous practice, the document had been drafted in co-operation with all interested foreign policy agencies. The new concept had been approved by the heads of all so-called 'power structures' (including the then Defence Minister Pavel Grachev, Security Minister Vadim Barannikov, and Director of the Foreign Intelligence Service Yevgeny Primakov).

The new concept, however, had met a negative reaction from Kozyrev and some foreign countries. Kozyrev was discontent with the document's recommendations on Russian policies towards the CIS and the United States (Orlov 1993: 9). The Baltic states expressed their concerns as to Russia's intention to protect its citizens in the 'near abroad'. In a hard-hitting speech to an audience in Stuttgart, Germany, on 3 May 1993, the then Estonian President Lennart Meri termed the stance a 'Monroe doctrine'. "The change in Russia's foreign policy places the democratic world

before a choice, which has a great deal in common with the fateful pre-Munich days", he said. "I recall, for example, the use of armed forces beyond internationally recognized boundaries under the pretext of 'protecting' the human rights of the Sudeten Germans."[4]

In spite of the adoption of his version of the concept Skokov failed to retain his influence on the President. In May 1993, he was forced to resign due to his questionable loyalty to the President. Kozyrev who for a few months remained outside the 'ring of power' regained his former influential position (Malcolm/Pravda/Allison/Light 1996: 111, 135–136; Baev 1996: 45).

13.3 The Russian Military Doctrine of 1993

By autumn 1993, Yeltsin decided to proceed with the adoption of a new military doctrine. There were several reasons why a military doctrine had to be declared. The military badly needed guidance by the state in organizing, equipping and training the new armed forces. Moreover, the emerging civil society needed such a document for organizing democratic control on and accountability of the armed forces. Russia's international partners also wished to know about Moscow's intentions in the military sphere. Finally, the new doctrine was one of the rewards the military had received from the President for their loyalty in the October 1993 coup de état. The new military doctrine was approved by the Russian Security Council on 2 November 1993 and published. According to the document,

> The Basic Provisions of the Military Doctrine of the Russian Federation are part and parcel of the security concept of the Russian Federation and represent a document covering Russia's transitional period - the period of the establishment of statehood, implementation of democratic reform and formation of a new system of international relations. They represent a system of views officially accepted by the state on the prevention of wars and armed conflicts, on the development of the armed forces, on the country's preparations to defend itself, on the organization of actions to ward off threats to the military security of the state, and on the use of the armed forces and other troops of the Russian Federation to defend the vital interests of Russia (Yeltsin 1994: 6).

In contrast with the earlier versions of the military doctrine and foreign policy concept of 1993, this document clearly defined both external and internal sources of military threats. The doctrine singled out ten major external challenges to Russia's military security:

1. territorial claims of other states on the Russian Federation and its allies;
2. existing and potential seats of local wars and armed conflicts, above all in the direct proximity of the Russian borders (there was a special section on the attitude of Russia to armed conflicts);
3. the potential use (including the unsanctioned use) of nuclear and other mass destruction weapons owned by some states;
4. the proliferation of nuclear and other mass destruction weapons, their delivery vehicles and latest military technologies, coupled with the attempts of certain states, organizations and terrorist groups to achieve their military and political ambitions;
5. the potential undermining of strategic stability by violations of international agreements in the sphere of arms control and reductions and the qualitative and quantitative arms build-up by other countries;
6. attempts to interfere in the internal affairs of and destabilize the internal political situation in Russia;
7. the suppression of the rights, freedoms and legitimate interests of citizens of the Russian Federation in foreign states;
8. attacks on military facilities of the Russian armed forces situated on the territory of foreign states;
9. expansion of military blocs and alliances to the detriment of the interests of Russia's military security; and
10. international terrorism.

In a separate section, the document highlighted five crucial factors facilitating the escalation of a military danger into a direct military threat to the Russian Federation:

1. the build-up of forces on the Russian borders to limits which upset the existing balance of forces;
2. attacks on the facilities and structures on the Russian border and the borders of its allies, border conflicts and armed provocations;
3. the training of armed formations and groups on the territory of other states for dispatch to the territory of the Russian Federation and its allies;
4. the actions of other countries which hinder the operation of the logistics system of the Russian

4 See in: *The Baltic Independent*, 14–20 May 1993: 3.

strategic nuclear forces and of state and military control of, above all, their space components; and
5. the deployment of foreign troops on the territory of states adjacent to the Russian Federation unless this is done to restore or maintain peace, in accordance with the decision of the UN Security Council or a regional agency of collective security, by agreement with Russia.

Along with the external threats the new doctrine identified seven major internal threats against which the armed forces and other services may be used:

1. the illegal activity of nationalist, secessionist and other organizations, designed to destabilize the internal situation in Russia and violate its territorial integrity and carried out with the use of armed force;
2. attempts to overthrow the constitutional regime and disorganize the operation of bodies of state power and administration;
3. attacks on the facilities of nuclear engineering, chemical and biological industries, and other potentially dangerous facilities;
4. the creation of illegal armed formations;
5. the growth of organized crime and smuggling on a scale where they threaten the security of citizens and society;
6. attacks on arsenals, arms depots, enterprises producing weapons, military and specialized equipment, and organizations, establishments and structures which have weapons, with the aim of capturing them; and
7. illegal proliferation of weapons, munitions, explosives and other means used for subversion and terrorist acts on the territory of the Russian Federation, as well as illegal drug trafficking.

The section on threat perceptions had many important implications. Along with the systematic description of these threats it demonstrated rather substantial changes in Russia's strategic thinking. In contrast with the General Staff draft of 1992 the new doctrine did not identify the USA and NATO as a primary source of military danger. Rather, they were warned not to provoke a new confrontation by violating the strategic balance, military build-up in the regions adjacent to Russia, NATO expansion and so on. This implied that Russia also would refrain from any destabilizing actions.

Instead of the traditional threat from the West, other challenges such as armed conflicts, subversive activities and territorial disputes in the post-Soviet space were seen to be a major danger. This was understandable because by the moment of the adoption of the above document all but two FSU (former Soviet Union) inter-state borders were disputed and 164 different territorial-ethnic disputes were identified in this region (Dick 1994: 3). The doctrine, however, did not specify what kinds of territorial claims and local conflicts that really threatened Russia's security and which ones might be potentially dangerous. For example, the Russian-Japanese dispute on the Kuriles originates from the World War II and Russian-Norwegian disputes on economic zones and maritime borders in the Barents and North Seas date back to the 1920's. However, these conflicts do not create an immediate military threat to the Russian Federation. Moreover, most of the countries being in dispute with Russia are simply unable to pose a military threat because they lack a sufficient potential. On the contrary, these countries fear the potential use of military force by Russia pursuing its interests.

The proliferation of weapons of mass destruction and international terrorism, which have been on the periphery of the Russian strategic priorities in the previous doctrines and drafts, were given a rather important status in the new concept. Above all, this brought Russia closer to the major Western countries that also refer to these phenomena as the most dangerous international developments.

The identification of violation of the rights of Russian citizens in foreign states and attacks on Russian military facilities in foreign countries as potential sources of military threat is a rather common stance not only for the Russian but also for other great powers' security doctrines. However, from a legal point of view it was not clear who could be considered as Russian citizens in the FSU countries and what was the status of the Russian military bases in these republics for the time being. The Russian foreign policy concept of 1993 acknowledged that Russia was only in the very beginning of negotiating and concluding corresponding agreements with the former Soviet republics. In fact, the lack of a legal framework for the relations with the FSU countries gave a certain number of excuses for interventions in the 'near abroad' (Ra'anan 1995: 21–22).

The most significant change in the Russian threat perceptions occurred with regard to internal threats. The Law on Security of 1992 only mentioned that some of these might exist. The General Staff draft of the military doctrine (1992) simply ignored the very possibility of internal threats to Russia's security and therefore did not foresee any internal mission for the armed forces. This view was a result of the military

elite's belief that the armed forces should protect the country only from external enemies, not internal ones. The latter should be the business of the Ministry of Interior and of the security services. However, accepting reality, the military doctrine of 1993 acknowledged that there were many dangers stemming from domestic developments. This inevitably led to a commitment of the military to an internal role. As the failed coup of August 1991 and the attack on the White House in October 1993 demonstrated, the armed forces have already been involved in domestic power struggles.

The new reading of military threats has led to the new approaches to military strategy, as well as to an appropriate organization and training of the armed forces.

Since the main threat to stability and peace in the post-Cold War period comes from local wars and armed conflicts, the document called for a re-targeting of the Russian armed forces from large-scale war to low intensity conflicts. The main aim of the use of the armed forces and other services in armed conflicts and local wars, the doctrine said, was "to localize the seat of tensions and stop hostilities at the earliest possible stage, in the interests of creating conditions for a peaceful settlement of the conflict on conditions suiting the interests of the Russian Federation" (Yeltsin 1994: 9). Military operation in armed conflicts and local wars should be carried out by peacetime groups of forces (those which organized for peace-time conditions, i.e. have incomplete personnel and arsenals; in the war-time period they are reorganized to be a full-fledged military units), deployed in the conflict area. In case of need, they might be strengthened by a partial deployment and redeployment of forces from other regions.

According to the document, the priority was to develop the armed forces and other services designed to deter aggression, as well as mobile elements, which can be quickly delivered and deployed in the required area and carry out mobile operations in any region where the security of Russia might be threatened.

When faced with conventional war, the armed forces must act decisively, using both defensive and offensive methods to destroy the enemy. The armed forces should

a.) repel the attacks of the enemy in the air, on land and in the seas;
b.) defeat the enemy and create conditions for ending hostilities at the earliest possible stage and signing a peace treaty on conditions suiting Russia; and
c.) carry out military operations together with the armed forces of allied states, in accordance with international obligations of the Russian Federation.

A number of tasks have been set up by the doctrine for other services:

a.) to ensure a stable operation of intelligence, control and communication systems and to seize and keep the initiative in different spheres;
b.) to isolate the intruding groups of forces of the aggressor;
c.) to flexibly combine firepower and manoeuvre;
d.) to ensure close co-operation of the arms and services, including special services of the armed forces and to co-ordinate the plans of using the armed forces and other services in armed conflicts and wars, and in performing joint tasks;
e.) to hit the facilities of the enemy's troop and weapon control systems.

This combination of defensive and offensive methods was an important distinction from Gorbachev's military concept that had been oriented only at defensive operations.

Some military experts were concerned with the fact that the doctrine said nothing about the country's role in regional security systems; this absence could be interpreted as an intention to ensure Russia's security by unilateral, purely national efforts (Davydov 1996: 267). Despite the focus on local conflicts the military doctrine of 1993, however, said nothing about the need for a different force structuring, equipping and training for low intensity operations. Besides, some military experts noted, the emphasis on mobile forces could be seen as a preparation for an intervention in the 'near abroad' (Dick 1994: 4; Grigoriev 1995: 6).

In the document, the requirement to deploy troops outside the Russian territory is specifically stated. This resulted both from threat perceptions and Russia's international obligations (peacekeeping operations, military bases, joint groups of forces, etc.). It was underlined that irrespective of the terms of deployment, Russian military formations deployed on the territory of other states remain a part of the armed forces and should act in accordance with the procedure established for the Russian armed forces on the basis of bilateral and multilateral treaties and agreements. However, some specialists believed that despite the reference to international agreements and commitments the possibility was left open that such

agreements could be imposed by Russia on weaker states (Davydov 1996: 267).

The doctrine did not exclude the possibility of large-scale war. It was mentioned in the document that under certain conditions, armed conflicts and local wars can develop into an all-out war. Factors which increase the danger of the escalation of conventional war into a nuclear war can be deliberate actions of the aggressor designed to destroy or undermine the operation of strategic nuclear forces, early warning systems, nuclear and chemical facilities. The document also included a provision according to which any, including limited, use of nuclear weapons even by one of the sides can provoke a mass use of nuclear weapons, with catastrophic consequences.

The doctrine clarified Russia's nuclear policy, which had not been updated since the Gorbachev period. It has been declared that the aim of the Russian Federation's nuclear policy is to avert the threat of a nuclear war by deterring aggression against Russia and its allies. Therefore, nuclear weapons were no longer regarded by the Russian strategic planners primarily as war fighting means. Instead, their main use has been seen as a political deterrent to nuclear or conventional aggression. This marked the change in Russian strategic thinking to a Western-like concept of deterrence, compensating for conventional weakness.

The most distinct departure of the new Russian nuclear doctrine from the Soviet one was Russia's abandonment of the principle of no-first-use (introduced by Leoinid Brezhnev in 1982). At the same time, the document promised that Russia would never use its nuclear weapons against any state party to the Non-Proliferation Treaty (1968), which does not possess nuclear weapons, unless:

> (a) such a state, which is connected by an alliance agreement with a nuclear state attacks the Russian Federation, its territory, Armed Forces and other services or its allies; (b) such a state collaborates with a nuclear power in carrying out, or supporting, an invasion or an armed aggression against the Russian Federation, its territory, armed forces and other services or its allies (Yeltsin 1994: 6).

In one way or another all NATO members, China and Japan as nuclear states or the allies of nuclear powers, the Baltic states and Central and Eastern European countries should they join NATO or WEU (Western European Union) come into these categories.

The reaction of Russia's international partners to the repeal of the no-first-use principle was rather contradictory (Davydov 1996: 267). On the one hand, they considered this change to a Western concept of deterrence as evidence of a greater inclination towards openness and frankness in military matters on Russia's part: few in the West took the old Soviet doctrine of 'no-first-use' seriously. They understood that Russia's new nuclear doctrine reflected Moscow's intention to rely mainly upon nuclear deterrence to compensate for its conventional weakness and keep its great power status. On the other hand, they perceived this change as a clear message to them, especially to the Baltic states and the Visegrad countries (Czech Republic, Hungary, Poland and Slovakia) that they would come into the categories of exceptions if they joined NATO or the WEU or supported any Western intervention in Russia or the 'near abroad', for example, by giving rights of passage or providing bases. This had also been a pressure on Ukraine, which delayed the transfer of the nuclear weapons deployed on its territory during Soviet times to Russia (Dick 1994: 2; Lockwood 1994: 648).

Along with these innovations the document confirmed Russia's long-standing interest in (a) a comprehensive nuclear weapon test ban; (b) reduction of nuclear forces to a minimum which would guarantee against a large-scale war and maintain strategic stability, and eventual elimination of nuclear weapons; and (c) strengthening of the non-proliferation regime and making it universal.

Since internal armed conflicts have also been regarded as a considerable threat to the vital interests of the country, the document described the aims of using armed forces and troops in this case as to localize and blockade the conflict zone, suppress armed clashes and disengage the warring sides, take measures to disarm and eliminate illegal armed forces and confiscate weapons from the population in the conflict zone, carry out operational and investigative operations in order to remove the threat to internal security, normalize the situation as soon as possible, restore law and order, ensure social security, render the requisite assistance to the population and create conditions for a political settlement of conflicts. These functions had to be fulfilled mainly by the Interior Troops. However, as the document prescribed, separate elements of the armed forces and other services (the border guards and counter-intelligence) might be used to help the law-enforcement bodies and Interior Ministry troops localize and blockade the conflict zone, preclude armed clashes and disengage the warring sides, and protect strategic facilities. Having in mind antipathy of the military to internal missions General Manilov of the Security Council explained that the armed forces can only be used

> when nationalist or separatist groups are active, using armed violence and posing a threat to Russia and its integrity, or when attempts are made to use force to overthrow the constitutional system, or when nuclear facilities are attacked, and also when illegal armed formations are being created (Dick 1994: 4).

So, the legal foundations for the use of the armed forces in internal conflicts such as Chechnya had been laid by the new doctrine (Davydov 1996: 267). Given that fact that the Interior Troops had been manned and equipped insufficiently, the use of the armed forces in internal operations was inevitable. And the two subsequent Chechen wars have confirmed this suggestion.

13.4 The National Security Concept of the Russian Federation (1997)

On 17 December 1997 President Yeltsin signed the decree No. 1300 thus approving a new Russian national security concept. It outlined Russian national interests, the major threats to the country's security and established a set of domestic and foreign policy goals aimed at strengthening Russia's statehood and geopolitical position. As it was emphasized in the document, the concept was

> a political document reflecting the officially accepted views of the goals and state strategy in ensuring the security of the individual, society and the state against external and internal threats of a political, economic, social, military, technogenic, ecological, information and other character with account of available resources and opportunities (Yeltsin 1997: 4).

Similar to the Law on Security (1992) and the Duma draft of the Law on National Security (1995), the new doctrine departed from the broad understanding of security and focused not only on the interests of the state but also on the interests of the individual and society. According to one of the authors of the concept, Deputy Secretary of the Security Council Leonid Mayorov, this document, which had been developed in the course of several years, comprehensively reflected, for the first time in Russian history, the system of views on the security of the individual, society and the state (Chugayev 1997).

In fact, the concept was a sort of guideline, a theoretical base, which could be used to develop such requisite programme documents as the military doctrine and the economic security doctrine. This was also the base for military reform. At least it made it possible to understand better what armed forces Russia must have and which conflicts they should be prepared for. It was specified in the preamble that "The Concept is the basis for the development of concrete programmes and organizational documents related to the national security of the Russian Federation" (Yeltsin 1997: 4).

The paper described the global situation and Russia's place in the world. Similar to the foreign policy concept of 1993, the paper saw the rise of a multipolar world as the most important characteristics of contemporary world dynamics. According to the doctrine, Russia should find its own 'niche' in this complex world structure and even become one of the 'poles'.

Despite the fact that the document mentioned a couple of times, *en passant*, the need for retaining Russia's great power status it did not insist on Russia's global responsibilities and interests (as some previous doctrines did). On the contrary, the paper acknowledged that Russia's capacity to influence the solution of cardinal issues of international life has greatly diminished.

The document singled out both positive and negative factors affecting the country's position in the world system. Interestingly, the paper pointed to the changing nature of world power in the post-Cold War period. "While military force remains a significant factor in international relations, economic, political, scientific-technical, ecological and information factors play a growing role" (Yeltsin, 1997: 4).

The document noted that some prerequisites have been created for the demilitarization of international relations, strengthening the role of law in conflict resolution, and that the danger of a direct aggression against Russia has diminished. There were some prospects of greater integration of Russia into the world economy, including some Western economic and financial institutions. Russia shared common security interests with many states in areas such as nuclear non-proliferation, conflict resolution, combating international terrorism, environmental problems and so on. At this point, the paper arrived at an important conclusion that Russia's national security may be ensured by non-military means.

At the same time, a number of international and especially domestic processes undermined Russia's international positions. The shift of world power from military-strategic parameters to economic, technological and information ones has intensified international competition for natural, financial, technological and information resources as well as for markets. Some states did not accept a multipolar world model. In some regions, traditions of the 'bloc politics' were

still strong and attempts to isolate Russia could be identified (the document refers to NATO's enlargement and to the Asia Pacific). The document said that the Russian domestic environment was not very helpful for developing an active foreign policy. Russia had yet to develop a unifying national idea that would determine not only the view of the world but also transform the society. The country's economic, scientific and demographic potentials (Lutz 2009) were shrinking. The former defence system has been disrupted and the new one had yet to be created.

However, the concept was quite optimistic with regard to the country's prospects. It stated that Russia had all the prerequisites for maintaining and strengthening its position in the world. Russia possessed a sizeable economic and scientific-technical potential as well as natural resources. It occupied a unique strategic position in Eurasia. The country has created a democratic system of government and a mixed economy. The paper also mentioned Russia's century-old history, culture and traditions which could be an important spiritual resource for rebuilding the country.

The new national security concept asserted that Russia faced no immediate danger of large-scale aggression, and that, because the country was beset with a myriad of debilitating domestic problems, the greatest threat to Russia's security was now an internal one. The document said: "An analysis of the threats to the national security of the Russian Federation shows that the main threats at present and in the foreseeable future will not be military, but predominantly internal in character and will focus on the internal political, economic, social, ecological, information and spiritual spheres" (Yeltsin 1997: 4). This was a distinct departure from previous doctrines. Even the military doctrine of 1993 was based on the assumption that the main threat to Russia's security was posed by external factors such as local conflicts or territorial claims.

As some analysts emphasized, no less important was the fact that for the first time it has been substantiated at such a high official level (the President, Security Council, and Parliament) that there was no external military threat to Russia.[5] The concept clearly suggested that today's relatively benign international climate afforded Russia the opportunity to direct resources away from the defence sector and toward the rebuilding of the Russian economy.

> The development of a qualitatively new pattern of relations with the leading world states and the political absence of the threat of a large-scale aggression against Russia, while it preserves its nuclear deterrent, makes it possible to redistribute the resources of the state and society to address priority internal problems (Yeltsin 1997: 4).

In general, it placed this rebuilding effort in the context of continued democratization and marketization.

The document focused in particular on the dangers posed by Russia's *economic* woes, which were described frankly and at length. It was underlined in the paper that "The state of crisis in the economy is the main cause from which threats to national security of the Russian Federation arise" (Yeltsin 1997: 4). The concept highlighted a number of major threats to economic security such as a substantial drop of production and investments; destruction of the scientific-technical potential; disarray in the financial and monetary systems; shrinkage of the federal revenues; growing national debt; Russia's overdependence on export of raw materials and import of equipment, consumer goods and foodstuff; 'brain drain', and uncontrolled flight of capital.

The document also pointed to internal *social, political, ethnic* and *cultural* tensions that threatened to undermine both the viability and the territorial integrity of the Russian state. Among these social polarization, demographic problems (in particular, the reduction of the birth rate, average life expectancy and population), corruption, organized crime, drug-trade, terrorism, virulent nationalism, separatism, deterioration of the health system, ecological catastrophes and disintegration of the 'common spiritual space' were singled out.

Along with the major internal threats to Russia's security, the document identified a number of dangers stemming from the *international* dynamics. The doctrine highlighted the following sources of external threat: territorial claims; attempts of foreign countries to use Russia's domestic problems for weakening its international positions or challenging its territorial integrity; local conflicts and military build-up in the country's vicinity; mass migration from the troubled CIS countries; proliferation of weapons of mass destruction; international terrorism and drug-trafficking and growing activities of foreign intelligence services. These, however, were of less significance than internal threats.

In general, this shift in Russia's threat perceptions could be assessed positively. Looking at the bright side of the document, three main advantages could be distinguished. First, this was a step to a more realistic

5 See the section on: "Russian National Security: the Concept" of "The Fortnight in Reviewî, in: *The Jamestown Foundation Prism,* 4,1 (9 January 1998).

estimation of Russia's domestic and international problems. Second, given Russia's limited resources this doctrine helped in setting a proper system of political priorities. Finally, it almost dismissed xenophobia regarding to Russia's relations with the West and, thus, laid foundations for more intense international co-operation.

From the critical point of view, two minor comments can be made. First, some threats (environmental, information, spiritual, etc.) have just been mentioned but not substantiated. Some of them, however, were described implicitly in the section on the national security strategy. Second, there were some grounds for concern that 'securitization' of Russian domestic politics, i.e., identification of main security threats inside rather than outside the country, under certain circumstances might result in a sort of 'witch-hunt'. To prevent this, some analysts believed, individuals and civil society should serve as a check on the state and should not allow the state to be the sole agency in national security matters (Chugayev 1997; Sergunin 1998b).

Along with explaining Russia's national interests and threat perceptions, the doctrine determined ways and means of the country's security policy. According to the document,

> The *chief purpose* of ensuring national security of the Russian Federation is to create and maintain such an economic, political, international and military-strategic position of the country which would provide favourable conditions for the development of the individual, society and the state and preclude a danger of weakening the role and significance of the Russian Federation as a subject of international law and of undermining the capability of the state to meet its national interests on the international scene (Yeltsin 1997: 4).

The document set up a number of *particular tasks* to ensure national security of the Russian Federation: a) to develop the country's economy and pursue an independent and socially-oriented economic course; b) to further improve the legislation and strengthen law and order and social-political stability of society, Russian statehood, federalism and local self-administration; c) to shape harmonious inter-ethnic relations; d) to ensure Russia's international security by establishing equal partnership with the major states of the world; e) to strengthen state security in the defence and information spheres; f) to ensure the vital activity of the population in a technogenically safe and environmentally clean world.

With regard to Russia's military policy, the national security concept served as a post-facto justification for the down-sizing of Russia's armed forces that has occurred since the Soviet Union's dissolution, and for the continued restructuring envisioned in the Kremlin's still evolving military reform programme. By emphasizing domestic rather than foreign threats to Russia's security, it seemed also to justify the rapid strengthening of the country's internal security forces relative to the regular army during the past ten years, even if defence reform plans aimed to moderate that policy somewhat. In a related fashion, the document described an alleged threat to Russian economic interests posed by foreign competitors, and underscored the importance of the role played by Russia's intelligence services in countering it.

The document also emphasized the overriding importance of Russia's strategic forces to the country's security and again disavowed the no-first-use principle. With regard to conventional weapons, the concept proclaimed a policy of 'realistic deterrence' in discarding officially any effort to maintain parity with the armed forces of the world's leading states. The concept highlighted the importance of Russian participation in international peacekeeping missions as a means of maintaining Russia's influence abroad.

The document declared that in preventing war and armed conflicts Russia preferred political, economic and other non-military means. However, as far as the "non-use of force" (Art. 2,7 of the UN Charter)[6] has not yet been fully implemented as a norm of international relations, the national interests of the Russian Federation required sufficient military might for its defence. The document said that Russia might use military force for ensuring its national security, proceeding from the following principles:

- Russia reserved the right to use all the forces and systems at its disposal, including nuclear weapons, if the unleashing of armed aggression results in a threat to the actual existence of the Russian Federation as an independent sovereign state.
- The armed forces of the Russian Federation should be used resolutely, consistently up to the point when conditions for making peace which are favourable to the Russian Federation have been created.
- The armed forces should be used on a legal basis and only when all other non-military possibilities of settling a crisis situation have been exhausted or proved to be ineffective.

6 This is referred to in Art. 2,7 of the UN Charter of June 1945 and are binding on all states although this principle has been largely ignored.

- The use of the armed forces against peaceful civilians or for attaining domestic political aims shall not be permitted. However, it was permitted to use individual units of the armed forces for joint operation with other services against illegal armed formations that present a threat to the national interests of Russia.
- The participation of the Russian armed forces in wars and armed conflicts of different intensity and scope shall be aimed at accomplishing the priority military-political and military-strategic tasks meeting Russia's national interests and its allied obligations.

The doctrine underlined that Russia had no intention of entering into confrontation with any state or alliance of states, nor did it pursue hegemonic or expansionist objectives. Russia will maintain relations of partnership with all interested countries of the world community.

The concept reiterated Russia's opposition to NATO enlargement and it called for multilateral collective security organizations such as the UN and the OSCE to play a greater role in ensuring international security. The paper called on the international community to create a new Euro-Atlantic security system on the basis of the OSCE as well as to strengthen (with Russian participation) multilateralism in the Asia Pacific.

The national security concept formally stated what has long been a cornerstone of Russian declared foreign policy: i.e., that the rebuilding of Russia is best served not by a passive diplomatic posture, but rather by an aggressive and multi-faceted diplomacy aimed at winning membership, or increasing Russia's influence, in various international organizations, while simultaneously striving to make Russia an important global player.

13.5 The Putin and Medvedev Era

During the late Yeltsin and early Putin period four major factors have changed Russian threat perceptions – its financial collapse of 1998, NATO's military intervention in Kosovo (1999), NATO's new strategic doctrine (1999) and the second Chechen war that also started in 1999.

Russia's financial crisis of August 1998 undermined to some extent the popularity of liberal concepts (including a positive attitude to globalization) in the country by exposing Russia's vulnerability to the international economy and financial markets. But some specialists believe that the fundamental sources of this crisis were internal policy failures and economic weakness, but it was triggered by the vulnerability of the ruble to speculative international financial markets (Wallander 2000: 2). Moreover, because Russia's economy began to recover in the aftermath of the decision to devalue the ruble and implement limited debt defaults, the crisis reinforced statist arguments that a less Western-dependent, more state-directed policy of economic reform could be Russia's path to stability and eventual prosperity. One of the lessons of the 1998 financial meltdown was that globalization may be a source of threat to Russia's economic security.

As for the Kosovo war of 1999, Russia has again become suspicious about NATO's real character and its future plans. In the Russian view, in this case NATO – contrary to previous declarations on its intentions to be transformed from a military-political to a political-military organization – demonstrated that this alliance still preferred to be a 'hard' security organization and continued to reproduce a Cold War-type logic and policies. Moreover, NATO demonstrated its ambitions to be a major (if not a sole) security provider in Europe trying to sideline other regional organizations, such as OSCE, EU, the Council of Europe, the Council of the Baltic Sea States, etc.

In addition, the Kosovo war coincided with the adoption of a new NATO strategic doctrine that turned out much more expansionist than the previous one (Wallander 1999: 4). In particular, the new doctrine envisaged further enlargements of NATO towards the east, a redeployment of its military infrastructure closer to Russian borders and even military operations beyond its traditional 'zone of responsibility' (in fact, globally). Finally, the Kosovo crisis gave the Russian military much needed arguments to force through their view that a large-scale conventional war is not a nearly remote possibility as stated in the national security concept of 1997 (Ball 1999: 2).

The second Chechen war has affected Russian threat perceptions as well. First of all, it demonstrated that in the modern era international and domestic terrorisms are intertwined and it is impossible to fight them separately. In addition, it turned out that the financial and military-technical basis of terrorism in the North Caucasus was that strong that it was unrealistic to wage the war only by special forces and internal troops (without the help of regular armed forces). As mentioned, Russia's previous military and security doctrines admitted only a limited and short-term involvement of the regular army. It should also be noted that Russia was both disappointed and irritated by

what it called a Western 'policy of double standards' with regard to Chechnya. On the one hand, Western countries called on Russia to join a 'global war on terror' after the events of 11 September 2001 and Russia responded in a positive way. But, on the other hand, the West treated Chechen rebels as 'freedom-fighters' rather than terrorists, provided Chechen leaders with political asylum, allowed Chechen representative missions to wage anti-Russian propaganda in Europe and in the U.S. and heavily criticized Russia for human rights violations in the region. Such a policy contributed to the rise of new mutual suspicions and mistrust in Russia's relations with its Western partners.

In 2000, under the new President Vladimir Putin, a series of new security-related documents was adopted, among them a national security concept, a military doctrine, a foreign policy concept and even an information security concept. The national security concept of 2000 was the most significant document for understanding Russia's new approaches to its security policies.

There were several differences between the concepts of 1997 and 2000. The most important aspect of the 2000 concept was that it elevated the importance and expanded the types of external threats to Russian security. The concept no longer stated that there were no external threats arising from deliberate actions or aggression. It provided a substantial list of external threats, including: the weakening of the OSCE and UN; weakening Russian political, economic, and military influence in the world; the consolidation of military-political blocs and alliances (particularly further eastward expansion of NATO), including the possibility of foreign military bases or deployment of forces on Russian borders; proliferation of weapons of mass destruction and the means of their delivery; weakening of the CIS, and escalation of conflicts on CIS members' borders; and territorial claims against Russia (Putin 2000: 4).

In several places the concept of 2000 emphasized that the natural tendency of international relations after the Cold-War confrontation was toward the development of a multipolar world in which relations should be based on international law and a proper role for Russia. It argued that the United States and its allies, against this tendency, under the guise of multilateralism have sought to establish a unipolar world outside of international law. The document warned that NATO's policy transition to the use of military force outside of its alliance territory without a UN Security Council approval was a major threat to world stability, and that these trends could create the potential for a new era of arms races among the world's great powers. The concept of 2000 links the internal threat of terrorism and separatism (clearly with Chechnya in mind) to external threats: it argues that international terrorism involves efforts to undermine the sovereignty and territorial integrity of Russia, with the possibility of direct military aggression. However, in dealing with the threat the document calls for international cooperation (Putin 2000: 4).

Russia's military doctrine of 2000 enlists almost the same threats to Russia's security. Perhaps there was the only exception: in addition to the threats that were mentioned in the national security concept of 2000 and in the military doctrine of 1993 the new document points to a new threat of an information war against Russia as an important factor of the contemporary security environment in the world.

The military doctrine of 2000 describes in detail the nature of contemporary and future wars distinguishing the following trends:

- The use of high-precision and non-contact weapons (with a minimal involvement of ground forces);
- An emphasis on the predominant use of air/space and mobile forces;
- An aspiration to destroy an enemy's military and administrative command structures; making strikes on military, administrative, economic and infrastructure objects throughout the whole enemy's territory;
- Widespread use of methods of information war – both world-wide and inside the enemy's country;
- Potential technical catastrophes as a result of strikes on nuclear, chemical and industrial installations and communications;
- Involvement of irregular/paramilitary formations in waging war (along with regular armed forces);
- The high risk of escalation of an armed conflict to a large-scale war in terms of a number of participants and the use of weapons of mass destruction (WMD).

Depending on the level of confrontation the doctrine singles out the following types of armed conflicts:

- Armed conflict – intra-state (Chechnya, Trans-Dnistria, Georgia-Abkhazia, Georgia-South Ossetia, the civil war in Tajikistan) or inter-state (Russia-Georgia);
- Local war (Iran-Iraq in the 1980s, Armenia-Azerbajan: Nagorny Karabakh);
- Regional war with the participation of a group of states (Afghanistan, both Iraq wars);

- Large-scale war (both world wars). The possibility of a large-scale war is seen by Russian strategists as purely theoretical.

With a political and economic stabilization and subsequent economic growth in Russia under President Putin Russia's foreign and security policies became more assertive. President Putin's 'Munich speech'[7] of 10 February 2007 exemplified a new Russian stance (Putin 2007). Although there were no radical changes in Russia's basic threat perceptions, President Putin has emphasized some interesting nuances in Russia's approaches to international security. Moscow's security concerns were related to the following recent developments:

- The unilateral use of military force by the U.S. and its allies (in Kosovo, Afghanistan and Iraq). The Russian Federation was also discontent with regular U.S. military threats to Iran, Syria and North Korea.
- The weakening of traditional international security institutions such as the UN (Security Council) and OSCE where Russia is represented on equal footing with other countries. President Putin said that the crisis of these organizations is a result of a deliberate strategy conducted by a small group of states that are interested in creation of a unirather a multi-polar world.
- NATO's eastward extension and the growth of its military infrastructure on the Russian borders.
- The U.S. plans to deploy elements of ABM (anti-ballistic missile) defence system in East and Central Europe (in Poland and in the Czech Republic).
- The lack of progress in arms control and disarmament. In particular, Putin criticized also other nuclear powers who do not want to join existing arms control regimes and reduce their nuclear arsenals. The Russian President also criticized NATO for its unwillingness to ratify the 1999 Adaptation Treaty on Conventional Forces in Europe that aimed at significant force reductions and development of confidence-building and security measures in Europe. Protesting against NATO's position Putin has suspended Russia's participation in the CFE Treaty in 2007.
- The lack of efficient cooperation between Russia and its Western partners on fighting international terrorism. Putin reiterated Russia's famous stance on the Western 'policy of double standards' and proposed to the international community an intensified cooperation in this sphere.

Russian security thinking under Putin was also deeply affected by a series of the so-called colour revolutions (Ukraine, Georgia and Kyrgystan). It has resulted in a certain re-assessment of Russian security perception towards the 'near' abroad, particularly in implementing 'tightening of the screw' policies. The Russian leadership now believes that Russia cannot be a regional great power (and a pole of the world multi-polar system) if it cannot keep its central position in the former Soviet space. Along the same lines, Putin tried to re-animate CIS collective security structures such as the protection of the common CIS borders, a single air defence system and the creation of the collective rapid reaction forces.

The new Russian President Dmitry Medvedev has repeatedly said that his foreign and security policy course will continue the strategy of his predecessor and that there should be no expectations of major changes in Russia's threat perceptions and security policies.

However, the beginning of his presidency was marked by two security challenges that earlier were seen as highly hypothetical – the inter-state military conflict with Russia's participation (South Ossetia) and 'energy wars' (Russian-Ukrainian gas conflict).

When in August 2008 Georgia has attacked South Ossetia and the Russian peace-keepers who were located there, for the first time in its post-Soviet history the Russian government had to execute a full-fledged peace-enforcement operation forcing Georgia to return to a *status-quo* situation. It appeared that the Russian armed forces were ill-prepared for such an operation (although the possibility of a limited armed conflict was foreseen in the Russian military doctrine). It took a long time to re-deploy forces from North to South Ossetia. The mobile forces were almost not engaged in the operation. The air and electronic intelligence were inappropriate and this inevitably led to mistakes in command chain and losses in manpower and military equipment. It was reported that the Russian General Staff has initiated a special investigation to draw lessons from the South Ossetian conflict.

The 'gas war' with Ukraine that had quite serious repercussions for Europe has demonstrated Russia's vulnerability in the energy sector, its dependence on the transition countries and challenged its credibility as a reliable energy supplier.

7 See President Putin's presentation at the Munich Conference on International Security; at: <http:// www.securityconference.de/konferenzen/rede.php?sprache=en&id=179>.

In both cases (South Ossetia and the Ukraine) Russia called for multilateral decisions. To avoid conflicts similar to the Russian-Georgian one President Medvedev proposed a new Trans-Atlantic Security Charter that should lay foundations for a new international security architecture in this huge region. A multilateral mechanism to prevent and solve local conflicts was proposed. Although the US and EU reaction to the Medvedev's proposal was cautious, it was not completely rejected and further discussions were suggested.[8] In addition, at the EU-Russia summit in November 2008 the EU and Russia decided to intensify their cooperation on external security, including conflict management and joint peacekeeping operations throughout the world.[9]

As far as the problem of reliable energy shipments to Europe is concerned President Medvedev has also proposed to create an international control mechanism that could monitor the supply process. It is planned that the issue of energy security will become an important part of a new EU-Russian cooperative agreement that is now under negotiation. In addition, President Medvedev invited European energy companies to actively invest in the construction of alternative gas pipelines that could be independent of transit countries (the so-called projects 'Nord stream' and 'South stream').

Medvedev has continued Putin's course on strengthening the CIS collective security system (i.e. the Tashkent Treaty of 1992). In 2009, he signed an agreement with President Alexander Lukashenko on the creation of a single Russian-Belarussian air defence system and completed the creation of collective rapid reaction forces of the CIS (mainly consisting of the Russian airborne troops).[10]

The new Russian National Security Strategy that was adopted by the presidential decree no. 537 of 12 May 2009 has incorporated these developments into the Russian strategic thinking. The list of military threats remained almost unchanged but they were presented in a slightly different way. For example, it distinguished between threats to the state and society, on the one hand, and to the individual, on the other. The paper is a bit more detailed in the description of the sources of the military threats to Russia than previous documents. And it has a more strategic, forward-looking character (Strategia Natsionalnoi Bezopasnosti Rossiyskoi Federatsii do 2020 goda).

13.6 Conclusions

Six conclusions emerge from the above review of the evolution of Russia's military threat perceptions and national security doctrines:

- *First,* during the past two decades Russia has managed to formulate its national interests, threat perceptions and a more or less coherent national security strategy.
- *Second,* Russian national security doctrines defined both national interests and security threats quite realistically. They are based on the assumption that there are no major external threats to its security and that internal sources of threats should be given more attention. Logically, Russian security concerns have shifted from the 'hard' to the 'soft' security domain.
- *Third,* Russian national security doctrines are based on a broader understanding of the notion of security in which the non-military issues such as the economy, social problems, environment, demography, information, culture and religion are included.
- *Fourth,* in line with the democratic principles, these concepts acknowledged the need for ensuring national security at three levels (the individual, society and the state) albeit the state 'bias' still remains (particularly in the field of implementation of the national security strategy).
- *Fifth,* with the adoption of a non-aggressive military strategy and clarification of Russia's national security interests, Russia becomes a more attractive and predictable international partner.
- *Sixth,* it appears that the national security debate has been a rather effective way of nation-building and constructing a new Russian identity. The national security concepts claim that they are based on national values and traditions and aim at the search for a national consensus and a unifying national idea.

8 See at: <http://www.vz.ru/politics/2008/11/14/229303.html>.

9 See at: <http://www.infox.ru/authority/foreign/2008/10/28/document2001.phtml>.

10 See in: *Rossiyskaya gazeta*, 5 February 2009: 1–2.

14 Russian Security Policy in the 21st Century Based on the Experiences of Its First Decade

Pál Dunay

14.1 Introduction

Russia's security policy and perception of the 21st century cannot be understood without taking a glance at the preceding fifteen years or so (Sergunin 2008; see chap. 12; Bailes/Baranovsky/Dunay 2007). Although there are certain elements of continuity between the 15 years since the mid-1980's to the end of the 20th century and the first decade of the 21st century, there are also major elements of discontinuity. Therefore historical references may be of limited relevance for the recent past and the near future.

This chapter analyses the security policy of the Russian Federation during the first decade of the 21st century based on official documents, which summarize the country's security perceptions, the actions it has taken from the second Chechnya conflict (1999), to the five-day war with Georgia (2008), and Russia's assertions regarding its future status in the international system.

A key question is whether security is conceived either with a narrow or wider meaning (Brauch 2009). This poses a challenge as the contours of Russian security policy cannot arbitrarily be defined and the author cannot ignore how the state uses the concept. Various Russian security concepts did not follow the same line and they showed a certain discrepancy in their use. Although the narrow security concept is deeply rooted in the Soviet past, it does not reflect current Russian security thinking. Russia's security concerns entail elements of soft security and its security strategy has also integrated elements of a wider concept. The state of health of the Russian population, its declining life expectancy and the overall demographic situation belong to the former (Lutz 2008), energy security issues to the latter. Thus, this chapter must remain eclectic as far as the concept of security is concerned.

Analysing Russian security policy requires a consistent analytical framework. For many, Russia is a model of a realist great power in the early 21st century. Russia pursues its national interests, it is ready to clash for their realization and it uses a full array of available economic, political, and military means. Russia has no permanent allies. Thus, it is impossible to draw a clear conclusion. Russia's realism is mitigated by its integration into the international system and its objections to the interests of Western great powers, rather than their full rejection. Its rejection of Western values has been hesitant and tacit. Furthermore, the domestic foundations of Russian politics do not fully underline either a dictatorial, or even an unambiguously authoritarian regime. Taken together, Russia represents a puzzle for the security analyst.

Beyond the grand theories of international relations, it is clear Russia has changed fundamentally since the end of the Soviet Union. The country has remained semi-authoritarian with a bureaucratic hard core, the result and reflection of a recentralization. It is sometimes described as an authoritarian system with a market economy. In this sense parallels are drawn with China. However, this parallel has been largely missing the point. The authoritarianism of both states is very different as are their economic foundations. Russia had at least some short lived experience with democracy during the 1990's, China does not. Furthermore, the expectation of the West which Russia is supposed to live up to is a set of expectations of a prospective member of a value community. China has faced similar expectations. For more than a decade the human rights related demands against China were concrete complaints without an underlying system of expectation to become Western in its approach. Since the late-1990's they have been expressed in a lukewarm manner and often did not go beyond lip service. However, Russia faced systematic expectations to eventually live up to Western standards. Although both China and Russia experienced impressive economic growth rates, their foundations differ fundamentally. Russia's growth largely

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depends on world prices of natural resources, specifically on hydrocarbons. China is the world's production site. Hence it is unfounded to assume that the Russian model is a carbon copy of the Chinese. The Russian model faces the danger of a rentier economy where the taxes of the population play a marginal role and its opinions are disregarded by the establishment. In this regard the prospects of Russian democracy may be in doubt.

14.1.1 Where, Why, and How History Matters?

In the international system adaptation is one of the most painstaking processes. The past imposes itself on the present particularly if states do not face up to reality and partly base their actions on illusions. This is relevant for the Russian Federation during the first decade of the 21st century. From the Soviet legacy there are three elements to mention:

1. The Soviet Union after the end of the Second World War qualified as one of the two superpowers and thus as a centre of the bipolar international order.
2. Among the combined elements of the power base of the Soviet Union, military force, including the possession of the largest arsenal of nuclear weapons, and an ideology spread by force played a central role.
3. The Soviet Union, largely based on Russian conquests in the 18th and 19th centuries, integrated many nations and large territories not inhabited by ethnic Russians that became mixed ethnically during the Tsarist and the Soviet eras.

These elements have influenced Russia's conduct since the end of the Soviet Union. Russia had enormous difficulties to adapt to the changes regarding these three elements:

1. The decline of the Soviet Union prior to its end weakened its position but avoided facing the loss of its status as a superpower. That happened later during the first half of the 1990's. Thus, the Soviet legacy could present a status or a point of reference.
2. The power base of the Soviet Union lost its international appeal with regard to the Marxist-Leninist ideology and its relevance as a symbol of military power, and shifted to other sources of power and influence where its performance was less outstanding.
3. The end of the Soviet Union resulted in the loss of all its territorial gains during the last three centuries and disconnected Moscow from its 'backyard'.

For the first years of the Russian Federation two elements are worthy of mention:

1. Russia could learn that its domestic weakness ranging from its economic output to shortcomings in governance undermines its international performance.
2. The West did not reciprocate the readiness of Russia to accept a junior partner status in the international system by a benign attitude or generosity, and several decisions have been made that Moscow perceived as interfering with its essential interests.

The end of the 1990's reconfirmed the earlier experience that Russia has accumulated. A series of events demonstrated the depth of the problem it faced, including the collapse of its financial system in 1998, the extensive influence of oligarchs on managing state affairs in the second term of the Yeltsin presidency, the outbreak of the second Chechnya War. Internationally this coincided with the first eastern enlargement of the Atlantic Alliance in March 1999, the new NATO strategic concept of April 1999, including the declaration of the continuation of its open door policy and NATO's war against Serbia in 1999. There was no doubt left, if Russia wanted to return to the international scene it had to fix its problems ranging from generating a larger GDP and tax revenues to consolidating its government structures and offering an ideology to the population that could find acceptance. It needed a better performance and more stability. The consolidation started with the arrival of the new leadership and not much later with the new era.

These all happened during the last moments of the 20th century with repercussions for the first years of the 21st century. However, the memories of the Soviet Union were still fresh enough to believe that the better performance of Russia as a national economy, a functioning government, more international respect, particularly in its traditional sphere of influence, could re-establish it as a major world political player. These achievements have given the impression to Russia that it could also reclaim its status.

14.1.2 Economic and Social Foundations

At the turn of the century the Russian Federation had a small GDP, a backward economy with regard to the spread of high technology, and an overall poor population (except for some large cities that have benefited

from the lion's share of the inflow of capital). During the Putin presidency the GDP of Russia rose from US$ 560 billion in 1999 to 1.3 trillion in 2007, which moved the Russian Federation from the 14th largest economy to the 12th largest during those eight years.[1] In 2009 it reached US$ 2.1 billion and was the 8th largest national economy in the world (CIA 2010).[2] Its GDP per capita was US$ 15,200 in 2009, ranked as 73rd in the world, compared to US$ 6,775 in 1999.[3] Its currency reserves rose from US$ 8.5 billion to US$ 540 billion between 1999 and 2008.[4] Between 1998 and 2007 the Russian economy rose at an average annual rate of 7 per cent.[5] The consumption of Russian households grew even faster between 1999 and 2007, at a rate of 10.1 per cent (Petro 2009) and significantly less people were living under the official subsistence minimum in Russia. By 2007 it was down to 14 per cent of the population (Petro 2009). Due to these facts, a domestic political consensus was achieved and maintained. As the renewed centralization and the constraining of democracy were accompanied by economic prosperity, the priority attributed to the economic factor in the process remains unquestioned.

However, more recent developments have shown that although Russia is well integrated in the world economy, it is not a central player. In 2008 more than 70 per cent of the value of companies registered at the Russian stock exchange disappeared within four months from May to September (Herd 2009). Even though political factors, like the war between Georgia and Russia, played a role in this, it had far more to do with the spill-over effect of the world financial crisis and the temporary bursting of the oil (and gas) price bubble. This has highlighted that Russia's economic performance to a large extent depends upon the exploitation and export of a few natural resources, i.e. its economy is not sufficiently diversified, high technology industries play a minor role and the financial sector is not developed enough. In 2007, 64 per cent of Russian export revenues relied on the export of oil and natural gas, and the fuel sector accounted for 20.5 per cent of the GDP.[6] But it would be wrong to attribute all positive features in the Russian economy to oil and gas prices, and all weak spots to an insufficient economic modernization. It is recognized that prudent management of public finances, the accumulation of significant reserves in the stabilization fund certainly contributed to the success. Furthermore, on the basis of a general economic boom, the spillover was significant in other sectors, like construction, trade, services, and also in banking. Russia is divided and top-level politics seldom faces the reality of Russia's economic situation. Since the steady growth of the Russian economy has been interrupted, President Medvedev pointed to the need of economic modernization.[7] This is backed by the expert opinion that the "Russian economy is not diversified and is built on the commodity market".[8] Russia reacts allergically if external political players draw critical conclusions on the state of its economy.[9]

It is not only the economy that gave mixed signals during the last decade. Social security does not excel either. Retirees still often face basic subsistence problems, and depend on the next generation. Unemployment has become more widespread due to the finan-

1 See "About Russia/Economy, Business and Marketing Analytic Centre"; at: <http://www.bma.ru/eng/russian_economy>.

2 CIA: CIA World Factbook (Washington, D.C.: Central Intelligence Agency, 2010); at: <http://www.cia. gov/library/publications/the-world-factbook/geos/rs.html>.

3 Indexmundi, 2010; at: <http://www.indexmundi.com/russia/gdp_per_capita_(ppp).html>.

4 Lúcio de Vinhas Souza: "A different country: Russia's economic resurgence"; at: <http://www.voxeu.rg/index.php?q=node/1224>.

5 See Souza, *op. cit*.

6 See U.S. Energy Information Administration, 2008: "Russia, Independent Statistics and Analysis"; at: <http://www.eia.doe.gov/emeu/cabs/Russia/Background. html>.

7 Dmitry Medvedev: "Go, Russia! 10 September 2009"; at: <http://eng.kremlin.ru/speeches/2009/09/10/1534_type104017_221527.shtml>; originally published at: <www.gazeta.ru>.

8 Lilia Shevtsova: "Russia at the Fork Again: to Tighten the Screws or to Open the Windows", in: *Quaderni di Relazioni Internazionali* (9 March 2009): 19; at: <www.ispionline.it/eng/documents/QRI-L.Shevtsova–Russia at the Fork again.pdf>.

9 Lynn Berry: "US Vice President Biden hits nerve in Russia", in: *The Washington Post*, 27 July 2009; at: <http://www.washingtonpost.com/wp-dyn/content/article/2009/07/27/AR2009072701154.html>. U.S. Vice President Joseph Biden argued on Russia: "They have a shrinking population base, they have a withering economy, they have a banking sector and structure that is not likely to be able to withstand the next 15 years, they're in a situation where the world is changing before them and they're clinging to something in the past that is not sustainable." An author at a critical Russian website called attention to the fact that the U.S. vice president told the truth and that offended the Kremlin. See Aleksandr Golts: "Biden skazal pravdu, Kreml obidel'sya" [Biden told the truth, the Kremlin was offended], in: *Yezhednevnyi zhurnal*, 27 July 2009; at: <www.ej.ru/?a= note&id=9313>.

cial crisis induced economic contraction. Cities with mono-cultural economies often based on the performance of one company may be hit particularly hard.[10] Alcoholism continues to be widespread, now exacerbated by drug use that changed Russia from a transit state to a destination. A phenomenon closely linked with Russia's economic emergence has been that the life expectation, particularly for men, is short, and population decline is massive. Globally, with 12 years, the difference between the life expectancy of men and women is the biggest in Russia. Although immigration from the former Soviet area has continued, it has not compensated for the loss. Further population decline is beyond doubt, it is only the proportions of the problem that is disputed. These factors present complex problems but more is said than done to alleviate them effectively. Thus, the socio-economic foundations of Russia's security will continue to be in trouble. They pose problems of their own and they also react to other more narrowly defined areas of security.

14.2 Russian Security Documents (2003-2010)

Vladimir Putin's era as President of the Russian Federation began with the adoption of four major documents that outlined the country's thinking on national security: Russia's national security strategy in January 2000, its military doctrine in April 2000, its foreign policy concept in June 2000, and its information security concept in September 2000. The drafting in the first three cases preceded the new President's office term but the new administration certainly left its mark on them. Thus, the country could base its activity in the area of international security on adequate documents. Beyond its start the Putin era has not at all been rich in strategic documents.

The first major addition came in 2003 when the document on "The Topical Tasks of the Development of the Armed Forces of the Russian Federation" was published.[11] It is not surprising that a document which addresses the tasks of the armed forces puts the emphasis on the contribution of military power. It is Russia's most important novelty that it concludes that military power has retained its importance in guaranteeing security if its role has not eventually increased. It is further accentuated when the document states: "It is increasingly impossible to guarantee the security of the Russian Federation exclusively on the basis of relying on political opportunities, membership in international organizations, partnerships and political influence." This is certainly in reaction to the developments of the post-bipolar era and the most important event that had preceded the adoption of the document, the Iraq War of 2003.

As far as the topic of nuclear weapons is concerned, the document does not add much to the position of Russia elaborated above. Earlier documents also recognized the first use of nuclear weapons under strictly defined conditions. However, the argument underlying it has developed further in light of current developments. Accordingly, the use of force without the approval of the UN Security Council increases the probability to use weapons of mass destruction, including nuclear arms. This means that according to Russia the nuclear threshold has lowered. Moscow has reaffirmed the doctrine of nuclear deterrence as part of its security policy.

While Western analysts concluded that Russia became more assertively 'militaristic' with the 2003 document, this position is not supported by facts. The Russian Federation only reacted to the change of the international environment. If the world developed in a direction where military force is employed more freely and where those institutions which provide for the enforcement of global order and universal international law lose ground, Russia would recognize the rules of the game and adjust to them. As Russia regards itself as a global player, such rearrangements of the sources of power and of power relations appear on Russia's security agenda faster and more directly than they will affect smaller states, which are not directly exposed to these changes. It reflected that Russia was sufficiently self-confident to react autonomously when it concluded that the lasting rearrange-

10 It is sufficient to mention the situation of the VAZ factory in Togliatti (in the Samara region) where the Lada passenger car is produced. The same applies to the GAZ factory in Nizhny Novgorod less than 500 kilometres east of Moscow where the well-known Volga cars have been produced. The shrinking market threatens with mass unemployment at both places. This can only be tempered by significant governmental assistance but the problem cannot be resolved due to the fact that Lada is not the favourite passenger car either of the Russian or of the foreign customers.

11 Aktualnye, 2003: "Aktualnyye zadachi razvitiya vooruzhennykh sil RF" [The topical tasks of the development of the armed forces of the Russian Federation], at: <http://www.mil.ru/articles/article5005.shtml>.

ment of international power relations was to its disadvantage.

The documents adopted in 2003 and before reflected a mounting Russian dissatisfaction with global processes. The Russian leadership that maintained certain elements of the Soviet legacy faced further challenges when between late 2003 and early 2005 landslide political changes occurred in three former Soviet republics. In two cases more western leaning leaders came to power. This was perceived more as an existential challenge. Russia was deprived of the integrity of its regional backyard (and its unchallenged leadership in the former Soviet area). It found this unacceptable when its President argued that the dissolution of the Soviet Union was the single biggest catastrophe of the 20th century. Furthermore, it perceived that Russia's position as a pole of the multi-polar international system was, among others, based on its regional dominance in the post-Soviet space.

The growing dissatisfaction and bitterness of Russia was reflected in the address of President Putin at the Munich Security Conference in 2007.[12] Although the speech is often mentioned as a turning point in the relations between Russia and the West, a closer look would leave no doubt that all its elements could be found in earlier pronouncements of the Russian leadership. It was new that President Putin systematically summarized the points of contention and their spread was giving the impression of a turn.

The main points included the unilateral use of force against states ranging from Serbia to Iraq and the threat of force to other countries, like Iran, Syria, and North Korea. In conjunction with this it was mentioned that those organizations where Russia was on equal footing with other states, including Western great powers, were marginalized, ranging from the United Nations and most importantly its Security Council to the OSCE. NATO's ongoing enlargement to the East formed part of the list. This was all the more understandable as it formed part and parcel of the western domination of regional and also some global institutions. The deployment of ballistic missile defence in East-Central Europe and the discontinuation of European arms control, including the non-ratification of the adapted CFE Treaty added to the list of grievances. Last, but not least, Russia was dissatisfied with counter-terrorist cooperation. It is an area where Moscow's attitude was no doubt exemplary with particular reference to the immediate demonstration of solidarity with the USA after 9/11. The Russian President did not add the colour revolutions to the list as they were more ambiguous points of reference. Apparently, local populations practised their right to political self-determination, beyond doubt with some external support. On the other hand, Russia remained mute on human security issues, particularly on Moscow's human rights record. This litany could be regarded as one-sided and biased but certainly not fully unfounded. Its relevance has reached beyond the Bush administration and the Putin presidency.

The inception of office by President Medvedev has not resulted in the adoption of a new series of documents due to the succession of power but much more due to the completion of drafting processes long overdue. The foreign policy concept was adopted in June 2008, the National Security Strategy in May 2009.[13]

The foreign policy concept offers a broad overview of Russia's interests. Strengthening the principles of multilateralism, developing a security architecture based on the indivisibility of security that also recognizes diversity lies at its philosophical foundation. A stable system of international relations is to be based on equality, mutual respect, mutually beneficial cooperation, and the norms of international law. As far as international institutions are concerned, Russia attributes importance to those where it is a member on equal footing, with a strong preference for the United Nations in the management of global affairs. The UN Security Council has a monopoly to sanction the use of force for the purpose of coercion to peace. In the area of international security Russia presents its complaints about the absence of arms control both bilaterally (USA-Russia) and multilaterally in Europe.

In its regional policy Russia clearly puts the priority on the former Soviet area and attributes importance to various multilateral frameworks of cooperation. With regard to NATO, the document takes a reactive view and makes Russia's relations dependent upon the readiness of the Alliance "for equal partner-

12 Vladimir Putin: "Speech of President Vladimir Putin at the Munich Security Conference on 10 February 2007"; at: <http://www.securityconference.de/Conference-2007.268.0.html?&L=1> (A summary).

13 "The Foreign Policy Concept of the Russian Federation", in: *Maxim News Network*, 31 July; at: <http://www.maximsnews.com/news20080731russiaforeignpolicyconcept10807311601.htm>; "The strategy of national security of the Russian Federation until 2020 approved by the decree of the President of the Russian Federation on 12 May 2009"; at: <www.scrf.gov.ru/documents/99.html>.

ship". It is clearly opposed to further NATO enlargement with specific reference to Georgia and Ukraine, and the bringing of the NATO military infrastructure closer to Russia's borders. Overall, the document marks the Russian view in a fairly non-confrontational manner.

The National Security Strategy starts out from a broad definition of national security similarly to concepts like the one adopted in 1997. This is the prime reason for the caveat above according to which Russia does not have a security conception that would help define its contours. The list of security relevant issues includes the development of democracy and civil society, the raising of the living standards of its citizens, defeating population decline, support for the middle class, shrinking the gap between the poor and rich, improvement of the health care system, economic growth and competitiveness (through transformation to an economy based on innovation), reduction of corruption, scientific and technological progress, environmental protection, and resource conservation. The list gives a clear non-military emphasis to security similar to earlier concepts and also to the preferred approach of President Medvedev. Even though it would be an exaggeration to attribute the strategy of 2009 to the President it can be taken for granted that his priorities were set against those of others. There could be another reason for focusing upon internal issues rather than searching for external adversaries: This timing was passed just a few months after the new US administration of Barack Obama came to office. A confrontational tone would have been counterproductive whereas enthusiasm about a new era of cooperation would have been premature and thus unfounded.

This did not mean that Russia did not put forward a list of external threats. It contains neither new elements nor is it novel in its formulation. NATO's eastern enlargement, or more accurately, the moving of the military infrastructure of the Alliance closer to Russia's borders, is of primary concern. Russia clearly focused more on immediate regional concerns than on global ones. Its aspirations are also clear to end the bloc confrontation, to search for creating a multipolar world, and a multi-vector diplomacy. As a lasting element of its foundation, Russia intends to be a regional power in the former Soviet space. It certainly means leadership without hegemony – the latter, a word thoroughly avoided in this concept. On this basis Russia wants to be an independent centre of power in a multi-polar world.

The drafting of the National Security Strategy went in parallel with the development of a new framework of Russia's European policy. The European Security Treaty initiative associated with President Medvedev's inception to power was a vaguely defined concept. It took the form of a few passing remarks of the President of Russia and the initiative was only made more specific on the insistence of Russia's partners who were willing to seriously consider it. It is important to pay attention to it as it reflects both Russia's perception of the international environment as well as its own influence and possibilities to shape it. Taken together, the initiative aims at reconceptualizing the opposition of Russia to the changes that occurred during the last decade (Dunay/Herd 2010). There could be eight reasons behind it, five on the substance, and three tactical ones.

With regard to the substance of the initiative:

1. It is the single most important element of the initiative to stop the further change of the *political status quo* in Europe, and where it has changed to the disadvantage of the Russian Federation, to reverse it. This is particularly the case with respect to the results of the so-called colour revolutions, the establishment of western oriented regimes in the former Soviet area, which are reluctant to pay sufficient attention to Russia's position and concerns.
2. It is to guarantee the respect for certain principles of universal international law and to suppress some others. States in the Euro-Atlantic area should focus on sovereignty and the prohibition of the threat and the use of force. The right to self-determination should in fact be excluded, particularly regarding the creation of new states.
3. Certain organizations of the post-Soviet space, notably the *Commonwealth of Independent States* (CIS) and the *Collective Security Treaty Organization* (CSTO), should gain international recognition in the West.
4. The Russian dissatisfaction with the long-held asymmetry between various dimensions of the OSCE should be rectified. Namely, more attention should be paid to the politico-military dimension and significantly less to the human dimension, particularly to the democratic transformation and election monitoring.
5. European arms control should be revived.

Furthermore, it referred to three tactical reasons:

1. Test the position of Russia's main European partners and the USA with particular emphasis on the new US administration.

2. Position Russia through conceptualizing its dissatisfaction with the evolution of the European security architecture and the political context during the last ten years, since the late 1990's.
3. Present the new President as a political actor internationally and offer a combination of continuity and discontinuity. The initiative has been composed of elements which were present in Russian policy during the Putin presidency, or emerged during this period. However, the framework in which they were presented was somewhat novel.

The Russian Federation was apparently interested in getting feedback to its concerns to regain the initiative in international security and to establish the process where it has superiority due to the fact that the exchanges would be organized around its initiative. The process thus could have been more important than the outcome. It seems that it was neither urgent nor particularly important for Russia to formulate its position in a draft treaty. Finally, after mounting pressure from its Western partners, Russia put forward a draft treaty that has summarized many elements of the initiative.[14]

According to Article 1 of the draft treaty text, "security measures taken by a Party to the Treaty individually or together with other parties, including in the framework of any international organization, military alliance or coalition, shall be implemented with due regard to security interests of all other Parties". This article faces the problem: What does 'due regard' mean? Does it mean subordination of organizations like the EU, NATO, and the CSTO to a collective body of the states parties? If it does, this may well jeopardize the activity of any such organization/alliance/coalition or may well mean constant violation of the Treaty if the parties decide to act (out of necessity) through their institutions and disregard the objection of the other party(ies). This element of the draft closely resembles the differentiation of the Yeltsin-Kozyrev era on dividing institutions into 'mandating' and 'mandated' ones (the former being the UN and the OSCE, the latter NATO and the EU). As the CSTO has not established itself as an organization of similar weight to NATO, there is no 'tit-for-tat' here. Leaders of NATO member states may not yet see any major advantage in curtailing the freedom of action of the CSTO by the same article that would apparently curtail the freedom of NATO.

According to Article 2 "decisions (...) taken in the framework of (...) alliances, coalitions or organizations do not affect significantly [the] security of any Party or Parties to the Treaty". On this basis there is a wide range of possibilities to interpret practically any action of any organization as 'significantly affecting' the security of other parties. As the EU and NATO have well-established enlargement policies based on membership criteria and a declared open door policy, it is difficult to imagine that member states would be ready to expose it to the mercy of non-members. Furthermore, the text is highly ambiguous. It actually reminds of the text the former Soviet Deputy Foreign Minister Yuliy Kvitsinsky brought to capitals of East-central Europe in the spring of 1991 when the new friendship and cooperation treaties were negotiated with the Soviet Union. There it was Moscow's idea that no party to the (bilateral) treaty would join any alliance directed against the interests of the other party. The question emerged immediately during the talks, who would decide which alliance was 'directed against the interests of the other party'. If the party willing to join an alliance herself would do it, that would be 'auto-interpretative'. If the other party, then it would result in endless dispute as far as the legality of such a step. This idea was then soon taken off the negotiating table and there is no reason to assess the situation differently now.

Some other parts of the draft treaty are more difficult to object to. The prohibition to "use the territory of a state party with the purpose of carrying out an armed attack against any other Party (...)" belongs to this category, as the text goes in parallel with the definition of aggression adopted by the United Nations General Assembly back in 1974 (resolution 3314) that was endorsed by every OSCE member state. It is unclear whether this prohibition would also apply to such measures as hosting elements of a ballistic missile defence system on the territory of another party; a measure that could be regarded as fully defensive by some and offensive by others as it would weaken the second strike capability of a state and thus could undermine deterrence.

According to Article 10 of the draft, the area of application of the Treaty would be "the Euro-Atlantic and Eurasian space from Vancouver to Vladivostok". This is an ambiguous definition as it does not make it clear whether it extends exclusively to the current participating states of the OSCE or whether, for instance, the People's Republic of China could also participate in it. The ambition of the original initiative to extend its purview to several institutions which are active in

14 Dimitry Medvedev: "Treaty on European Security"; at: <http://eng.kremlin.ru/text/docs/2009/11/223072. shtml>.

the Euro-Atlantic area has been retained. One of them is all-European (OSCE), two are 'western', the EU and NATO, and two are 'eastern', the CIS and the CSTO. This reflects the long held ambition of Russia to give similar recognition to organizations which operate in the former Soviet area as to the somewhat better established Western ones. The Council of Europe is missing from the list, what raises the question whether it is not regarded as part of Europe's security architecture. Also the *Shanghai Cooperation Organization* (SCO) does not appear in the same capacity. The absence of the SCO from the draft may offer an indirect answer concerning the participation (or rather the non-participation) of China in the draft treaty.

It remains to be seen whether the draft treaty will generate sufficient support to start exchanges or it will be absorbed by other processes and fora. The first reaction of the US administration that followed the publication of the draft treaty text by two months recognized some merits of the initiative but emphasized its reservations as far as the process is concerned:

> the Russian Government under President Medvedev has put forth proposals for new security treaties in Europe. Indivisibility of security is a key feature of those proposals. And that is a goal we share, along with other ideas in the Russian proposals which reaffirm principles of the Helsinki Final Act and the NATO-Russia Founding Act. However, these common goals are best pursued in the context of existing institutions, such as the OSCE and the NATO-Russia Council, rather than by negotiating new treaties, as Russia has suggested – a very long and cumbersome process.[15]

In early 2010, Russia finally adopted a new military doctrine (Doktrina 2010).[16] With this Russia has recently adopted documents on all major elements of the country's external relations and also on a broad range of its internal security. The military doctrine, compared to the one adopted a decade ago, does not refer to the 'defensive nature' of the doctrine. Those who have drafted similar documents know well that the differences between them are often due to inadvertent mistakes. That may also be the case this time.

Military threats and dangers are characterized as follows: The ideological confrontation declines, the economic, political and military influence of certain states (and group of states) weakens, while the influence of other ones that claim global domination is on the increase. Regional conflicts continue to be resolved by the use of force. The international security architecture does not provide equal security for every state. But the likelihood of a large-scale war against the Russian Federation with a global domination is unlikely.

The doctrine lists 11 external military dangers. Among them "the attribution of global function to the force potential of the North Atlantic Alliance (NATO) in violation of international law, the approach of the military infrastructure of NATO member states to the borders of the Russian Federation, including through enlargement" is mentioned first. The importance thus attributed to the Atlantic Alliance demonstrates that Russia declares its popularized threat perception. The further ones include the following: 1. Attempts to destabilize certain states and regions and undermine strategic stability; 2. Deploying military contingents of foreign states on the territory of countries bordering the Russian Federation; 3. Establishing and deploying strategic anti-missile defence system that undermines global stability and violates the current ratios in the nuclear rocket forces; 4. Territorial claims on the Russian Federation and its allies, interference into their domestic affairs; 5. The proliferation of weapons of mass destruction missiles and missile technology; 6. The violation of international agreements and arms control agreements concluded earlier; 7. The use of military force on the territory of states neighbouring the Russian Federation, the violation of the UN Charter and other norms of international law; 8. The emergence of military conflicts and their escalation on the territory of states neighbouring the Russian Federation and its allies, on the territory of states neighbouring the Russian Federation; 9. Spread of international terrorism; 10. The emergence of inter-ethnic and inter-confessional tension, the activity of radical international armed groups in the vicinity of the borders of the Russian Federation and its allies, territorial conflicts, the growth of separatism and religious extremism. It is clear that the list cannot claim a high level of cohesion.

The list of military threats is less exhaustive, though not particularly accurately defined. It is clear that Russia regards every 'hostile' military presence and activity in its neighbourhood and the neighbourhood of its allies adversarial, as well as the activity of

15 Hillary Rodham Clinton: "Remarks on the Future of European Security", in Paris at L'École Militaire, 29 January 2010; at: <www.state.gov/secretary/rm/2010/01/136273.htm>.

16 "Voyennaya Doktrina Rossiyskoy Federatsii", 5 February 2010; at: <http://www.scrf.gov.ru/documents/33html>; "Russian Military Doctrine"; at: <http://www.globalsecurity.org/military/world/russia/doctrine.htm>.

illegal military formations on the territory of the Russian Federation.

In the framework of strategic deterrence, Russia claims the right to use nuclear weapons in reaction to the use of nuclear weapons or other types of weapons of mass destruction against the Russian Federation and/or its allies. It is a novel addition that Russia is also ready to use nuclear weapons if conventional weapons are used against it, and the existence of the state is endangered. This latter formulation is important as the advisory opinion of the International Court of Justice back in 1996 added a very similar condition to the exceptional, legitimate use of nuclear weapons.

14.3 Russian Security Policy Practice: From the Protection of Sovereignty to the Protection of Influence

The 21st century, as outlined above, started with great troubles for the Russian Federation. The first one was an imminent threat to the state's territorial integrity. The second Chechnya War, irrespective of how ambiguous the circumstances that led to its breaking out, was a conflict Moscow had no choice but to fight. It could not afford not to fight a war that threatened its territorial integrity. There could be two somewhat interrelated reasons:

1. The eventual danger of a spillover to a largely destabilized North Caucasus could be one reason why Russia felt compelled to react in the strongest possible terms to the challenge against its sovereignty.
2. No great power can afford to face a challenge against its territorial integrity as it would indicate that its great power status is in jeopardy. Russia, in a large-scale military confrontation gained superiority and could consolidate its rule over there.

However, it is important to point out that even though Chechnya is still not under the full control of Russia, it is no longer a secessionist territory. This is a major success of Russian security policy even though not of the Russian armed forces. Russia had an enormous concentration of heavy armour and used massive force. Despite it, Russia arrived at military victory painstakingly slowly. Moreover, Russia had to realize that its regular forces based on conscription were of extremely doubtful value. It was not surprising that first it gradually replaced them by contract soldiers and then by interior ministry troops. It is also a difference compared to the aftermath of the first Chechnya War of the mid-1990's that Russia in the early-21st century was much better organized and had more to offer to the North Caucasus than in the mid-1990's when the first Chechnya War was fought. Furthermore, Russia, in difference from the first Chechnya War, also addressed the post-conflict phase and started some peace-building after ending the military operation. This complex approach has already paid off and may also pay off in the long run. The counter-insurgency operation in Chechnya was formally terminated only in 2009. However, the stabilization of Chechnya[17] did not result in a general stabilization of the North Caucasus (Melvin 2007). Security threats emanating from terrorist activities and more broad ranging instability continue to prevail from Dagestan to Ingushetia, North Ossetia, and beyond. One could conclude preliminarily that the reduction of the conflict level in Chechnya went in parallel with the spread of terrorism in the North Caucasus unrelated to events in Chechnya.

Russia was still fighting in order to bring Chechnya into submission when the international environment changed fundamentally due to the 9/11 terrorist attacks against the USA. Having emphasized the importance of cooperation in fighting terrorism, Russia found the moment opportune to reaffirm this by its positive attitude to counter-terrorism and offered its collaboration to the USA. In turn, it was expecting American support to its own counter-terrorist activity, in particular in Chechnya. Reciprocity was hesitant and partial at best. Some were more willing to regard the Chechens fighting for their self-determination rather than Russia fighting terrorists. In the end, throughout the first decade of the 21st century Russia was disillusioned as far as the West's reception of its counter-terrorism policy and the activity in the North Caucasus were concerned. More broadly, a narrow path remained between Islamic radicalism, separatism, and terrorism in the policy of the West, and hence its reaction to Russian behaviour remained varied. Double standards often prevailed. Priority to zero sum games over stability prevailed in the attitude of some Western powers. Right after 9/11 the Russian Federation thought to have brought its entry to a point of reconciliation with the USA, and through it with the West. Having been halfway turned down by

17 The recognition of stability in Chechnya does not mean the approval of the means used by the Kadyrov leadership or its predecessors for stabilization.

the West, the Russian Federation understandably felt disenchanted. That impression fed into a larger list of grievances.

The Putin presidency started after the NATO war against Yugoslavia (Serbia and Montenegro) between March and June 1999. Moscow regarded that war as a 'loss of western innocence'. Russia faced the next large-scale Western war in 2001 when the USA and some of its allies reacted to 9/11 by initiating regime change in Afghanistan. Russia was not in the position to object to it, among others as the underlying case was a *prima facie* case of harbouring terrorists on the country's territory and hence a case of fighting terrorism. Furthermore, Russia had to remain mute for two additional reasons:

1. Its predecessor, the Soviet Union, invaded and occupied a large part of Afghanistan between 1979 and 1989.
2. It has been aware that a failure to eliminate Taliban rule and hence the continuing symbiosis between the Afghan government and al-Qaeda would carry severe risks on Russia due to the vicinity of that country to Russia, as well as neighbouring on three successor states of the former Soviet Union.

Two of the three (Tajikistan and Uzbekistan) are members of the *Collective Security Treaty Organization* (CSTO), a regional grouping addressing security matters. It is clear that the Russian Federation plays a prominent role in that organization. Hence, the spill-over of instability from Afghanistan to its northern neighbours would further undermine security also for Russia. Over the years Tajikistan has also developed a bilateral strategic partnership with Moscow that would result in a direct impact upon Russia if the West cannot contain the further destabilization of Afghanistan.

In post-9/11 Afghanistan Russia took a hesitant, in light of current Russian policy one may say, a pragmatic position. Memorably, back in 2001, Russia itself transferred weapons and ammunition worth US$ 140 million to the so-called Northern Alliance and also helped with military advisers. On the one hand, it has been cooperating with the West, and specifically with NATO, to resupply troops in Afghanistan through Russian territory even if not by weapons proper. This has been a demonstration that Russia was well aware of the importance of its cooperation with the West to keep the situation under control to whatever extent possible and prevent the eventual horizontal escalation of the conflict. On the other hand, however, Russia both bilaterally and multilaterally contributed to appeals that invited 'extra-regional' countries to leave Central Asia as the Afghanistan operation was coming to a close. First, Russia and the People's Republic of China called on the extra-regional member states present in Afghanistan. Just a few days later, the Shanghai Cooperation Organization considered the same necessary.[18] It was certainly not only the perception of the Afghan operation coming to a close that was unfounded and the conclusion wrong. It also served for a purpose to indicate Russia regarded Central Asia as its backyard where it found Western military presence unwelcome.

Contrary to Afghanistan where Russia faced difficulties to establish an unambiguous position, it was much easier in the case of the next military action of the United States and some of its allies. The rhetoric that the Bush administration used before the military intervention against Iraq left no doubt that it was ready to go alone if other major players do not play along. The USA was ready to apply military 'sanctions' irrespective of whether the UN Security Council would support them or not. The events followed that pattern. For Russia this was troubling in multiple senses: First and foremost as the unilateral action of the USA denied the monopoly of the Security Council to decide in such cases. Russia is a very strong advocate of the UNSC, where its position is extremely strong on the basis of the UN Charter. The evidence provided to legitimize the military action was not particularly convincing. However, it was probably most important for Russia that the issue went beyond the concrete case. It was measuring the limits of unilateralism. For Russia it was clearly unacceptable that major international contingencies would, as a rule, be decided unilaterally. This has strengthened the conviction of the Russian leadership that it should put the demand of a multi-polar world order in the centre of its international politics. It has in fact put this claim in the centre and continues to base its policy on it now and for the foreseeable future.

Russia was by far not the only opponent of the US intervention in Iraq. There were many other countries that had strong reservations, including France, Ger-

18 Just a few days later, the summit meeting of the *Shanghai Cooperation Organization* (SCO) issued a very similar appeal according to which: "respective members of the antiterrorist coalition set a final timeline for their temporary use of the above-mentioned objects of infrastructure and stay off their military contingents on the territories of the SCO member states".

many, and China. Russia joined them and believed it formed part of a new multilateral coalition that objected to the intervention. It resulted in even more disenchantment for Russia. The anti-Iraq War coalition was confined to that event and did not result in a lasting rearrangement of allegiances.

Beyond the prominent conflicts, Russia also faced challenges as far as the broad area of arms control. The United States, and in some cases the West more broadly, has been ignorant as far as the arms control *acquis* and ignored Moscow's insistence on the continuation of arms control in those traditional areas where it developed during past decades. Russia wanted to continue arms control for three main reasons:

1. Russia was of the view that arms control may continue to make a useful contribution to strategic relations.
2. Russia, that noticed its declining importance during the 1990's, found this area where it could establish and prove its status and demonstrate its prestige as a major player, later as a pole of the international system.
3. An experienced Russian arms control establishment wanted to regain its political importance inside the national administration. In spite of Russia's efforts, arms control did not regain its once enjoyed status, and not without reason.

For the unipolar power of international security (if not of the whole international system) there was no narrowly defined security reason to pursue arms control any longer.[19] The USA, with a passive acceptance of other Western powers, has taken a pragmatic stance and replaced arms control with non proliferation. This meant moving from Russia as the main partner and refocusing attention on certain Asian countries from North Korea to Iran through India and Pakistan. No negotiations beyond SORT were pursued after the termination of the ABM Treaty and the (re-)launch of ballistic missile defence. Multilateral arms control in Europe was interrupted and taken hostage to an originally legitimate, later increasingly counter-productive US-NATO policy. Overall, Russia felt to have been downgraded and marginalized in its traditional comfort zone. The Western policies taken together, ranging from the management of burning conflicts to armed conflicts overall, gave the impression to Russia of unilateralism of the West and the systematic disregard for Moscow's interests.

In the previous cases Russia's security policy was reflective of actions of other major actors, first and foremost of the United States and the West more broadly. However, there were other areas where Russia took the initiative and shaped the international agenda. The Russian Federation has become a status quo power not long after the dissolution of the Soviet Union. Protecting the territorial and the political status quo was an adequate reflection of the significant weakening of Russia's position compared to its predecessor state. In such a situation any reasonable actor of international politics would follow that line. During its decline it has been a realistic objective to prevent its continuation and stabilize what the state is left with. Already in the second half of the 1990's, during the second term of President Boris Yeltsin, Russia made an effort to consolidate its situation internationally. However, objective reasons were not favourable at that time.

The enrichment of Russia both preceded and was going in parallel with the consolidation of the government and the recentralization of political power. These factors have increased the country's appetite. Russia was also aware that its international influence and status beyond domestic consolidation depended on a sphere of influence that was ready to follow its leadership. For Russia there was only one region that it could count on in such a capacity: the rest of the former Soviet Union. Except for the three Baltic States; Estonia, Latvia and Lithuania, the successor states of the Soviet Union were connected by multiple ties ranging from economic to ethnic and cultural links. The Russian leadership, following its inattention in the second half of the decade, by the turn of the century recognized the strategic importance of its backyard. For a while it seemed Moscow retained its monopoly in the post-Soviet space and no other influential players competed for influence over there. The few exceptions remained strictly limited to matters like building alternative oil transport routes not crossing the territory of the Russian Federation, like the Baku-(Tbilisi)-Ceyhan pipeline. Compared to its predecessor, the more assertive position of the Putin administration and its determination to establish its leadership and control in the former Soviet area collided both with the aspirations of some other great

19 See the "Declaration of Heads of Member States of Shanghai Cooperation Organization", in Astana, 6 July 2005; at: <www.sectsco.org/en/00500.html>. The George W. Bush administration pursued an arms control policy based on a narrow definition of its objectives. It considered exclusively the desired outcome, the agreements to achieve, rather than the process that it could entail for political reasons.

powers and in some sense their coalition, like the EU and the perceived interests of some successor states themselves.

There is some tendency in the world at large, primarily in the West, to be extremely critical of Russia's conduct in the former Soviet area. The criticism is certainly not unfounded. It is necessary, however, to take a fresh look and differentiate between various types of Russian actions. Some did not take the form of action beyond the normal persuasion of partners. Some took the form of economic incentives and coercion, others blackmail and intimidation. Last but not least in one specific case, Russia, in support of secessionist forces, used armed force against a successor state, namely against Georgia in 2008. One could conclude that the relationship of Russia with the Soviet successor states applied the entire spectrum of means of international politics demonstrating the intensity and the complexity of relations. Bearing in mind the level of interdependence among the successor states of the Soviet Union, this is fully understandable. The seventy (and in some cases including the history of Tsarist Russia many more) years that these countries spent together in one multinational (federal) state created economic and cultural interdependence including a national mix. Here, it is necessary to emphasize that Russia, which had the upper hand vis-à-vis each and every other country of the region, certainly demonstrated some level of intolerance and often relied on those traditional means of great power politics that its predecessor often used in the so-called socialist countries throughout the decades between the late 1940's and the mid-1980's. Sometimes Russia has not given indication of its experience with democratic politics in international relations. Overall, the record it has established is very mixed and may result in raising doubts about Russia as a power representing different political culture from the Soviet Union in its international behaviour vis-à-vis weaker states in its region. Contrary to many fields presented earlier where Russian policy was reflective upon the activity of other major players of international politics, the situation was different in Russia's neighbourhood. Although, understandably, the activity of others had influence on Russia there as well, the Russian Federation took a proactive stance based on its desire to return and shape, if not outright determine the international politics of the area.

If one takes a closer look, the Putin era gave demonstration of the reliance on means available to a country that has increased its power base and has become increasingly assertive. The fact that Russia collided with some major players of international politics, first of all with the United States in its neighbourhood, added to its determination. It would be unfounded, however, to draw the conclusion that Russia played a similarly reactive role here as in other fields of international politics. It would be interesting to imagine how Russia would have reacted had some states of the post-Soviet space declared their willingness to pursue a Western-orientated policy without this being condoned by the West. Most probably, Russia may have acted very similarly to its actual behaviour. Due to the importance of its post-Soviet neighbourhood, Russia is of the view that it cannot relinquish its authority. This included claiming the right to curtail the freedom of other post-Soviet states to choose their political course and their international allegiance.

During the first decade of the 21st century the Russian Federation aspired to consolidate its leadership role in the former Soviet area. This seemed possible in the beginning of the century. There was no state in the region which was openly and fundamentally opposed to the course represented by Russia and its leadership. It would be wrong, however, to assume that there were no controversies in the post-Soviet space. They remained fairly easily manageable, however. This was partly due to the fact that not even those states which had aspirations different from the Russian Federation presented a major challenge. First of all because their aspirations, like joining the EU and/or NATO, were not credible and hence were not supported by those Western states and institutions that were the indispensable partners of those countries. The half-hearted attempts of Ukraine to get closer to the EU or the only multilateral cooperation framework of Georgia, Ukraine, (Uzbekistan), Azerbaijan and Moldova (GU(U)AM) that was measured on its distance from Moscow are cases in point. Declaratory Western orientation until the beginning of 2004 was nowhere in the former Soviet area backed by sustainable governmental policy. (Melvin 2007)

The situation has changed when the colour revolutions took place in Georgia and in the Ukraine. It made the alternative thinking of those two states credible and easier to support. Furthermore, the George W. Bush administration very early broke away from the idea of the Clinton administration's 'Russia first' policy. With the colour revolutions the USA (and to lesser extent Western Europe) soon found two post-Soviet states worthy of support in their transformation. The external support to the now fundamentally changed regimes upset the earlier balance.

Russia demonstrated its difficulties to react in a measured and sophisticated manner to those processes. It became apparently part of the domestic policy of Ukraine, openly supporting some political forces against others. Irrespective of the complexity of the situation, including the internal division of Ukraine and Russia's stakes ranging from deep-rooted economic interests to the situation of the Russian ethnic minority through geostrategic considerations, it was certainly unwise to take sides so clearly and carelessly in a neighbour's domestic policy. This could also be regarded as a demonstration that Russia 13 years after the end of the Soviet Union still had difficulties in recognizing the independence of another Soviet successor state.

After the so-called Orange Revolution, Russia continued on an often confrontational path with Ukraine. This took various forms of coercion with particular reference to energy matters. There Russia contributed to a series of crises. They have followed the same pattern. Russia changed the price of gas supplied to Ukraine. Ukraine also had a certain often major role in the matter due to its unreliability as a transit country and as a customer with a not entirely reliable payment record. In the end, Russia did not succeed in demonstrating to the world at large that it did not use its energy wealth as a political tool, not to mention as a weapon.

Russia as well as Ukraine had to remain careful to manage their energy affairs as all this happened in front of an eagerly watching West. Namely, Western European countries wanted to see clearly who was to blame: Russia or Ukraine. If the former, the conclusion could be drawn that Europe has to diversify its gas import and reduce the dependence on Russia. If, however, Ukraine was to blame for sniffing gas out of the pipeline system to satisfy its own consumption needs and for its lack of financial discipline to pay for the gas it has consumed in time, then those Russian and other efforts which aim at the reduction of dependence on the Ukrainian gas transit infrastructure may well be sufficient. Consequently, gas pipelines, like Nordstream and Southstream, based on Russian gas delivery without Ukraine's involvement as a transit state may be the solution. If there is reason to assume that both Moscow and Kiev have contributed to the three crises in the winters of 2005, 2006 and 2009, then it is not only necessary to reduce dependence on Ukrainian transit but also on Russia as a supplier. That is the intention of the planned Nabucco pipeline system. These are technical solutions for a set of larger problems. Namely, Russia will continue to use its rich energy resources in its external relations. Due to the long-term supply-demand asymmetry the world will have to rely on Russia as an energy supplier. As long as the current constraints characterize the gas markets of the world with particular emphasis on Russia (most Russian pipelines head to Europe from Russia, the liquefied natural gas supply infrastructure is underdeveloped and some potential Asian consumers, first of all China, buy gas at a much lower price than Europe), there is no imminent reason to worry. The situation cannot be described as unilateral dependence of Europe on Russian gas, much more as interdependence between Russia and Europe. This may give sufficient leverage to the European customers particularly if they coordinate their stance more closely than in the recent past. In the longer run, however, the global energy balance gives ground for concerns as hydrocarbon suppliers, due to the relative shortage of resources, will have the upper hand. Then it will be decisive whether the West is united and whether it has a strategy to diversify its energy consumption both as far as the source, relying more on other energy resources and also geographically. The Russian activity in the energy field in the first decade of the 21st century has attempted to reassure the West and divide it at the same time while being firm with its partners in the former Soviet area. This attempt could not be fully successful but did not fail entirely either.

The Russian-Ukrainian relationship since the Orange Revolution has remained troubled as Moscow wanted to have the upper hand in various areas that the post-Orange leadership strongly opposed. Nevertheless, Russian firms gained significant influence in the Ukrainian economy. Furthermore, Ukraine could not build a strongly pro-Western policy and downplay Russia's importance as this would not have been supported by a very large part of the population and the political elite. Not to mention that western support for Ukraine could only be reflected in an eventual integration in the very long run if and when the attitude of the population were to change one day. Hence, Russia has succeeded to reassert its influence vis-à-vis a disunited and malfunctioning Ukraine. Thus, it has indirectly demonstrated that the successor states of the Soviet Union should seriously consider its perceived security interest and its position when deciding upon their political orientation and international aspirations. President Medvedev's August 2009 message anticipated that relations would improve between Russia and the Ukraine after the January-February 2010 Ukrainian presidential elections.[20] It is clear that

the Russian vector of Ukraine's international relations will remain of primary importance.[21]

The other troubled relationship that is worth mentioning here is between Georgia and Russia. Georgia was the first country where a colour revolution occurred. The new, Western-educated and Western orientated Georgian President Mikheil Saakashvili put the unification of the country very high on his government's agenda the moment he came to power. This aspiration planted the seeds of a conflict as in three areas of Georgia (Abkhazia, Ajaria and South Ossetia) puppet regimes took control since the first half of the 1990's that existed due to the mercy of Moscow. In the case of Ajaria that was not adjacent to Russia, Georgia soon achieved success. The small area returned to Georgian rule. When Georgia tried to follow its government's promise in 2006 and made an attempt to achieve the return of South Ossetia to Georgian rule, it collided with Russia and came close to a violent conflict. Russia tried to coerce Georgia by applying a variety of sanctions.

What followed after the so-called Rose Revolution was six years of constant clashes between Russia and Georgia. The former wanted to curtail the choice of the latter, in particular its aspiration of an eventual accession to Western institutions, notably to NATO. The more Russia insisted on that, the more the Georgian leadership emphasized the importance of its NATO membership. The Republican administration of the United States strongly supported Georgia and thus fuelled its expectations. The result was two assertive powers, though in highly asymmetrical positions of strength, trying to implement diametrically opposing agendas and both confident that their security can be guaranteed only if the other does not achieve its goal (Fedorov 2008: 2).

The conflict escalated vertically and gained a more clearly military dimension. A Georgian UAV was shot down in the airspace of Abkhazia (Georgia) in April 2008 shortly after the Bucharest NATO summit that in unambiguous terms offered the prospect of eventual NATO membership to Georgia (and Ukraine): "We agreed today that [Ukraine and Georgia] will become members of NATO."[22]

On 7 August 2008 war broke out between Georgia and Russia. The conflict, though intensive in the tactical sense, remained limited. Georgia was not occupied, and the Saakashvili government was not overthrown. It was Georgia's aim to achieve the return of South Ossetia to Georgian rule. There could have been such forces which were of the view that the conflict was worthwhile as Russia suffered a major propaganda defeat and was identified as an aggressor. Those who contemplated such an outcome did not count on subsequent developments. The results of the five-day war were highly detrimental to Georgia. The two territories, which were *de jure* under Georgia's control, Abkhazia and South Ossetia, have been lost irrevocably. Furthermore, their independent statehood was recognized by the Russian Parliament, the Duma, two weeks after the end of military confrontation. The expectation that Russia would be identified as aggressor was also undermined a year later by the independent international fact-finding commission that was tasked to report to the Council of the European Union. It concluded that the "shelling of Tskhinvali by the Georgian armed forces ... marked the beginning of the large-scale armed conflict in Georgia" (IIFFMCG-CEIIG: 11). It is a separate matter that Western public opinion continues to be convinced that Russia was the aggressor. Russia, that had certainly provoked Georgia before the war in various ways, went to war and came out of it with a positive sum result for itself. It created a new territorial status quo in the South Caucasus as a result of the use of force. This carried the message that force continued to be a useful tool of international politics and could be used for the resolution of territorial conflicts. Russia was fortunate to achieve some gains without being identified as the aggressor. A situation to the contrary would have certainly significantly curtailed the freedom of Western states to return to 'business as usual'.

20 Robert Coalson: "Russia's Message to Ukraine Echoes Across Former Soviet Union", RFERL, 12 August 2009; at: <http://www.rferl.org/content/Russias_Message_To_Ukraine_Echoes_Across_Former_Soviet_Union/1798413.html>.

21 The most eloquent demonstration of the major improvement of Russian-Ukrainian relations has been the extension of the Russian lease on the territory of Ukraine for the Black Sea navy for further 25 years beyond 2017 (until 2042) followed by an optional five-year extension after that term expires. Dmitry Medvedev signed Federal Law On Ratification of the Agreement between the Russian Federation and Ukraine on the Presence of the Russian Federation's Black Sea Fleet in Ukrainian Territory, 21 April 2010; at: <http://eng.kremlin.ru/text/news/2010/04/225721.shtml>.

22 "Bucharest Summit Declaration Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Bucharest on 3 April 2008"; at: <http://www.nato.int/cps/en/natolive/official_texts_8443.htm>: 23.

It has demonstrated as well, however, that the Russian armed forces do not excel even against a significantly weaker adversary. Last but not least, it served as a deterring example for the eventual forceful resolution of other territorial disputes, like the pending conflict between Armenia and Azerbaijan concerning Nagorno-Karabakh.

14.4 Conclusions

Following a decade of weakness, internal chaos, and a set of humiliating experiences with the West, first of all with the United States in the 1990's, it was Russia's main aspiration in the first decade of the 21st century to return to the scene of world politics as a great power and a pole of the multi-polar international order. This was the main underlying factor of its international policy. It identified the United States as representing the main challenge against this aspiration since the USA has established a unipolar international security order and since the late-1990's represented it assertively. Russia was generally less anxious about the fact that even if due to the co-existence of various reasons the world would turn to multipolarity, Russia would face difficulties to establish itself as a pole of the system.

Russia's return would require consolidating its situation domestically, modernizing its economy, and reducing its dependence on the export of hydrocarbons and other natural resources. It would also require guaranteeing that it fights effectively against challenges to its territorial and political integrity. It has achieved a lot in this area; its territorial integrity is no longer challenged. It still has not been able to eliminate domestic terrorism, however.

The international security policy of Russia raised some concerns. In some directions it was rather reactive first and foremost with respect to the United States. It has tried to reverse the adverse change of international politics. This started with the 1999 so-called Kosovo War and continued throughout the decade. There were two areas where Russia took a proactive stance and made sustained efforts to determine the course of international security. These two areas have been energy policy with an emphasis on hydrocarbon export and the post-Soviet space. Activity in these two areas has raised doubts about the goodwill of the Russian state. However, Russia was proactive in the former Soviet area where it was Moscow's objective to determine the agenda of the region. Due to the resistance of some states Russia felt it necessary to impose its will on those others which did not follow it voluntarily. In the area of the former Soviet Union it has claimed nearly exclusive right to gain influence on the behaviour of other sovereign states. This is understandable as Russia very well knows that without decisive influence in "its backyard" it cannot present itself as a pole of the international system. Nevertheless, Russia cannot "draw lines in the sand" and curtail the freedom of choice of other countries. It has to revise its current approach and find a more constructive one. The West, among others in light of its recent experience, will no longer push for the rapid political transformation of Eastern European and Central Asian countries in the post-Soviet space. It is certain nevertheless that some parts of the former Soviet area will remain the least settled and most contested part where Russian and Western interests in one form or the other may collide. Unless the post-Soviet area unanimously recognizes Russian leadership without reservation – a highly unlikely scenario – or the West retreats and thus betrays those in the region who seek modernization and democratization and independence from Moscow.

Russia presented itself as a great power in supplying hydrocarbons. This has been accompanied by an offensive energy strategy. There was no doubt left that energy policy has become part and parcel of the country's external relations. That has raised concerns in particular as Russia did not succeed to demonstrate that it would not rely on its rich resources and the dependence of some countries on them at critical moments. It is possible that Russia gave 'too early warning' about its intentions. This might make its European partners consider options that would reduce dependence on Russia as the single most important energy supplier of Europe. Russia's reliance on energy supply as a political tool illustrates the thesis that states tend to stand on their 'strong leg' in their policies.

Russia, in continuation of the best Soviet traditions, regards its armed forces as a national institution and a matter of national pride. Although Russia achieved victory in those two wars (Chechnya, Georgia) which its armed forces fought in the first decade of the 21st century, in neither case has it demonstrated convincing superiority. It has underlined that Russia could regard itself fortunate that it does not face a more formidable adversary. It has also demonstrated the fact that the increased defence expenditures have not resulted in a breakthrough of performance, yet. This illustrates that introducing an adequate, effective

structure is a precondition of the increase in efficiency.

Russia has been at least partly successful in fighting terrorism. It achieved that North Caucasian terrorists moved away from massive hostage taking and re-orientated themselves to other tactics. The fact that terrorists attack hardened targets in the North Caucasus nowadays demonstrates that the Russian authorities continue to face domestic contingencies they do not fully control.

Russia has partly realized its objective. It is recognized as an important player of the international system and a potential pole of a multi-polar order. In spite of its great power traditions, nuclear arsenal, and energy resources, it is not the strongest among those poles which combine market economy with authoritarian politics. For Russia, in spite of the experiences of the eight years of unipolar politics of the George W. Bush administration, it is not the USA that presents the biggest challenge in the multi-polar system. But it may well be that another major actor of international politics that represents similar combination of authoritarian politics and market economy is, the People's Republic of China. If the USA and China were to head in a direction of bilateral cooperative global management, Russia would have a new difficult reality to face. But in the early 21st century this appears unlikely.

15 Non-Traditional Security and the New Concept of Security of China

Zhongqin Zhao

15.1 Introduction

With progressing globalization after the end of the Cold War, the *national security concept* (NSC) has experienced new situations and has faced new challenges. Globalization, as an important variable affecting national behaviour around the world, has deeply influenced the people's understanding of national security to adopt a new perspective in addressing NSC issues, thus initiating relative changes in the NSC. On this background the Chinese government adopted a new security concept based on mutual trust and benefit, on equality and cooperation. Based on this guidance, the Chinese government launched diplomatic moves for a new security environment in the 21st century.

15.2 Towards a Comprehensive Security Concept

During the Cold War period, the security concept was interpreted narrowly to mean territorial security against external aggression and to maintain national independence. Then the attention focused only on military and political security. Since the end of the Cold War, the security problems facing each nation have become more complicated. The definitions of security have changed and gradually a comprehensive security concept emerged. Related notions of 'economic' and 'ecological security' were advocated. The means for realizing security are gradually turning from 'zero-sum' considerations to 'win-win' situations. The thinking shifted from confrontation, contradictions, and conflict among nations to seeking cooperation and common ground to overcome the 'security dilemma' while differences remain. In accordance with changes in security bodies, the security content and the means for realizing security, i.e. 'absolute state sovereignty' has been severely undermined due to globalization, and this has changed the way of safeguarding a nation's sovereignty.

15.3 China's Evolving New Security Concept

Globalization and non-traditional security problems resulted in a new security concept. Non-traditional security issues are increasingly posing new threats. As a consequence, changes have occurred in basic concepts of international and national security. This requires modifications in the theories of security, of the causes of security threats, and regarding the means to safeguard security. Mutual trust, mutual benefit, equality and cooperation have been fundamental for China's new security concept.[1] In dealing with non-traditional security, China's new security concept has been deepened and enriched since the early 1990's by globalization and non-traditional security. 'Comprehensive security'[2] is the key characteristic of present security, and 'common security'[3] is the ultimate goal for safeguarding security while 'cooperative security'[4] is the effective way of its implementation.

Since the end of the Cold War, non-traditional challenges for the security of nations and human beings have increased. The concept of non-traditional security has been widely used in international politics and international relations. Major countries tabled

1 See Jiang Zemin's speech on 1 July 2001 in honor of the 80th anniversary of the foundation of the Communist Party of China

2 On comprehensive security see Zhu Yangming: *On the Asian-Pacific Security Strategy* (Beijing: Long March, 2001): 132–134.

3 On common security see Zhu Yangming: *On the Asian-Pacific Security Strategy* (Beijing: Long March, 2001).

4 Cooperative security is defined as seeking security through cooperation. See Zhu Yangming: *On the Asian-Pacific Security Strategy* (Beijing: Long, March 2001): 134–135; Ren Xiao: *From Collective Security to Cooperative Security* (Beijing); Zai Ren Xiao, *New Horizon Theory of International Relations* (Beijing: Long, March 2001): 182–193. Essentially, the definition of cooperative security takes the concepts of common security and comprehensive security as its basis.

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new security concepts, such as 'comprehensive', 'common' and 'cooperative security'. Since the Asian financial crisis in 1997, China gradually developed the basic idea of its new security concept where 'comprehensive security' is crucial. 'Common security' is the ultimate goal and 'cooperative security' is the effective way of safeguarding international peace. China has combined its new security concept with the principle of mutual trust, mutual benefit, equality, and cooperation.

15.3.1 Features of China's New Security Concept

China's non-traditional security concept has the following features. *First*, it stresses the diversity of actors. The new non-traditional threats come from non-state actors, such as individuals, organizations and groups, not always from a country. *Second*, many new security threats are transnational with regard to their causes and possible solutions. They refer to no specific problems in a certain country, but to problems that are possibly related with benefits for some countries or human beings. This does not only threaten the security of an individual country but also, to a degree, the national security of other countries. *Third*, China's understanding of non-traditional security stresses the uncertainty and changeable nature of 'soft' security problems. Soft security always has changing elements which are not only interchangeable with traditional security threats but also related to other policy fields. *Fourth*, China's non-traditional security stresses the non-military nature of security, which does not directly threaten the country with military measures but is related to a combination of economic problems, environmental deterioration, cultural acknowledgement, and social system and conventions. These factors may threaten regional stability and the security of human beings. *Fifth*, China wants to resolve these non-traditional security problems through international cooperation and coordination. These non-traditional security threats overcome the so-called 'prisoner dilemma' and the antagonistic 'zero-sum' relationship and promote cooperation among each other. *Sixth*, China's non-traditional security concept stresses the security of human beings and takes the existence and development of humankind as the core of its soft security concerns.

Since the early 1990's the Chinese government has formulated its new non-traditional concept of security. Globalization creates social and environmental problems affecting the existence and development of human beings across the borders and regions. They become a common threat to humankind. These widespread transnational security problems can neither be solved by an individual or a country, nor with military means. The Chinese government maintains that comprehensive measures and cooperation should be pursued by the international community and that a new security concept is needed to solve these global problems.

This new security concept differs from the traditional security concept. *First*, in the traditional concept 'national security' is placed in the centre, being mainly confined to the security of the country. Every country perceives other countries as potential threats to its security and as elements of its reality. However, this new security concept emphasizes that the problems of non-traditional security are related to human beings and to the security of peoples. In addition to pursuing its own security, each country should take the security of other countries and of the international community into account; otherwise there will be no security of its own. The non-traditional security approach creates common benefits based on this new common security concept. The traditional security concept focuses on military security, while the new security concept includes economic, social, environmental, and cultural security dimensions besides the narrow traditional military security, thus making it a comprehensive security concept. *Third*, the traditional concept of security stresses the formation of military blocs based on zero-sum games on issues of life and death, while the new security concept stresses the establishment of new organizations, mechanisms, and new ways of cooperation. *Last but not least*, the traditional security concept addresses how to deal with the threats, while the new security concept stresses how the threats can be prevented from occurring.

Comprehensive security is the basic feature of the present security concept. During the 1980's the security concept gradually widened to include economic and environmental issues. Since the 1990's, comprehensive security expanded from the military to other fields, and in the early 21st century the security concept comprises military, economic, and environmental dimensions. Non-traditional threats and traditional security problems can be easily intertwined and cause tensions in international relations and turmoil in some regions. Whenever the government of a country addresses traditional security, e.g. military defence, it is expected to express concern for other threats to security such as the environment and economy and social problems. Common Security is the ultimate goal

to safeguard international security. Globalization creates more common benefits for each country as countries depend more on each other. The global crises confront each country with common shocks and challenges. Thus, countries are closely related to face these new security dangers. The international community should seek common security where cooperative security offers an effective way to safeguard international security. Non-traditional security is related to a wide range of problems, including security issues of the economy, finance, culture and society, which cannot be easily settled merely by using military measures. In order to deal with these new threats, efforts should rely more on joint multilateral mechanisms and on the involvement of the international community. Thus, to deal with non-traditional security threats in the era of globalization, regional and international cooperation are required as an effective way to cope with these new problems. The security of human beings is the focus of attention of this new security concept. It includes the right of existence by averting starvation, diseases, war and natural disasters, and it also implies the right to seek better living conditions and a healthy environment, which are core values of this new concept of security.**t**

15.3.2 Implementing China's New Security Concept

This new concept of security requires the establishment of mechanisms at three levels of the state, the region, and the globe. From the national perspective each country should improve and optimize the mechanisms to guarantee the comprehensive security of its citizens. It should a) consolidate the construction of legal systems, b) improve its social security system and the mechanism for the allocation of social resources, c) coordinate the benefits of different regions and groups, d) establish the preventive mechanism, and e) propel the society to develop in a comprehensive manner. From the perspective of regional cooperation, the neighbouring countries have a better understanding as they face certain problems of non-traditional security and as it is easier for them to establish the cooperative mechanisms. Therefore, the regional cooperative mechanism is an effective way to solve non-traditional security, as a necessary and fundamental complement. From the perspective of multilateralism, the governments and some NGOs cooperate with each other on some issues of common interest and establish a series of cooperative mechanisms which are good for information exchange, coordination, and for having a sense of common interest. It is also beneficial for creating the basis for cooperation and providing support for each other on some key issues at critical moments. From the global perspective, the UN and other international organizations can solve common issues and conduct international exchanges.

China is an active initiator and promoter of this new concept of security and it was the first country to abandon the Cold War mentality. In the early 1980's, when the Cold War had not yet ended, Deng Xiaoping argued, with keen political insight, that peace and development were the two themes of the time. The thinking on non-traditional security became an important element in China's efforts to foster a new concept of security after the end of the Cold War.

Especially after the financial crisis in Asia in 1997, China began to pay more attention to the security questions pertaining to the economy and finance. After the terrorist attack on 11 September 2001, the Chinese government and academic circles began to better understand several non-traditional security threats, like terrorism. China has repeatedly stressed that traditional and non-traditional security are interwoven in the present world, and it refers to the escalation potential of non-traditional security threats for the security of China and for world peace.

In fact, since the end of the Cold War, the Chinese government has deepened its understanding of international security. It has pointed to the changes in the regional security environment and has concluded that military action cannot thoroughly solve international disputes and contradictions. A security concept that relies only on the use of military force cannot create a lasting peace. Thus, the strategies for seeking security have become diversified. The new security concept requires the strengthening of dialogue and cooperation, which has become an important measure. The purpose for launching this new concept of security is to abandon the Cold War thinking and to actively meet the challenges posed by the threats in the new security environment. All this reflects the comprehensive thinking of the Chinese government on national security and on the principles of international relations.

At the core of the new security concept are mutual trust, mutual benefit, equality, and coordination. All countries should secure their common security through mutual trust and by solving their disputes peacefully through friendly negotiation and consultation. Mutual trust means that each country should go beyond its ideology and social system, and should har-

bour no suspicions of the other or be hostile. The countries should inform each other on relevant issues of security, defence, and on important actions. Mutual benefit means that countries should respect each other and create conditions for others to realize common security when it is defending its own benefits and security. Equality means that each country is a member of the international community. Each country, big or small, strong or weak, should respect and treat all states equally. No country should interfere into the internal affairs of other countries and impede the move towards democracy in international relations. Coordination means that each country should solve disputes through friendly negotiations and consultations and should have deep and broad cooperation on security issues of their common concern to overcome potential perils and prevent wars from happening.

The *Shanghai Cooperation Organization* (SCO) is a successful example for effective ways of carrying out this new security concept. The SCO's predecessor, the Shanghai Five mechanism, originated and developed from a joint endeavour by China, Russia, Kazakhstan, Kyrgyzstan, and Tajikistan to strengthen confidence-building and speed up disarmament in the border regions. In 1996 and 1997, the heads of the five states met in Shanghai and Moscow respectively, and signed the 'Treaty on Deepening Military Trust in Border Regions' and the 'Treaty on the Reduction of Military Forces in Border Regions'. These five countries successfully solved their historical border disputes and agreed to jointly fight against terrorism, separatism, and extremism. After the establishment of the SCO, the 'Shanghai Convention against Terrorism, Separatism and Extremism' was signed, in which those three challenges in its five member states were clearly defined for the first time. Furthermore, an 'Agreement of the SCO Member States on the Regional Structure for Counterterrorism' was signed. The main purposes of the SCO are: a) strengthening mutual trust, good neighbourhood and friendship among member states; b) developing their effective cooperation in political affairs, the economy and trade, science and technology, culture, education, energy, transportation, environmental protection and other fields; c) working together to maintain regional peace, security, and stability; and d) promoting the creation of a new international political and economic order featuring democracy, justice, and rationality.

The *Association of Southeast Asian Nations* (ASEAN) '10+3' (China, Republic of Korea and Japan) and the '10+1' (ASEAN and China) cooperative mechanism were launched after the Asian financial crisis. The fields of cooperation were expanded from the economy and finance to closer cooperation in science, information, environmental protection, and society. Under the framework of ASEAN '10+3', a multilevelled cooperative network has been established, which consists of ministerial meetings and deputy ministerial meetings of foreign affairs, economy, finance, transportation, labour, information and education, and some semiofficial seminars and academic conferences. It is the largest cooperative mechanism among governments in Asia.

The new concept of security is not only beneficial for the solution of the problems of non-traditional security, but also helpful for improving and developing traditional relations among major powers. Several years[5] after the new concept of security was launched, China established new partnership relations with major global powers and formed a new international security environment for China based on this new security concept as its guiding principle.

In addition to strengthening the cooperative mechanism of regional security, China cooperates with the US and EU to fight against international terrorism and other non-traditional security threats. After the events of 11 September 2001, China and the US established long-term and medium-term cooperative mechanisms to fight against international terrorism. So far many departments in both states have been involved and these mechanisms have worked well. China actively participates in concerted actions launched by international organizations. China has worked together with the UN to deal with non-traditional security threats, and it cooperated with the WHO during the SARS period, bringing this severe pandemic effectively under control. Thus, China uses diplomatic opportunities to enhance cooperation with other countries on non-traditional security threats, and China has acquired an international image as a responsible big power.

However, during the process of implementing this new security concept, some countries still adhere to the concept of power politics and use it as an excuse for fighting terrorism to pursue a new form of imperialism. In the present international situation, each country stresses the role played by soft forces and employs different resources and means to improve its in-

5 In March 1997, the Chinese government officially announced the new concept of security at the ASEAN Regional Forum.

ternational image. 'The year of the nation' and 'the culture of the nation' are actively promoted. At the same time, some barriers among different cultures and civilizations are not easily overcome. The disputes over international order, sovereignty, and human rights are endless. The world economy is developing unevenly under the conditions of economic globalization. The prices of key products like crude oil are highly fluctuating and the international competition for energy resources has become increasingly fierce. Trade protectionism and economic nationalism have gained ground. But the coordination among international economic policies and the regional economic cooperation is being strengthened and deepened.

15.4 Conclusion

After the end of the Cold War, with the rapid development of globalization, the concept of 'national security' is undergoing rapid changes both theoretically and practically. Since nations came into being, they have always been the main actor in the international system. In a globalized world, national security is going beyond the main body and category of the 'nation', and expanding its focus to 'human security' and 'international security'. 'Human security' started to become an important subject in the area of national security research. Maintaining the security of civilians and ensuring the realization of their rights has become an essential part of national security. The security content is also expanding horizontally from the previous military and political security to a notion of 'comprehensive security' that includes economic and ecological security.

Globalization and non-traditional security problems brought about the concept of new security. Most challenges to the NSC in the era of globalization were originally addressed in the academic world and by international organizations. Whether the changes of the NSC will be adopted as a national policy greatly depends on whether they are accepted and chosen by a nation.

After absorbing some positive elements of the new security concept from the western academic debate, the Chinese government has formulated its new security concept with 'mutual trust, mutual benefit, equality and cooperation' as its core. To meet the aim of security, the Chinese government calls for constructing a 'harmonious world', seeking 'universal security' of the international community; As to the security content and security means, China emphasizes 'comprehensive security'; and with regard to its implementation, China advocates 'cooperative security' based on mutual trust and mutual benefit. This new security concept reflects the progress of our times by vigorously promoting world peace and development. It has become the guidance for the planning of China's national security policy.

Guided by such a 'comprehensive security concept', humankind should overcome the 'zero-sum' relations among nations, establishing international relations based on coexistence aiming at 'mutual benefit' and 'win-win' situations where interests are shared and risks are countered jointly in order to promote cooperation among countries.

16 Perceptions of Hard Security Issues in the Arab World

Gamal M. Selim

16.1 Introduction

During the last half century, Western literature on International Relations (Haas 1964; Lindberg 1963; Haas/Schmitter 1964; Buzan/Wæver/de Wilde 1998; Keohane/Nye 2001) has developed a number of dichotomies, the most important of which have been the high politics vs. low politics, geopolitics vs. geo-economics, old security threats vs. new security threats, and the hard security vs. soft security dichotomies. These dichotomies are based on the assumption that it is possible to dissect the elements of the dichotomy, at least temporarily, and to focus on its second element, which will eventually influence the first in a positive way. For example, one of the most significant conventional arguments of the functional theory of integration has been that cooperation in the area of low politics may spill over to high politics. In the age of globalization, some theorists have argued that geo-economics has surpassed geo-politics, and that emphasis on the geo-economic issues will facilitate dealing with geo-political ones.

In the same vein, one of the main dichotomies has been between 'hard' and 'soft' security. Whereas hard security refers to the military aspect of security, and deals with issues associated with territorial control, use of military weapons especially those of mass destruction, and terrorism, soft security addresses the non-military dimension of security, and is associated with issues related to the environment, energy, drugs, technology, and population. It is assumed that each type of security entails different priorities, and tools. This distinction between hard and soft security mainly emerged after the end of the Cold War in the context of the end of the Soviet threat to the West. This meant the decline of 'hard security threats' to the West, and the shift of attention towards soft security issues (Brauch 2008, 2009). However, this was not the case in other regional areas where hard security threats became more dominant and acute.

The objective of this chapter is to review Arab perceptions of hard security issues at the governmental and non-governmental levels with a view of comparing them, identifying elements of change and continuity of these perceptions, and assessing their implications for security in the Arab world and the Middle East. This review is based on the assumption that perceptions influence the prospects of regional stability and conflict resolution.

16.2 Arab Views on Hard and Soft Security

By and large, the security dichotomies have not been significantly integrated in the Arab discourse at the academic and policy-oriented levels. This can be attributed to the conceptual underpinnings of Arab political thinking which tends to view issues as interrelated rather than compartmentalized. Issues are mostly seen as part of an overall phenomenon in which all elements lead to each other. There is little distinction between the political and the non-political, politics and ethics, politics and economics, and state and religion. It is mostly argued by Muslim jurists that Islam is 'a system of life' in which the social, moral, economic, and political components are part of the overall system. In his book, *The System of Life in Islam*, Al-Mawdoody (1965), a leading Muslim jurist, asserted that in Islam all elements of life are, and should be inter-related, if the objective is to build a genuine Muslim society. He argued that Islam is a way of life encompassing moral, social, economic, and political sub-systems which are an integral part of an overall Islamic system. Muhammad 'Abid al-Jabiri, one of the most distinguished thinkers in the contemporary Arab world, has also emphasized this element of inter-connectedness in Arab and Muslim political thinking. In his book, *The Structure of the Arab Mind,* Al-Jabiri argues that Muslim thinkers "did not view space and location as independent of their sub-

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stance, as they linked the object with its location and space, and viewed them as one entity" (Al-Jabiri 1996: 191). Such a tendency partially explains why a disagreement among Arab countries on one issue spills over to all other issues which may not necessarily be a matter of dispute.

The distinction between hard and soft security issues has not readily been accepted in Arab political discourse due to other factors. The distinction assumes that hard security issues have been controlled and that soft security issues have emerged as the most urgent security threats. This has not been the case in the Arab world. The end of the Cold War did not end hard security threats for the Arabs. On the contrary, some of these threats have deteriorated even further, especially after the events of 11 September 2001. When hard and soft security issues co-exist in a certain domain, as has been the case in the Arab world, it is hardly possible to separate or prioritize them. Further, most Arabs have not been convinced that a focus on soft security issues would help to resolve their hard security challenges, as they see them deteriorating even further. In addition, Western countries have reinforced this trend in Arab political thinking, as they have focused on hard security issues and approaches in securing their own interests in the Middle East. This direction was evident in relationship to Iraq, which was subjected to the most severe system of sanctions in the twentieth century, and which led to the misery of millions of Iraqis. This focus culminated in the Anglo-American invasion of Iraq in 2003 which resulted in the virtual destruction of that Arab country. After 11 September 2001, the Arab world almost returned to the 'Hobbesian' state of nature in which 'hard power' became the main tool of Western actors in achieving their interests in the region. Some Western powers focused on 'the War on Terror', employing mainly military instruments including military invasions. They also focused on eliminating weapons of mass destruction from Arab and Iranian hands, leaving those with Israel intact. In addition, the second Palestinian *Intifada* [Uprising] of 2000 was mostly dealt with through military means, which led to the destruction of the Palestinian infrastructure. After the completion of the Anglo-American invasion of Iraq, the Iranian nuclear issue dominated Middle Eastern politics and as a result, hard security issues gained more momentum.

Under these conditions, it was almost impossible for Arabs to distinguish between hard and soft security issues, and when they made such a distinction they tended to place more emphasis on hard security issues. One of the best illustrations of this trend is the anthology of articles on Arab national security edited by Ayoub (2003), an Egyptian analyst, and written by a number of Arab intellectuals representing different political stances. Seventeen out of twenty-five articles dealt with hard security issues, and when the editor short-listed the main threats to Arab national security, he referred mainly to hard security issues such as unbalanced US policy in the Middle East, Israel's territorial ambitions, and Turkish-Israeli military co-operation.

The West has also reinforced the Arab tendency to think of hard and soft security issues in a single framework in another important way. The Western literature on security questions the validity of the distinction between hard and soft security. For example, Buzan, Wæver, and Wilde (1998: 196) adhere to a 'sectoral' approach to security, according to which they dissect security into five sections (or dimensions): military; environmental; economic; societal; and political. However, they conclude that there is too much overlap and interplay among the sectors, and that "units integrate the sectors both in their policy making processes and in the way they relate to each other. Therefore, in political terms, there is *one* integrated field of security" (italics added, GS). This trend was reinforced after 11 September 2001 as Western scholars contended that in the events of September 11, civilian airliners were used by civilians against civilian targets, and as a result they concluded that "the neat dividing line between hard and soft, civil and military is rapidly dissolving, requiring far more flexibility on the part of Western state security institutions than has been hitherto been the case" (Lindley-French 2004: 2). One may also cite the case of energy, which has been traditionally classified as a soft security issue (Selim/Sahar 2009). Oil pipelines have been exposed to armed attacks which threatened the flow of oil, and turned the issue into a hard security problem.

If Arabs emphasize the inter-relatedness of hard and soft security issues, most of them do not necessarily advocate hard (military or coercive) security strategies to deal with hard security issues. As a result of the American military occupation of an Arab country, and the overwhelming tilt of the balance of power in the region in favour of Israel, it has become obvious that Arabs have no military option, and as a result most of them, with the exception of some militant resistance groups, advocate political means to deal with hard security issues. This includes Syria, the staunchest champion of hard security issues. Numerous Israeli military attacks on Syria have not been recipro-

cated, and Syria is advocating a strategy of negotiation with Israel.

16.3 Levels of Arab Perception of Security Issues

In examining the content of Arab perceptions of hard security issues, it is hardly possible to determine a unified Arab perception of any of the issues under review. In this respect, one can differentiate between two dimensions. The first is the distinction between perceptions of different Arab countries, and the second is the distinction between elites and mass perceptions.

In the first dimension, one can distinguish between perceptions of three categories of Arab countries: i) Arab Maghreb countries (Algeria, Libya, Morocco, Mauritania, and Tunisia); ii) Arab Mashreq countries (Egypt, Iraq, Jordan, Palestine, Lebanon and Syria); and iii) Yemen and *Gulf Cooperation Council Arab States* (GCC), which include Bahrain, Kuwait, Qatar, Oman, Saudi Arabia and the *United Arab Emirates* (UAE). Perceptions of security issues vary as we move from one Arab sub-region to the other. This is because the distances between each Arab country and each issue are not the same. Whereas hard security issues are dominant in the Arab Mashreq and the GCC states, they are of less importance in the Arab Maghreb. In the Arab Mashreq and the GCC, security issues related to the Arab-Israeli conflict and threats emanating from the American invasion of Iraq, the Iranian nuclear issue, and terrorism, are quite central in Arab political thinking. With the exception of the conflict over Western Sahara, most of the dominant issues in the Maghreb are soft security ones.

On the second level, there are wide variations between perceptions of the ruling elites, and civil society on hard security issues.[1] At the level of the ruling elites one may identify three basic elements. The first element is the gap between the actual threats ('objective security') and the perceived ones ('subjective security'). Whereas the Anglo-American military interventions in the region are a hard security threat, the ruling elites in Egypt, Jordan, and the GCC states do not perceive them as such. On the contrary, they facilitated them. This can be accounted for by the American 'existential' pressures on Arab regimes to cooperate with the Anglo-American design in the region, or face assured collapse. In this respect, Arab ruling elites are acting to secure regime survival, as regime collapse is viewed as the most crucial security threat. This has been acutely articulated in the case of Libya, which abandoned its nuclear programmes under these Western threats. This was done despite Libya's continued emphasis on the Israeli nuclear arsenal as a security threat. In this case, regime survival has been perceived as more important than deterring Israel. The second element is that the most central hard security threat articulated by most Arab ruling elites is the threat of domestic terrorism. In fact, dealing with this threat has become the main security concern of most GCC states, as such threats de-legitimize regimes, and put them at loggerheads with the USA when local networks attempt to go to Iraq to fight Western forces. The third element is that Arab ruling elites are also more likely to focus on domestic security issues rather than external ones, as the latter seem to be out of their control. For example, the political platform of the Egyptian President Mubarak during the presidential elections of 2005 hardly dealt with external security issues, and only dealt with them, when it did, in vague terms.

Generally, Arab civil society is more radical than the ruling elites. Civil society radicalism comprises two levels. The first is an emphasis on hard security issues to the detriment of soft security ones. That does not mean that Arab civil society marginalizes soft security issues. In fact, there are numerous civil society groups dealing with issues of the environment, human rights, and energy, among many others. Rather, it means that hard security issues are viewed as more central and urgent. The second level is the subscription of Arab civil society to the most radical views on hard security issues. For example, on the Iraqi question they call for the defeat of the American project in Iraq, and are quite critical of any normalization with

1 Mass perceptions of most hard security issues are hardly articulated, as mass involvement in these issues in most Arab societies is limited. In fact, Arab masses, at the grass root levels, are almost apolitical given the traditional authoritarian character of Arab regimes which tends to penalize involvement in opposition politics, and given the impact of the oil wealth which over the last three decades has oriented the masses towards the quest for wealth accumulation rather than politics or security. This does not mean a lack of interest in security issues, but rather reluctance to articulate that interest in public forums unless at times of acute crises. Arab mass perceptions are best articulated in public opinion polls conducted during the broadcasting of the weekly programme "The Opposite Trend" of the Qatar-based satellite channel Al-Jazeera; one clearly finds that the majority adopt the radical side of each issue being discussed (see at: www.aljazeera.net).

Israel before the full withdrawal of Israeli forces from Palestinian, Syrian, and Lebanese territories. Contrary to the dominant views of the ruling elites, they consider Israel as the main security threat in the Arab-Israeli conflict, and the USA as the main security threat in the Iraqi conflict.

In addition, one may distinguish between two main trends in Arab civil society: the neo-liberals, and the radicals. Whereas the first is a minority, the second represents the majority. The neo-liberals, represented by intellectuals such as Abdel-Monem Sa'id, director of Al-Ahram Center for Political and Strategic Studies in Cairo, and Khalil Haider, a prominent Kuwaiti author, argue that Arabs should focus on geo-economics and soft security issues, fully and unconditionally integrate with all aspects of globalization, and endorse US regional and global projects. In fact, some of them were openly supportive of the Anglo-American invasion of Iraq, did not consider the Arab-Israeli conflict as a security priority, and were critical of the slow pace of privatization and trade liberalization in most Arab countries. They assert that an emphasis on soft security issues will lead eventually to the resolution of hard security threats and geo-political issues (Said 1996; Haider 2006). The radicals, in turn, are a conglomeration of Arab nationalists, Islamists, and leftists. The nationalists are best represented by institutions such as the Center for Arab Unity Studies based in Beirut, and the Arab Nasserite Party based in Egypt and its weekly *Al-Araby* (Al-Araby. com). Among the leading Islamists in the Arab world are Mohammad Emara of Egypt, Sheikh Yussef al-Qaradawy of Qatar, and Prof. Said Hareb of the United Arab Emirates (Mabrouk 1999). One may also add here the *Islamonline.net* website. Finally, the leftists are represented by the ruling party of Syria, al-Ba'ath Party, and the scholars such as Gouda Abdel-Khaleq of Al-Tajammu Party in Egypt. All of them have in common either a rejection of globalization, or advocacy of a cautious and conditional integration with its processes. They also view security issues, such as the Iraqi and Palestinian questions, the Israeli nuclear threat, as the most crucial security issues, and are critical of the Western projects in the Arab world.

Finally, Arab perceptions of security are not restricted to these two main ends of the spectrum. In fact, there are a number of variations of Arab perceptions between these two main extremes, with some political actors subscribing to some elements of the perceptions of each type. For example, although Al-Wafd Party in Egypt is a liberal institution advocating a capitalist mode of development, it adopts views on hard security issues quite similar to those of the leftists.

16.4 Arab Perceptions of Hard Security Issues

Perhaps the main Arab hard security issues are those related to the Arab Israeli conflict, the invasion and occupation of Iraq, Arabian Gulf security, the Iranian nuclear programme, and the hard security issues of the Maghreb countries. The choice of the issues is based on the frequency and intensity of their articulation in the public discourse of governments and civil society institutions. Further, whereas the first, third, and fifth of these issues are legacies of the Cold War era, the others emerged only after the end of that War, which proves that the end of the Cold War has not ended or marginalized hard security issues in the Arab world. A brief review of Arab perceptions of these issues follows below.

16.4.1 The Arab-Israeli Conflict

The Arab-Israeli conflict is the oldest and most acute security threat perceived by most Arabs, especially at the level of civil society. There is a great deal of emphasis in the Arab security discourse on the centrality of resolving the Arab-Israeli conflict as a prerequisite for resolving other hard security issues, although such emphasis has recently declined after the events of 11 September 2001. Most Arabs advocate a two state solution to the Arab-Israeli conflict. They argue that Israeli occupation of Arab territories occupied in June 1967 should end, a Palestinian state should be established on these territories with East Jerusalem as its capital, and the return of Palestinian refugees should be secured according to the UN General Assembly Resolution No. 194, in return for full normalization of relations with Israel by all Arab countries. These views were articulated in the 'Arab Peace Initiative' presented by the Arab Summit, held in Beirut in March 2002. However, Al-Qaddafi of Libya advocates a 'One-State Solution', according to which a new state called 'Isratine' should be established in which Palestinians and Jews would co-exist.[2] This should be achieved through serious negotiations

2 See the text of the "Arab Peace Initiative"; at: <http://en.wikipedia.org/wiki/Arab_Peace_Initiative>; and for the text of the Qaddafi proposal, see: *New York Times*, 21 January 2009.

supervised by great powers. The framework of these negotiations should be the United Nations resolutions on the Arab-Israeli conflict. Ahmad Jebriel, the secretary-general of the *Popular Front for the Liberalization of Palestine* (PFLP), has also come in support of the 'One-State Solution' as the most feasible strategy to resolve the Palestinian-Israeli conflict.[3]

Traditionally, and at least until the American occupation of Iraq, Arabs did not view Confidence-Building Measures (CBMs) as a viable strategy for achieving a Middle East peace. This was so because the conditions that led to their success in Europe in the 1970's do not exist in the Middle East. From an Arab perspective, introducing CBMs requires resolving the territorial conflicts in the Middle East and building arms control regimes. It was in this context that the Arabs were reluctant to accept the CBMs initiatives that were proposed by the Western powers (NATO and EU) during the 1990's in the light of the absence of meaningful progress in the Arab-Israeli peace process. Without the resolution of the Arab-Israeli territorial conflict, the application of CBMs, the Arabs argued, would lead to the legitimization of the territorial *status quo*, and thus 'normalizing' Israeli occupation of Arab territories (Al-Shazli 2000; Biad 2000).

Further, the Arabs used to link their endorsement of any regional or trans-regional project of cooperation in which Israel was involved with the resolution of the Arab-Israeli conflict. Such projects were understood as being introduced after, or parallel with the political resolution of the Arab-Israeli conflict. This explains Arab participation in the first three Middle East and North African conferences after the beginning of the Palestinian-Israeli peace process, and their boycott of the fourth conference which was held in 1997 after the collapse of the peace process following the election of an anti-peace government in Israel led by Netanyahu. The Syrians and Lebanese have been the strongest Arab advocates of this linkage.

The Arabs also perceive arms control and disarmament as crucial strategies for the durable resolution of the Arab-Israeli conflict. The Egyptians and the Syrians were quite attentive to the centrality of that strategy given their perception of the regional imbalance in favour of Israel. In their assessment, a Middle Eastern arms control regime should deal with conventional and non-conventional weapons in the Middle East (Selim 2000; Al-Dessouki 1996; Diyab 1995; Fakhr 1995; Abdel-Salam 1992). From an Egyptian perspective, the arms control regimes should focus on the limitation of all levels of armaments, and the ban of all weapons of mass destruction on a comprehensive and equitable basis. The most crucial element in Egypt's approach to arms control was the element of the comprehensive and simultaneous elimination of all weapons of mass destruction in the Middle East. The Middle East must be declared a zone free from weapons of mass destruction. This meant that Israel had to sign and ratify the *Nuclear Non-proliferation Treaty* (NPT), and that Egypt would link the signing of the Chemical Weapons Convention to Israel's adherence to the NPT. It was in this context that the Arabs did not endorse the global arms control plans in the Middle East during the 1990's, such as the American and French Arms Control Plans, as the plans aimed, through a simultaneous freezing of the nuclear *status-quo* and the eliminating of chemical and biological arsenals, at perpetuating Israel's nuclear monopoly in the region, while disallowing the Arabs their unconventional capabilities.

In fact, Arab views on the question of arms control were expressed within the framework of two regional projects. The first was the Egyptian Proposal on the Ban of Weapons of Mass Destruction, presented by President Mubarak in April 1990. The Egyptian Proposal reiterated that nuclear, chemical, and biological weapons must be banned from the Middle East. All actors must be mutually and equitably committed to this principle, and verification mechanism must be established. In September 1992, the *League of Arab States* (LAS) adopted a draft resolution in support of the Egyptian proposal. The LAS resolution called for freeing the Middle East from all types of WMD (nuclear, chemical, and biological) as the best guarantee for achieving security and stability in the region. In December 1994, the three Arab countries of Egypt, Syria and Saudi Arabia joined forces in support for the elimination of all types of WMD from the Middle East. They issued a tripartite communiqué, which called on the international community, especially the co-sponsors of the peace process, to work seriously toward the realization of a WMD Free Zone in the Middle East, and pressure Israel to adhere to this objective. The second project was the *Arms Control and Regional Security* (ACRS) working group within the framework of the Madrid multi-lateral peace talks. Within the ACRS, two major approaches toward arms control were debated. The first approach, adopted by Israel, advocated the introduction of CBMs between the main regional actors as the

3 "Ahmad Jebriel supports the one-state solution"; at: <http://www.aljazeera.net/NR/exeres/A7AC867D-3DC1-4495-B1D3-B6D03065CC45.htm>.

prelude for any discussion on arms control and WMD. The second approach, adopted by Egypt and backed by the Arab states, contended that arms control negotiations should focus on the limitation of all levels of armaments and the ban of all WMD. The Egyptians gave priority in the ACRS discussions to the Israeli nuclear weapons and the need to eliminate WMD from the Middle East on a comprehensive and equitable basis. In this respect, the Arabs stipulated that Israel must sign the NPT and accept IAEA safeguards over its nuclear facilities as a precondition for a comprehensive peace settlement in the region. Further, they linked the endorsement of the Additional Protocol of the NPT to Israel's endorsement of the NPT itself.

There have been some changes in these perceptions after the events of 11 September 2001, and such changes have been reinforced after the USA emerged in the Arab world, for the first time, as a military occupier of an Arab country in 2003. Between 2002 and 2003, the USA strove to establish an Arab regional understanding against Iraq, which was subsequently turned into an Arab-Israeli tacit understanding against Iran with Egypt, the Palestinian Authority, and the GCC states being the most important Arab actors in these understandings, and Israel being an undeclared member. That has led to a decline in Arab emphasis on the centrality of the Arab-Israeli conflict compared with their emphasis on the Iranian threat. Further, the Arab states that joined the American-led regional understanding have been more willing to enter into normalization initiatives with Israel, even though their conflict with Israel has not been resolved. This has been reflected in their participation in the Annapolis Conference held in 2007, and their endorsement of the participation of the *League of Arab States* (LAS) in the Union for the Mediterranean, in association with Israel. This was the first time the League has taken part in a regional arrangement in which Israel participates. In addition, the Arabs have dropped the linkage between endorsing the Additional Protocol of the NPT and Israel's endorsement of the NPT. Libya and Kuwait have already ratified the Additional Protocol, and Egypt, Jordan, and the GCC states have declared their intention to pursue a peaceful nuclear programme. According to Selim, these programmes are mechanisms to rationalize, for public opinion, their intention to endorse the Protocol, as signing that Protocol is a pre-requisite for proceeding with the nuclear programmes.[4] Hisham Fu'ad, the former chairman of Egypt's Atomic Energy Agency, shared a similar view, arguing that the signing of the Additional Protocol would be a pre-condition for developing an Egyptian nuclear programme.[5] This was the case, for example, with the UAE which signed the Additional Protocol in April 2009. The signing of the Additional Protocol was described by Al-Kaabi, the UAE's ambassador to the IAEA, as "an important step for the UAE and another demonstration of the country's commitment to complete operational transparency and the highest standards of non-proliferation."[6] This is despite the fact that the UAE did not possess any nuclear programmes or activities at that time. Finally, since the Arab Peace Initiate of 2002, and the introduction of the Road Map in 2003, the Arab states have dropped their traditional emphasis on the crucial role of Palestinian armed resistance to Israeli occupation. This explains the Arab boycott of Hamas, a radical Islamist organization advocating armed resistance against Israeli occupation, when it was elected to form the Palestinian government in 2006. With the outbreak of the rift between Mahmud Abbas, the head of the *Palestinian Authority* (PA), and the Hamas-led Government of Ismail Haniya, and the control of the latter of the Gaza Strip in 2007, Egypt and Israel imposed an economic blockade on the Gaza Strip hoping to bring about the downfall of that government. Both of them blocked all cross-points from Egypt and Israel to the Gaza Strip, which also included humanitarian supplies.

The Israeli military offensives against Hizbullah in Lebanon, and Hamas in the Gaza Strip in 2006 and 2008, respectively, helped to clarify new Arab perceptions of the Arab-Israeli conflict. In 2006, some Arab governments, mainly Egypt, Jordan, and Saudi Arabia, accused Hizbullah of provoking the Israeli military onslaught on Lebanon. In a joint statement amidst the Israeli aggression on Lebanon, King Abdullah of Jordan and Egyptian President Mubarak put the blame on Hizbullah for the outbreak of the war by referring to "uncalculated adventures that do not serve the interests of the region." The joint statement also made indirect reference to the need to implement UN Security Council Resolution 1559 which called, among

4 Mohammad Selim: "Revealing the Veiled Reality of Arab Nuclear Programs", in: *Al-Arabi* (Cairo), 20 April 2008).

5 Interview with Mr. Hisham Fu'ad, in: *Al-Masry Al-Youm* (Cairo), 10 April 2009.

6 "UAE, IAEA Sign Additional Protocol to Safeguards Agreement," in: *Khaleej Times Online*, 9 April 2009; at: <http://www.khaleejtimes.com/DisplayArticle.asp?xfile=data/theuae/2009/April/theuae_April219.xml&section=theuae&col=>.

other things, for the disarmament of Hizbullah.[7] The Saudi government also condemned Hizbullah's actions as "irresponsible adventurism". In addition, in 2008 the three Arab countries expressed an 'understanding' of the motives of the Israeli onslaught on the Gaza Strip by blaming Hamas, and used the onslaught to introduce measures which would de-throne Hamas from its rule in Gaza. Some Arab intellectuals also expressed the same position. Sa'id, for example, described Hamas as a source of security risks to the region, and to Egypt in particular, and charged Hamas with smuggling arms into the Sinai Peninsula, planning a 'demographic invasion' of Sinai by three quarters of a million Palestinians in January 2008, and becoming part of a much larger coalition of radical forces that target moderate Arab governments.[8] Al-Hadlaq, a Kuwaiti writer, took an even more extreme position by justifying the Israeli onslaught on the Gaza Strip and describing it as a war against 'Palestinian terrorists'. He went further to call upon the Israelis to 'crush' Hamas in Gaza similar to what they had done before in 2006 with Hezbollah in Lebanon.[9]

These stances were not widely shared in the Arab world, except by the ruling elites in Egypt and some GCC states. They were rejected by the ruling elites of Syria, Libya, the Arab Maghreb countries, and by most civil society institutions and actors. These actors argued that the roots of the Israeli attack on Gaza was inherent in the failure to recognize the results of the 2006 Palestinian elections which brought Hamas to power, the subsequent blockade on the Hamas government, and the numerous Israeli military incursions in Gaza and the West Bank which had resulted in thousands of Palestinian prisoners including the head of the Palestinian parliament and hundreds of assassinated civilians.

16.4.2 The Invasion and Occupation of Iraq

In 2002, the USA and UK launched a world campaign charging Iraq with possessing weapons of mass destruction in violation of Security Council resolutions. As a result, the UN inspection system was re-installed. Inspectors, however, came up with no evidence to corroborate the Anglo-American charges. Nevertheless, the USA and the UK persisted in their charges and mobilized their forces in the Arabian Gulf in preparation for a possible invasion of Iraq. Despite the mistrust of most Arab countries in the Iraqi regime, and the pressures exercised by U.S. Vice President Cheney to convince Arab countries to join the Anglo-American campaign against Iraq, Arab countries, with the exception of Kuwait, did not endorse the Anglo-American plans. On the contrary, the Arab summit, held in Beirut in March 2002, witnessed reconciliation between Iraq and other Arab countries, including Saudi Arabia. The Americans replied by giving Israel a green light to carry out its onslaught against the Palestinian city of Jenine which was almost demolished while the Arab leaders were still in Beirut. The United States also exercised intensive pressure on Arab regimes which finally succumbed, and joined, with the exception of Syria and Arab Maghreb countries, the Anglo-American campaign with varying degrees of publicity. The only country which openly supported the Anglo-American invasion was Kuwait on the grounds of the Iraqi invasion of that country in 1990.

At the level of civil society and public opinion, there was a vigorous opposition to the invasion which was reflected in mass protests in most Arab countries. A disparate collection of opposition and civil society groups across the Arab world joined forces in rejecting both the invasion of Iraq and US interventionist strategies in the region. As the US moved ever closer to attacking Iraq in January 2003, approximately one million persons marched in the Yameni capital, Sanaa, chanting slogans against the United States, Israel, and pro-American Arab regimes. In Bahrain, where the US Navy's Fifth Fleet was anchored, tens of thousands of angry Bahrainis marched to the US embassy in Manama in protest against the invasion. The protests terminated into clashes with the security forces in which two people were injured, and witnessed the throwing of three home-made petrol bombs into the embassy garden. In Egypt, which was the launch pad for the demonstrations that swept the Arab world, around 20,000 Egyptians gathered into a massive anti-war rally in Cairo's Tahrir (Liberation) Square on 20 March 2003 to protest against the US-led invasion of Iraq. The rally witnessed heavy clashes with the police where hundreds were arrested and injured. A larger rally also took place in the coastal city of Alexandria, where around 30,000 Egyptians held an anti-war demonstration and called for opening the door for Jihad in Iraq. Further, Arab opposition and civil society groups, belonging to a broad coalition of Islamists, nationalists, and leftists, called on Arab governments

7 *Al-Ahram Weekly* (Cairo), Issue No. 804, 20–26 July 2006.

8 *Al-Ahram Weekly* (Cairo), Issue No. 930, 15–21 January 2009.

9 *Al-Watan* (Kuwait), 21 December 2008.

to discontinue all forms of cooperation with the United States and Britain, organized public rallies in support of the Iraqi people, and staged an economic boycott campaign against American products and companies. The Egyptian Lawyers' Syndicate went a step further when it invited applications for Egyptians wishing to join the resistance groups in Iraq. The Syndicate's move attracted about 17,000 Egyptian volunteers, who protested outside the Syndicate's headquarter after they were informed that the government would not allow them to travel.[10] The rejectionist camp has also included mainstream intellectual trends in the Arab world. In March 2003, 40 Egyptian intellectuals – representing a wide range of the political spectrum – issued a joint declaration in which they outlined their position on the Anglo-American invasion of Iraq. The declaration explained that "they (the signatories) differ with the position presented by President Mubarak, who placed the blame on Iraq for the current war", and that the US war is a "colonial one waged against Iraq and the Arab nation".[11] Among the signatories of the declaration were prominent Egyptian intellectuals Fahmy Howeidy and Galal Amin. The same month, the Egyptian Judges' Club issued another statement in which they called on all Arab and Muslim governments "to declare their hostility to the countries taking part in the aggression, led by the United States, and to use all means to fight against their schemes; to deny them military bases, facilities or to take part in military exercises with them, and to offer all means of assistance to the Iraqi people and their government".[12] Abu-Taleb, the editor of the *Arab Strategic Report*, went further when he described the occupation as "a turning point in the history of the modern Arab world, similar in magnitude to the Nakba of Palestine in 1948 and to other major defeats and crises that the Arab regional system has weathered over the past five decades" (Abu-Taleb 2003: 7).

However, a few Arab intellectuals, who have been known for their traditional pro-American stance, openly supported the invasion. This was clearly reflected in the writings of Sa'id, who, in February 2003, wrote two articles subscribing to the Colin Powell charges in the UN Security Council that Iraq was developing weapons of mass destruction, arguing that in that conflict, the USA had the moral high ground, and attempted to persuade Arab countries to join the projected Anglo-American invasion to extract a part of the Iraqi spoils.[13] Al-Manna', a Kuwaiti scholar, also wrote in the second week of the invasion, expressing support for the Anglo-American invasion of Iraq. Al-Manna' called on the coalition forces to proceed with their military campaign in Iraq until the war's objectives are fully realized, including the removal of Saddam Hussien, the disarmament of Iraq, the formation of a transitional administration, the reconstruction of Iraq, and the drafting of a new Iraqi constitution as a prelude for the establishment of a democratic system in Iraq.[14] On the second day of the invasion, and in a move which reflected an implicit approval of the invasion, the pro-government Egyptian newspaper *Al-Ahram* published an interview with US Vice-President Dick Cheney, conducted by the newspaper's editor-in-chief Ibrahim Nafie. In this interview, Cheney defended the invasion, and outlined the main dimensions of U.S. plans in Iraq afterwards. "The military operation will proceed very quickly, and we do not want to stay in Iraq more than is necessary. ... We will work hard to install a democratic government in Iraq, and to protect the unity and sovereignty of the country," Cheney was quoted.[15] Haider (2006) also wrote during the period of the invasion in support of the Anglo-American invasion.

After the occupation of Iraq, Arab countries began to express concern about the destruction of the Iraqi infrastructure, the rise of sectarian conflict in Iraq, the increasing Iranian influence in Iraq, and possible partition of that country. This was mainly because these developments spilled over to the rest of the neighbouring Arab countries who also began to experience sectarian conflict. In this respect, there were two main approaches. The first was advocated by Syria and Libya, who called for the speedy withdrawal of Anglo-American forces from Iraq. Others, such as Egypt, and the GCC states openly called for these forces to remain in Iraq as their withdrawal would lead to an all-out civil war in Iraq. They also strove to prevent their nationals from joining resistance groups operating in Iraq. However, as the US in-

10 See: *The Arab Strategic Report* 2003–2004 (Cairo: Al-Ahram Center for Political and Strategic Studies, 2004), pp. 108–109.

11 *Al-Araby* (Cairo), 24 March 2003.

12 See the Statement of the Egyptian Judges' Club; at: <http://weekly.ahram.org.eg/2003/632/op59.htm>.

13 Abdel Monem Sa'id: "The Road to War", in: *Al-Ahram* (Cairo), 5 February 2003; Abdel Monem Sa'id: "Once Again: The Road to War", in: *Al-Ahram* (Cairo), 12 February 2003.

14 *Al-Watan* (Kuwait), 30 March 2003.

15 *Al-Ahram* (Cairo), 21 March 2003

tensified its pressure on Syria and Libya, these countries began to tone down their opposition to the Anglo-American occupation of Iraq. At the level of civil society, opposition to occupation and to the Bush-Blair policies persisted. One can assess that trend on the occasion of shoe-throwing incident at George Bush during his visit to Iraq in 2008, by the Iraqi journalist Al-Zobaidy. When this event was mentioned in the Egyptian parliament on 15 December 2008 there was a jubilant tremendous applause from all parliamentarians, including those who belong to the ruling party. Moreover, hundreds of Arab attorneys volunteered to defend Al-Zobaidy.[16]

Despite their subscription to major American policies in the Middle East, most Arab countries remain critical of American policies towards Iraq and Israel, though this criticism is largely muted. During the US-Gulf Forum held in January 2009, the Saudi deputy Foreign Minister contended that "the USA has adopted policies full of flaws against the Gulf nations, and the Middle East, while it has been extending all-out support to Israel."[17] Further, criticism of American policies is, however, more acute and well-articulated at the level of civil society and public opinion. The public opinion survey conducted by the Pew Research Centre in 2008 showed that only 19 per cent, 22 per cent, and 51 per cent of the Jordanians, Egyptians, and Lebanese had favourable views of the USA, respectively.[18] Arabs are also unconvinced that the USA has established democracy in Iraq. Rather, they assert, it has established a sectarian system unprecedented in Iraqi history. Al-Jasour (2008), the Dean of the Faculty of Political Science at Al-Mustansiriya University in Baghdad, has argued that what has been built in Iraq is a quota system based on sectarian identities rather than on the merit system. This view was supported by Al-Allawy, the first Prime Minister of Iraq after the fall of the Saddam Hussein regime, who contended that the Americans have installed a false democracy in Iraq based on sectarianism and political chaos.[19] Ismael, a prominent Iraqi scholar, has also asserted that political sectarianism has been encouraged and institutionalized in Iraq since the first day of occupation. This has been done through four main instruments that were employed by US occupation forces, and were intended to de-construct Iraqi national identity. These include i) the formation in July 2003 of the Interim Governing Council (IGC) on the basis of ethnic, sectarian and religious identity; ii) the building up of US-sponsored paramilitary forces along sectarian lines. This began with the formation of the Special Police Commandos and the Public Order Brigades, which came under the control of the Shiite-dominated ministry of interior, and has been associated with a campaign of ethnic cleansing against the Sunni Arab population. This was followed by the formation of parallel US-backed paramilitary Sunni groups in an attempt to protect the Sunni Arabs and balance the Shiite militias; iii) the US drafting of the post-Saddam Iraqi constitution, which provided for the establishment of regional governments, and encouraged the merging of regions into mega-states by conferring constitutional autonomy on such mergers. The constitution thus became "a recipe for transforming political sectarianism, resulting in the Balkanization of Iraq"; and iv) the pre-assignment of ethno-religious quota to cabinet positions (Ismael 2009: 452–455).

Iraq today remains a major security concern for the Arab Mashreq countries. The main concerns are that Iraq could be partitioned, triggering other disintegrationist movements in the region, and promoting sectarian rift which has been clearly echoed in the rest of the Arab world with the control of Iraq by Shiite political parties. Finally, there is the concern that Iran is increasingly dominating Iraqi society and politics.

16.4.3 Arabian Gulf Security

The Arabian Gulf region is plagued by a power asymmetry between the GCC states on the one hand and Iran on the other. Until 1991, Iraq was to be a part of that power asymmetry; however, it is no longer a credible component of the Arabian Gulf power equation. Indeed, power asymmetry of the GCC states with Iran is being further magnified by historical legacies of conflicting territorial ambitions which are manifested in Iran's occupation of three islands claimed by the United Arab Emirates. Moreover, Iraq used to consider Kuwait part of its territory. Power asymmetries and historical legacies led the GCC states to solicit the protection of Western powers in the form of security agreements, military bases, and the presence of Western navies in the Arabian Gulf.

16 *Al-Gomhuria* (Cairo), 16 December 2008.

17 "Israeli terror in Gaza overshadows US-Gulf forum," in: *Arab News*, 7 January 2009; at: http://www.arabnews.com/?page=1&section=0&article=117908&d=7&m=1&y=2009.

18 See the survey results at: http://pewresearch.org/pubs/1059/global-opinion-bush-years.

19 For a review of the works of this conference, see: http://corp.gulfinthemedia.com/gulf/view_article_ar_print.php?print=1&id=491432.

In addressing these hard security dilemmas, one can identify three main GCC approaches: i) the power politics approach, ii) the CBMs approach, and iii) the approach which combines a balance of power and CBM elements. Within each approach, there are differences over the bilateral or multi-lateral nature of CBMs to be included. Whereas some approaches advocate a pan regional framework of CBMs, others assert that CBMs can be more effective at the bilateral level. There are also those who restrict CBMs to the regional actors, and those who prefer to bring in extra-regional powers.

Advocates of the first approach argue that Arabian Gulf security can only be maintained through a change in the balance of power, and/or creating new security arrangements in cooperation with great powers. They assume that the elimination of certain elements of power from the Gulf region, or the establishment of new security arrangements with great powers would reinforce security and facilitate conflict resolution. This approach is mainly pursued by virtually all GCC states as they have signed security agreements with various Western powers and host military bases in their own territories as a security insurance against Iran. For example, Kuwait is considered by the USA as an ally outside NATO. In 2004 the Dubai-based *Gulf Research Center* (GRC) launched a proposal to establish a nuclear free zone in the Arabian Gulf region, which would include the GCC states, Iraq, Iran, and Yemen. As all other GCC states and Yemen had no nuclear capabilities, the proposal was targeting Iran. Later this proposal was expanded to include biological and chemical weapons and re-named the *Gulf Weapons of Mass Destruction Free Zone* (GWMDFZ). However, the change of scope seemed only symbolic, as all nine countries, which are supposed to be parties of the projected zone, are already parties to the global chemical and biological conventions regime. However, it was argued by advocates of this project that it would facilitate the development of a multilateral regional security arrangement (Alani 2005, 2006). At the official level, the GCC summits have been subscribing to a wider domain of the zone free of weapons of mass destruction as they argue that such a zone should cover the entire Middle East region. The implication is that it would necessarily include Israel. Egypt subscribed to a modified version of this approach and called for the creation of 'Arab' security arrangements in the Arabian Gulf region, in which Egypt would participate. This approach was vehemently rejected by Iran, and was also received with little interest by the GCC states.

The second approach advocates a CBMs strategy for conflict resolution and peace building in the Arabian Gulf region. There are a number of such CBM projects either advocated by institutions, or by individual intellectuals. In November 1999, the Gulf 2000 Project in cooperation with the Center for Research and Consultancy in Oman held a conference in Salala, the Sultanate of Oman. The conference recommended the introduction of non-military CBMs such as environmental cooperation, tourism, and exchange between academics, clerics and the media. It was also suggested that joint cooperation in the field of economic development, such as the Iran-Qatar exploitation of a common gas field, or the development of the disputed islands, is an important 'economic' CBM.[20] Also, Al-Marhoun (2006), an Arab scholar, advocated establishing a 'Gulf Forum for Regional Security' comprising the GCC states, in addition to Iraq, Iran, Yemen, Egypt, India, and Pakistan. The proposed Forum would act as a consultative mechanism to exchange ideas and form expert groups to study security issues and suggest solutions. Al-Marhoun's proposal was premised on the inter-regional linkages between the Mediterranean, the Arabian Gulf, and South Asia, which justified the inclusion of Egypt, India, and Pakistan. Great powers, however, were excluded from the proposal.

The third approach combines both balance of power and CBM elements. It attempts to place CBMs in their wider context of power relations and conflict issues. At the institutional level, the *Bahrain Center for Studies and Research* suggested the promotion of Gulf security by creating a zone free of weapons of mass destruction in the region, and introducing CBMs in the form of non-aggression treaties and pledges by all powers of non-intervention in the domestic affairs of the Gulf countries (Al-Ghatam/Galal 2007). Two scholars from the GCC states have advocated linking the introduction of CBMs with the territorial issues in the Arabian Gulf region. Al-Mani (2002), a Saudi scholar, suggested establishing an Arabian Gulf model of CBMs, which would include official and non-official measures. At the non-official level this model would include people-to-people contacts, and at the official level, military and economic measures would be taken such as prior notification of military manoeuvres, reducing military formations in border areas, cooperation in the areas combating drug trafficking, and transparency in Iran's nuclear activi-

20 For a review of this debate, see *Al-Sharq Al-Awsat* (London), 21 December 2005.

ties. However, a solution of the issue of the occupation of the islands which the UAE claims from Iran and the end of border conflicts in the region are prerequisites for the introduction of these measures. Al-Shaiji (2000), a Kuwaiti scholar, has also advocated the application of CBMs in the GCC-Iran relationships. His model enumerated measures such as hotlines, regional communications centre, periodic summit meetings, de-militarized zones, prior notification of military manoeuvres, transparency measures in military activities, exchange of information, and onsite inspection. He indicated that these measures were built on other CBM experiences and could be successfully applied in the Arabian Gulf region, arguing that CBMs have "succeeded in the Middle East in creating a clear qualitative shift in the two conflicting parties, the Arabs and Israel, towards tension and conflict avoidance." He went on to argue that a solution to the Iran-Emirates conflict over the three islands would tremendously facilitate the application of CBMs, and assist reaching a solution to other border problems.

16.4.4 The Iranian Nuclear Programme

After the Anglo-American invasion and occupation of Iraq in 2003, the Iranian nuclear programme came to the forefront of the Western agenda in the Middle East and the Arabian Gulf. Western powers have claimed that Iran is enriching uranium, and that such an enrichment programme will enable that country to go nuclear in the near future. The EU Troika (Britain, France, and Germany) took the lead in negotiating with Iran to halt its enrichment programme, and the UN Security Council issued a resolution also requesting Iran to do this. When these efforts failed, sanctions were imposed.

Arab perceptions of the Iranian nuclear programme have been mainly articulated in the context of the Western drive to persuade or coerce Iran to halt its programme, and in fact as a result of the Western attempt to isolate Iran by mobilizing Arabs against its nuclear programme. Before the launching of the Western anti-Iranian drive, virtually no Arab country voiced a concern over the Iranian nuclear programme. The Western strategy has been to create a coalition between Israel and pro-Western Arab countries, namely the GCC states, Jordan, the Palestinian Authority, and Egypt against Iran and its allies in the Middle East, namely, Syria, and non-state actors such as Hezbollah, and Hamas. Arab perceptions of the Iranian nuclear programme have been also molded by the dominant role of Iran in Iraq and its drive to promote Shi'ism in the Arab world, and reflected a concern that Iran was attempting to control the Arab world.

In addition, pro-American Arab actors have perceived the Iranian nuclear programme to be a threat, and demanded that Iran comply with the requests of the Security Council and the International Atomic Energy Agency. Perhaps this can be illustrated with reference to the criticism voiced by the GCC states to Amr Moussa, the Secretary-General of the LAS. Moussa sent a message to the GCC summit in Abu-Dhabi in December 2005 focusing mainly on the Israeli nuclear capability. Al-Atiya, the Secretary-General of the GCC, and Abdullah Al-Neamey, the Foreign Minister of the UAE, criticized Moussa publicly on grounds of ignoring the security concerns of the GCC states. Al-Neamey argued that the GCC states are also concerned about the Iranian nuclear programme because of their geographical proximity, and Iran's non-membership in the early warning system in case of any nuclear leakage from the Bousher reactor.[21] In March 2009, the Saudi foreign minister, Saud al-Faisal, reiterated the same position at an Arab League Council meeting. He called on his Arab counterparts to forge a common vision to deal with what he called the 'Iranian challenge', arguing that resolving problems among Arabs would depend on the creation of a joint position regarding Iran's stance on Gulf security and its nuclear programme.[22]

Meanwhile, the GCC states have voiced concern over the possibility of a Western-Iranian military showdown which they perceive will be quite detrimental to their security, given the Iranian threat to retaliate against the GCC states which allow the West to use military bases in the GCC states to attack Iran. In December 2007, Al-Atiya clearly expressed the GCC opposition to the military option against Iraq. "We want the military factor to be eliminated...What we care for in the GCC is finding solutions that enhance security and stability...and [we] believe in dialogue as a way to solve the crisis," he told a conference on regional security that was held in the Bahraini capital, Manama, and attended by US Defense Secretary Robert Gates.[23] On the same occasion, Sheikh Hamad

21 "GCC Calls for Nuclear-Free Middle East," in: *Arab News,* 20 December 2005; at: http://www.arabnews.com/?page=4&section=0&article=74971&d=20&m=12&y=2005. See also: *Al-Sharq al-Awsat* (London), 21 December 2005.

22 *Al-Ahram Weekly* (Cairo), Issue No. 938, 12–18 March 2009.

Bin Jassim Al-Thani, the Qatari Prime Minister, called on Washington to engage Teheran directly in a dialogue to reach a solution to the nuclear crisis. Sheikh Hamad went further when he countered a comparison drawn by Gates between an ambitious nuclear Iran and a responsible nuclear Israel. "We cannot really compare Iran with Israel. Iran is our neighbour, and we should not really look at it as an enemy. ... Israel for 50 years has taken land, is expelling the Palestinians, and interferes under the guise of security, blaming the other party," he told the conference.[24] The comments of the GCC leaders were delivered in response to Gates's remarks in which he stressed the danger of Iran's nuclear programme, and pointed to Iran as the prime source of chaos in the region. In addition to recommending the pursuit of the negotiation strategy, the GCC states have also demanded participation in any Iranian negotiations with the West as they suspect that the West may grant Iran an enhanced regional status as a reward for halting its enrichment programme.

Nevertheless, Syria and most Arab civil society groups have different views, arguing that Iran is entitled to uranium enrichments under the NPT, and should be allowed to use such a privilege. They also argue that excessive Western pressure against Iran will persuade that country to produce the nuclear bomb. Further, they contend that the Iranian nuclear programme should be assessed in the context of other nuclear programmes in the Middle East, namely the Israeli programme, and that if Iran developed a nuclear capability, that would contribute to Middle East stability as it would establish a balance of terror with Israel (Shaker 2007; Al-Shobaky 2007; Mahmud 2007). Amr Moussa, the Secretary-General of the LAS, expressed a similar view when he emphasized that Iran did not represent a threat to the Arab world. During a meeting of the World Economic Forum in Shuneh, Jordan in May 2009, Moussa stressed that

> We do not regard Iran as the main issue. The Arab world does not have any problem with Iran. ... The main problem and major threat to the region and Arabs is Israel's nuclear activity. ... Nuclear disarmament is a global issue, and it is not possible to forget Israel, which possesses a nuclear arsenal and refuses to sign the NPT, and talk about the Iran 'threat' all the time. ... This is a mistake.[25]

Moussa also defended Iran's right to have a nuclear energy programme as long as the IAEA has not reported any deviation in Iran's nuclear programme. In an interview with the Mehr News Agency on the sidelines of the World Economic Forum meeting, Moussa stated that "according to the International Atomic Energy Agency, Iran has had no diversion from the NPT (nuclear Non- Proliferation Treaty)...Therefore, Iran has the right to develop its peaceful nuclear programme based on this international treaty".[26]

These perceptions were corroborated by the findings of a major survey project that was conducted by the Anwar Sadat Chair for Peace and Development at the University of Maryland under the leadership of Shibly Telhami, in collaboration with Zogby International. The Sadat Chair/Zogby International survey was an umbrella survey project under which five surveys were conducted at annual intervals between 2003 and 2008.[27] The survey, which covered respondents in Egypt, Jordan, Saudi Arabia, Morocco, United Arab Emirates, and Lebanon, found that the majority of Arabs believe that Iran has the right to develop a nuclear programme, and that international pressure on Iran to curtail its programme should stop. Indeed, the percentage of Arab approval for Iran's nuclear programme jumped from 60 per cent in 2004 to 67 per cent in 2008, although approximately half of all respondents in the surveys suspected that Iran's nuclear programme was, in fact, intended for weapons manufacture. When asked in 2008 about the potential outcome of Iran's acquisition of nuclear weapons for the Middle East region, the majority of correspondents said the outcome would be positive, viewing a nuclear-armed Iran as a desirable counterweight to US and Israeli military dominance in the region. In fact, the highest approval rate was recorded in Saudi Arabia – the hotbed of Sunni Islam in the Arab world – where 73 per cent of the population expressed positive views toward the Iranian nuclear programme.[28]

23 *Al-Ahram Weekly* (Cairo), Issue No. 875, 13–19 December 2007.

24 Ibid.

25 "Arab World has no problem with Iran: Amr Moussa," in: *Tehran Times*, 18 May 2009; at: http://www.tehrantimes.com/index_View.asp?code=194813.

26 Ibid.

27 No poll was conducted in 2007.

28 See the results of the 2003–2008 Anwar Sadat Chair/Zogby International surveys in the Arab world. Available online at: http://sadat.umd.edu/surveys/index.htm.

16.4.5 Hard Security Issues in the Arab Maghreb Region

The Arab Maghreb countries share with their Mashreq counterparts their perceptions of the previously articulated issues. However, these issues are not high on their agenda. They have their own hard security issues which are mainly related to the Western Sahara conflict, Spanish threats to Morocco, and the Western rapid intervention forces in the Mediterranean.

The Western Sahara question is a major source of conflict between Algeria, Morocco, and the Polisario (*Popular Front for the Liberation of Saguia and el Hamra and Rio de Oro*). Morocco has claimed that the Sahara is an integral part of its territory, and King Mohammad VI has charged Algeria with expansionist designs on the Sahara, and meddling in Morocco's internal affairs. For their part, the Polisario and Algeria perceive Morocco as a security threat to the right of national self-determination of the people of the Sahara (Al-Sherbeany 2007).

Further, Morocco views Spain as a source of security threat given its stance on the issue of the island of Lily, and the cities of Melilla and Ceuta. Morocco claims that the island and the two cities are part of its territory, while Spain has completely rejected these claims, and used military force to evict the Moroccans from the island when the Moroccans attempted to take it in July 2001. Spain has also asserted its claim to the cities of Melilla and Ceuta which are located on the northern coast of Morocco. Spain's readiness to use military forces in these conflicts has been viewed by the Moroccans as a major security threat.

Finally, since the 1990's the Maghreb countries have developed attitudes of suspicion and preoccupation towards the EU common defense policy in the Mediterranean. This was particularly the case with the EU decision in 1995 to develop two rapid reaction forces, known as EUROFOR and EUROMARFOR, within the framework of the European Security and Defense Policy, to act as peace-keeping and humanitarian intervention forces in troubled areas. The EU decision was made following the conclusion of the *Euro-Mediterranean Partnership* (EMP), and without prior notification to its Mediterranean partners. The decision has had a negative impact on relations with the Mediterranean Arab partners, who are concerned about the presence in the Mediterranean of European forces which have been mandated to intervene in their domestic affairs under the pretexts of humanitarian intervention and peacekeeping operations. The Force was, in fact, used in Sudan to supervise and monitor cease-fire arrangements in southern Sudan. It was also used in Bosnia, Macedonia (FY-ROM), and in the Congo in 2003 (Bourantonis/Tsakonas 2003; Shedeed 2004). However, it could be also employed if EU security was threatened as a result of the flow of refugees across the Mediterranean or the collapse of a Maghreb political regime (Al-Sherbeany 2007).

16.5 Conclusion

As the dawn of the twenty-first century appeared, Arab countries, especially those in the Mashreq, were thrown back into the Hobbesian state of nature, and the Middle East region has been militarized as never before. Wars and invasions dominated the region in Iraq and Palestine, including its neighbourhood in Afghanistan. Also, Arab countries had to cope with strong armed domestic opposition movements. In this context, and because of more fundamental cultural factors, hard and soft security issues were viewed as inter-related with priority being given to the hard security ones because they represented the most immediate threats. In addition to the Arab-Israeli conflict, which remained as a main hard security threat, other issues were added, the most important of which were the issues of the occupation of Iraq, Arabian Gulf security, and the Iranian nuclear programme. On the other hand, the hard security issues in the Maghreb remained marginal compared to the more acute hard security ones in the Mashreq.

This review of Arab perceptions of hard security threats has come up with two main observations. The first is that contrary to conventional theory, Arab civil society is more hawkish than the ruling elites as far as its perceptions of Israel and the USA are concerned. In light of this finding, one should question the accuracy of the contention that interaction among civil society groups across the region would facilitate peace under conditions where there is a dominance of hard security issues. Further, the dovishness of Arab ruling elites, compared with civil society groups, has not led to any significant breakthroughs in dealing with hard security threats. This failure has discredited these elites and reinforced the perceptions of civil society groups. This has been acutely reflected in the 'Arab Peace Initiative' of 2002 which was an official Arab collective proposal for regional peace with Israel. The Initiative was rebuffed by both Israel and the USA, which led many civil society groups to call for its withdrawal. The second observation is that Arab perceptions of the Arab-Israeli and Iraqi security issues have

undergone major changes as a result of the American pressure. The changes have been in the direction of placing less emphasis on the Arab-Israeli conflict, and a greater focus on the 'Iranian threat'. In this, Arab countries had to conform to American policies under threats of regime change.

Finally, the dominance of hard security issues in the Arab world is reciprocal in the Middle East, allowing one to argue that these issues are also dominant in the Israeli and Iranian sides of the equation, which make the prospects of regional peace a remote possibility in the short-run.

17 Arab Perceptions of Soft Security Issues

Mohammad El-Sayed Selim

17.1 Introduction

The objective of this chapter is to review, compare, and assess Arab perceptions of 'soft security' issues and threats. In achieving this objective, there are two main themes. The first is that the concept of 'soft security' is hardly acknowledged in the Arab discourse on security. Although Arab politicians and analysts refer to the issues subsumed under the 'soft security' label, the concept itself is hardly employed in Arab public discourse on security. This is because the concepts of 'softness' and 'security' do not match in Arab thinking as the Arab region is plagued by mostly military and territorial (hard) security issues (chap. 16 by Gamal Selim). The second is that the Arabs have borrowed the concept from the Western literature, and in that literature the concept was vaguely defined, which was reflected in the Arab endorsement of the concept. The concept was originally used during the East-West détente era to distinguish military issues from other relevant security issues, including military-related issues such as confidence-building measures. It was later expanded to include about almost everything except defence proper. Consequently, the concept was vaguely defined in the Western literature. In some cases, the concept was used without a definition (Tanner 1996; Bell 2006), and when defined it was used as a generic concept which includes all non-military issues, which made it possible to study any set of such issues under the label of soft security (Lomagin 2002; Aldis/Herd 2004). This has led some analysts to call for the dismissal of the concept and its integration into a single concept of security on grounds that the dividing lines between soft and hard security in the post Cold War era are rapidly dissolving (Langlais 1999; Lindley-French 2004). These conceptual confusions have been projected into the Arab literature, and reinforced Arab reluctance to employ the concept, especially that its connotation in the Arabic language is disturbing.

This problematique calls for assessing Arab conceptualizations of soft security at two levels. The first is the assessment of the place of the concept of soft security in the Arabic literature on security; that is how the concept has been viewed and employed in that literature. The second is the identification of how the Arabs have viewed the issues which are traditionally categorized under the concept of soft security. Our assessment of the main Arab perceptions of soft security does not mean that these perceptions were articulated in the context of that concept. Rather, we selected certain issues traditionally categorized as soft security ones, and assessed how they have been perceived in Arab countries, by which we mean the twenty-two member states in the *League of Arab States* (LAS). These perceptions will be reviewed at the official and non-official levels as well.

17.2 Arab Conceptualizations of Soft Security

Some Arab analysts reject the concept of soft security outright. They argue that the concepts of hard and soft powers are inter-linked as soft power cannot be achieved or employed without hard power. This means that we should be talking about 'comprehensive power' which includes both branches of power. Whereas comprehensive power should be employed in international conflicts, soft power may be used in some aspects of international cooperation. Further, hard power is more crucial in achieving national objectives, especially in cases of the liberation of occupied territories, as soft power by itself cannot solely contribute to the achievement of these goals. For these reasons, advocates of this line of thought recommend the abandonment of the concept of soft security, and argue that if used at all, it should be used as meaning the ability to create a national model of development (Marzouk 2009).

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Further, Arab politicians do not use the concept of soft security, and Arab academicians hardly use it, although all of them frequently refer to issues related to that concept. It seems that the concept is the domain of Arab non-governmental groups, who use it in conjunction with their conceptualizations of the issues related to their own missions.

Few Arab analysts have employed the concept, arguing that soft security has become, or should become more crucial than hard security at least for the Arabs. In fact, most of those who use the concept subscribe to the view of the relative centrality of soft security in the process of maximizing Arab security, a view which is not widely shared by the Arab official and intellectual community on security.

Arab analysts, who employ the concept of soft security, do not agree on a definition of soft security. They define the concept in the context of one of four main schools. The first school adheres to the traditional definition of soft security as referring to issues of a non-military nature. Advocates of this school view soft security from the angle of the issues involved, which are all issues not directly related to military power. For example, Al-Mabrouk, the chairman the Academy of Higher Studies in Libya, argued that globalization has transformed the concept of security from the hard dimension to the soft one. He went on to argue that whereas the soft security refers to economic and social security issues, hard security deals with military security issues.[1]

The second school comprises those who define security in a more complex way to include two main elements, the issues and their controllability. They argue that soft security refers to issues which are of a non-military nature and can be influenced and managed by Arabs. This includes issues related to development, reform, education, population composition and expatriate labour, sectarian rifts, and diversification of income. This is in contrast with issues which are of a military nature and cannot be controlled by the Arabs.[2]

The third school uses the concept interchangeably with the concept of 'human security'. Prince Al-Hassan bin Talal of Jordan defined soft security as referring to maintaining human security, which could best be achieved by providing the people with their basic needs.[3] Likewise, Al-Hafez (2003) differentiated between two forms of security; those which attend to the dignity and spiritual needs of individuals, and those which focus on their material needs such as food, water, and military security. For him, soft security means preservation of the basic rights of individuals, human empowerment, and good governance, that is, human security. Whereas the first school considers food security as one of the elements of soft security, Al-Hafez classifies it under the category of hard security as it deals with material needs rather than spiritual ones.[4] Likewise, Al-Sayyid, (2008) a Lebanese political scientist, argued that whereas soft security is related to the people, hard security refers to defence issues.

The fourth school defines soft security from the perspective of the strategies used to promote it. It equates soft security with non-obtrusive and non-confrontational strategies of security. Jordanian analysts tend to use that version of the definition of the concept. They argue that soft security is best maintained when the state applies measures which create cordial relations with its citizens including police-people relations and tacit airport security measures. Al-Khawaja (2009) used the concept of soft security in that sense with a focus on how the police could create bonds with its larger community.[5] Ayasra (2006) also pleaded for a focus on soft security, which he defined as meaning issued related to the promotion of social dialogue and social peace.

The four main schools of Arab definitions of soft security have in common an emphasis on the non-military dimensions of the concept. However, they differ in their view of these dimensions. Whereas some analysts view soft security as also related to issues which

1 See at: <http://www.alacademia.edu.ly/letter10.asp>. This is the definition also used by some Arab analysts in a symposium of the Al-Arabiya, and Arab TV satellite station on 2 October 2005; at: <http://www.alarabiya.net/programs/2005/10/02/17332.html#>.

2 This was the definition used by Aisha Sultan (2007) and by Al-Shaiji (2008) and also in his presentation at the conference of the Gulf Center for Strategic Studies and Research in Abu Dhabi in March 2007; see at: <http://www.aljazeera.net/news/archive/archive?ArchiveId=1035107>.

3 Interviews with Prince Hassan; see at: <http://www.deutsche-welle.de/dw/article/0,,1953109,00.html>; and at: <http://www.alarabimag.net/arabi/Data/2009/5/1/Art_88739.XML>.

4 Yasser Kassem, an Iraqi Kurd, has also used the concept along the same lines in an article published in Al-Ittihad, the newspaper of the Kurdish Patriot Union; see at: <http://www.alitthad.com/paper.php? name=News&file=print&sid=22886>.

5 See also at: <http://ourhim.wordpress.com/2008/08/16>; and at: <http://ammannet.net/look/eom/eom_jo.tpl?IdLanguage=18&IdPublication=3&NrArticle=7642&NrIssue=5&NrSection=26>.

cannot be fully influenced by Arabs, others focus on the spiritual dimensions or the use of non-confrontational methods in dealing with societal issues. Further, these schools represent a small fraction of the Arab literature on security, which we argued earlier is mostly concerned hard security issues.

17.3 Arab Perceptions of Soft Security Issues

The choice of the issues of soft security perceived by the Arabs is based on two main criteria: the substance of the issue; and its relevance to the Arab world. The first criterion refers to whether the issue has been identified in the security literature as a soft security one. The second refers to whether the issue is relevant to the Arab regional system. For example, the issue of the safety of nuclear reactors is considered in the literature as a soft security issue. However, it is not relevant to Arab perceptions of soft security as there are virtually no significant nuclear reactors in the Arab world.

According to these criteria, the most important soft security issues perceived by most Arab countries are those related to terrorism, foreign interventions to promote democracy, foreign labour in the GCC states, sectarian rifts, environmental threats, and energy security. Arab perceptions of these issues will be viewed in the following sections.

17.3.1 Terrorism

Arab perceptions of terrorism differ from the mainstream Western definitions on several grounds. Arabs define terrorism more according to the motivations of the combatants rather than by the nature of the act. In this respect, they make a clear distinction between those individuals and groups involved in armed struggles against the illegal occupation of their land, and those using violence against civilian targets or legitimate governments to achieve their own self interests. This was clearly stated in *The Arab Convention for the Suppression of Terrorism*, adopted by the Council of Arab Ministers of the Interior and the Council of Arab Ministers of Justice held within the framework of the LAS in 1998. The Convention affirmed

> the right of peoples to combat foreign occupation and aggression by whatever means, including armed struggle, in order to liberate their territories and secure their right to self-determination, and independence and to do so in such a manner as to preserve the territorial integrity of each Arab country, of the foregoing being in accordance with the purposes and principles of the Charter of the United Nations and with the Organization's resolutions.[6]

Soon after the attacks of 11 September 2001, former Egyptian Foreign Minister Ahmad Maher expressed misgivings about American and Israeli attempts to confuse resistance with terrorism. Maher stressed that "the difference between terrorism and armed resistance is clear. ... People under occupation have the right, according to international conventions and the United Nations Charter, to struggle against the occupying power."[7] On that premise, before September 11, most Arab countries supported Palestinian and Lebanese armed resistance to Israeli occupation, but this support never included the Al-Qaeda organization headed by Osama bin Laden. The differentiation between terrorism and resistance to occupation was also found in survey projects conducted in 2005 by the *Centre for Strategic Studies* (CSS) of the University of Jordan on the perceptions of the Arab public toward a number of issues. The CSS project, entitled *Revisiting the Arab Street: Research from Within*, was conducted in collaboration with partner institutions in Jordan, Syria, Lebanon, Palestine, and Egypt across four samples in each country. On the question of terrorism, almost 90 per cent of those polled in the five Arab countries believed that the movements of Hamas, Islamic Jihad, al-Aqsa Martyrs Brigades and Hezbollah were 'legitimate' resistance organizations.[8] Whereas civil society perceptions of the difference between terrorism and resistance to occupation persisted after 11 September 2001, governmental stances changed in the direction of removing the dividing lines between terrorism and resistance to occupation and de-legitimizing both. This was evident in their stances towards Iraqi groups fighting American occupation, and Lebanese and Palestinian groups, namely, Hezbollah and Hamas, fighting against Israel.

In addition, Arab civil society does not subscribe to the exclusion of 'state terrorism' from Western definitions. In the West, 'terrorism' is mostly used to depict the violence of individuals or groups pursuing specific political agendas, not that inflicted by states. The U.S. State Department also restricts terrorism to

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6 "The Arab Convention for the Suppression of Terrorism" (April 1994); at: <http://www.ciaonet.org/cbr/cbr00/video/cbr_ctd/cbr_ctd_27.html>.

7 *Al-Ahram Weekly* (Cairo), Issue No. 560, 15–21 November 2001.

8 The survey project is available online at: <www.css-jordan.org>.

individuals or groups, and to states 'sponsoring terrorism'. Arabs add to this conceptualization the category of 'state terrorism,' according to which states themselves commit acts of terrorism. This includes depriving civilians of essential needs and damaging the institutional fabric of their societies. In this respect, the Arab civil society views the exclusion of states as agents of terror as intended to legitimize certain practices and policies that are carried out by Western states, and Israel against civilians in Afghanistan, Iraq, and Palestine. Al-Amir, an Egyptian analyst, noted that

> fundamental elements of the debate on terrorism, which included the legitimacy of armed resistance against foreign military occupation, the illegal acts of state terrorism committed against people under occupation and the persecution of individuals by dictatorships in the name of state security, were overlooked in favour of a broad, indiscriminate definition.

The result is that the whole issue of fighting terrorism has been "reduced to how to protect Western civilization against Muslim marauders who are incited by a murderous religious cult."[9] Bishara shared a similar view, arguing that for the United States and Europe, the notion of civilians has been used to refer only to the citizens of the US, NATO countries and Israel, while the abuse, punishment or elimination of other peoples for political reasons have been normalized under different pretexts.[10]

Further, most Arabs do not share the American view about the origins and causes of terrorism. In the aftermath of the attacks of 11 September 2001, the US administration linked terrorism with regime type in the Arab world, and viewed the attacks as an outcome of the presence of authoritarian regimes that do not provide legitimate channels for their citizens to express their political and social demands. In this respect, democratizing the Arab world was viewed as a fundamental element to uproot terrorism. In the Arab view, however, terrorism is a function of Western policies of un-balanced interventions in the Middle East. Matar advocated this view by tracing the recent upsurge of terrorist activities throughout the world to American arrogance and bullying in dealing with other nations, peoples, and cultures. In the Middle East, Matar referred to America's unlimited support of Israeli expansionism and its policies in the region as the major factors that have created unprecedented levels of hostility towards the US and Israel.[11] Sid-Ahmed also linked the present phenomenon of terrorism to the political, socio-economic injustices inherent in the US-led new world order. In his view, the new world order has brought the United States as the uncontested superpower which acts unilaterally outside the domain of the United Nations. It has tempted the United States to pursue its own agenda regardless of considerations of international law, state sovereignty or international public opinion. The result has been an unprecedented rise in the feelings of resentment and hatred toward the United States, and subsequently the creation of new breeding grounds for terrorism in many regions, particularly in the Arab and Muslim world.[12]

By and large, Arab analysts agree that terrorism cannot be uprooted using military means only. In fact, they contend that the USA has failed to combat terrorism by resort to military invasions, and that such invasions have led to the spread of attacks against American targets (Shady 2008).

Finally, there is the question of the link between terrorism and Islam in the Western, especially American media. Most Americans and Europeans tend to equate terrorism and extremism with Islam. This perception should not be viewed as an outcome of the events of 11 September 2001 as some observers might conclude. Rather, it is an outcome of accumulative historical memories that can be traced back, according to Edward Said, to the middle ages when the Muslim empire and armies were perceived as a direct threat to the West (Said 1997). Even with the decline of the Muslim empire, Western perceptions of the linkage between violence and terrorism on the one hand, and Islam on the other hand continued to persist for centuries.

Arabs reject the portrayed link in the West between terrorism and Islam (Abou-Soliman 2002). The Secretary-General of the LAS, Amr Moussa, expressed Arab resentment when he described Western media attempts to link terrorism with Arabs and Islam as 'catastrophic'. Moussa stressed that terrorism has no home or religion, and that there is a clear misunderstanding of the teachings of Islam in the West.[13] Al-

9 *Al-Ahram Weekly* (Cairo), Issue No. 752, 21–27 July 2005.

10 *Al-Ahram Weekly* (Cairo), Issue No. 569, 17–23 January 2002.

11 *Al-Ahram Weekly* (Cairo), Issue No. 709, 23–29 September 2004.

12 *Al-Ahram Weekly* (Cairo), Issue No. 705, 26 August–1 September 2004.

13 *Al-Ahram Weekly* (Cairo), Issue No. 558, 1–7 November 2001. The best reviews of most Arab perceptions of the question of terrorism are Eid (1999), and Ayoub (2003)

Sayyid (2002), an Egyptian scholar, shared a similar perception, arguing that attributing terrorism to a particular religion or faith is a misleading proposition that does not accommodate reality. He refuted the stereotyped linkage between terrorism and Islam, arguing that Islamist groups who view Islam as a guide to a different political order do not necessarily seek to establish that order through the use of violence. In this respect, he referred to many Islamic political movements that try to seek political power using peaceful methods, such as the Rafah Party in Turkey, the Muslim Brothers in Egypt, the Islamic Salvation Front in Algeria, and the Nahda Party in Tunisia. Al-Sayyid also warned against reductionism when it comes to the interpretation of Islam by particular individuals and groups. In his view, "just as no one in his or her right mind would charge all Protestants or Catholics of being terrorists because certain Protestant or Catholic groups in Northern Ireland resort to armed action, by the same logic, the presence of certain terrorist groups that call themselves Islamic does not make Islam and all its adherents potential terrorists and a threat to the rest of humanity." Fahmy (2008) also enumerated a number of terrorist organizations working in Israel exercising terrorism against the Palestinian people.

17.3.2 Foreign Intervention to Promote Democracy

The question of political reform in the Arab world has come to the forefront of the Arab agenda as a result of Western pressures following the attacks of 11 September 2001. The administration of George W. Bush Jr. claimed that the attacks emanated from the Arab world, and viewed them as an effect of Arab authoritarian regimes. In this respect, neo-conservative circles close to the US administration lobbied for the use of all means of American political and military power to support democracy in the Arab world, with arguments that the war against 'terrorism' would require social, political and economic changes in the Arab world. This new American policy was first expressed in the 2002 National Security Strategy and in a number of democracy-promotion initiatives, such as in the 2002 *Middle East Partnership Initiative* (MEPI) and the 2004 *Greater Middle East Initiative* (GMEI). The new policy also culminated in the US invasion of Iraq, and the toppling of the Saddam Hussein regime in April 2003. One of the rationales of the invasion was that it would lead to a democratic Iraq and subsequently to the spread of democracy to the rest of the Arab world, as Japan and Germany became democratic states friendly to the USA after their occupation, which was clearly articulated in the Bush statement on 5 April 2002.

The Anglo-American occupation of Iraq and the growing American pressures for political reforms in the Arab countries triggered an intensive debate in the Arab world on the question of reform from outside. Whereas some groups subscribed to the basic philosophy of the Euro-American projects of democratization in the region, others have rejected it, or at best have given it a lukewarm endorsement. The advocates of Western intervention argued that this was the only available avenue for Arab societies to democratize as local regimes are not likely to move in this direction. These groups, which consist mainly of intellectuals and civil society activists promoting Western liberal values, constitute a minority within Arab societies and are often viewed as 'Westernized' elites. Al-Hashem, a Kuwaiti analyst, welcomed the idea of external intervention to bring about political reform in the Arab world, arguing that waiting for political reform to take place from within is a waste of time.[14] Former Jordanian Information Minister Al-Qallab also supported Western reform projects in the Arab world. He expressed no objection to political reform being imposed from outside if it was impossible to achieve it from within by peaceful means and mutual persuasion. In his view, the Arabs must not panic when the West talks about reform and democracy in the framework of the GMEI, or any other framework. Rather, the Arabs should take advantage of these initiatives to push for democratization in their countries.[15] Sa'id, the director of Al-Ahram Center for Political and Strategic Studies in Egypt, went further in defending Western reform initiatives, arguing that the Arabs should not link their endorsement of Western reform initiatives in the region to the resolution of the Palestinian-Israeli conflict. In his view, making reform conditional upon resolving the Palestinian problem has triggered a "definite political and moral tragedy" in the Arab world, since it has made the realization of Arab human rights hostage and conditional upon the realization of Palestinian rights.[16]

On the other hand, there are the rejectionists, who are sceptical of the trans-regional democratization projects, and view them as attempts to serve only the political agenda of great powers, rather than real at-

14 *Al-Watan* (Kuwait), 6 March 2004.
15 *Al-Sharq Al-Awsat* (London), 10 March 2004.
16 *Al-Ahram Al-'Arabi* (Cairo), 27 March 2004.

tempts to democratize the Middle East. This group represents the mainstream trend within the Arab world, and is characterized by its diversity in terms of the type and number of actors involved. In this respect, one could distinguish between two types of actors within this group: i) Arab states, and ii) Arab civil society, which consist mainly of nationalist and Islamist groups as the most significant sector of civil society in the Arab world in terms of number. With respect to Arab states, one could refer to four main grounds upon which they have rejected the Western reform initiatives. First is the lack of consultation with Arab countries. Virtually all international projects for reform in the Arab world were unilaterally designed by the Western sponsors. Arab countries were viewed as a domain for implementation rather than partners in the agenda formulation and implementation. In the G-8 summit held in the USA in June 2004 some Arab leaders were invited, but as 'legitimizers' of the Western plans rather than as partners in the process. It was not thus surprising that some Arab leaders declined to participate. Second, there is the question of the marginalization of the Arab-Israeli conflict. Most Western reform projects overlooked the question of the Arab-Israeli conflict as a major cause of instability and insecurity in the region. Rather, the emphasis in these projects is on domestic change in the Arab world. Although the G-8 summit Declaration of June 2004 referred to the importance of resolving the Arab-Israeli conflict, it added that such resolution should not delay the reform process. More importantly, no single action was suggested in the Declaration to deal with the Arab Israeli conflict. Third, there is the question of the projection of Western values. Euro-American approaches to reform are postulated on the assumption that the reform process in the Arab world must emulate the Western experience. While this could represent a valid argument if one is dealing with economic and technological issues, such validity certainly declines if it impinges on cultural and religious values. In this respect, Arab governments viewed the external democracy-promotion projects as attempts to dominate Arab countries and dilute the Arab-Islamic identity of its people, as was clearly stated by Ahmad Maher, the former Foreign Minister of Egypt. Last but not least, there is the question of the very definition of the Greater Middle East. It was argued that that concept entails an arbitrary definition of a region that includes countries with little commonality with respect to their social, political and cultural backgrounds. This in turns makes it difficult to apply such a broad set of policies to a diverse geographical area.

In addition to mobilizing opposition against the Euro-American projects at both domestic and international fronts, Arab governments also reacted to such reform projects by offering their own reform programmes in an attempt to "avoid being perceived at home as unresponsive to demands for change at a time when the international community was set to take unprecedented (if largely rhetorical) action in support of political reform in the Arab world" (Gambill 2004). This led to the mushrooming of Arab reform initiatives in the period between February and June of 2004. In February 2004, for example, the Yemeni government hosted a regional conference on democracy, human rights and the role of the international criminal court, which produced the Sana'a Declaration. The Declaration reiterated delegates' support for the principles of democracy, called for an end to the occupation of Arab territories, and suggested the establishment of an Arab Democratic Dialogue Forum to foster communication on human rights and democracy between governments and civil society groups. In March 2004, the Egyptian government hosted a similar conference that was attended by non-governmental activists and intellectuals from several Arab countries. The conference produced the Alexandria Document, which called for individual Arab countries to push forward on their own reform programmes, while conforming to a general framework agreed to by all Arab countries. In May 2004, the LAS summit in Tunisia adopted a resolution on political reform in an attempt by Arab governments to take ownership of the reform process, rather than leaving it to independent Arab intellectuals and civil society groups.

While it was not surprising that Arab governments would not endorse the trans-regional reform projects for fear of losing their grip on political power, we find that, contrary to expectations, the largest segment of Arab intellectuals, opposition groups, and civil society activists have also rejected these projects. This rejectionist attitude toward the trans-regional reform projects should not come as a surprise, however, when viewed within the context of existing historical and cultural memories in the Arab world vis-à-vis the patterns of interactions with the West over the last two centuries. In the context of these historical memories, democratization in the Arab world has been shaped by its historical encounters with the European powers since the 19th century expansion of imperialism into the region. Even with the end of European colonialism by the mid-20th century, the Arab region has continued to be subjected to several forms of

Western domination that ranged between political and economic domination. The result is that the West has always constituted "a source of domination that must be resisted" in the Arab consciousness (Pratt 2007). In this context, attempts by Western governments to impose reform on the Arab world act to reaffirm the perception of Western dominance and interference in the internal affairs of Arab countries. Al-Beshri, a highly respected Egyptian scholar and ex-judge, exemplified this intellectual trend in the Arab world. He rejected the philosophy of the Euro-American projects to reform the Arab world, arguing that the West is indifferent to the existing types of governing structures in the Arab world, and when it (the West) talks about reform and democracy in the region, it does so to serve its interests rather than the interests of Arab societies. Further, the Arab world, he contended, cannot have imposed Western values and systems imprinted in the region as Arab societies have undergone different historical trajectories from those experienced by the West.[17] Howaidi, a prominent Egyptian intellectual, shared a similar view, arguing that the American democracy promotion projects in the Arab world are an attempt to restructure the political and ideological map of the region in a way that serves American interests, and thus he perceived these projects as a threat to Arab national security.[18] Darwish, a Syrian analyst, also noted that "the term 'Greater' as in the GMEI is aimed against Arabs and Muslims. ... Its objective is to erase the term 'Arabism' and destroy Muslim beliefs, then leave the gates wide open for the greater Zionist initiative, under the cover of American influence and its military machine that is (already) heavily concentrated in the area. ... Arabs will be the first to pay the price out of their land, sovereignty, dignity, and most importantly their identity."[19]

In addition to Arab intellectuals, the vast majority of Arab civil society and opposition groups have also rejected the trans-regional projects for reforming the Arab world. Perhaps the most outspoken in this respect were opposition parties and civil society groups in Egypt. On 14 March 2004, the general-secretariat of the Nasserite Arab Party issued an official statement in which it warned of replacing pan-Arabism with Middle Easternism if the suggested political and educational reforms of the GMEI were to be implemented. The statement viewed the GMEI as a revival of both the Baghdad Pact, proposed by US President Eisenhower in 1955 to expand American influence in the region, and the New Middle East Project, proposed by Shimon Peres in 1993, and aimed at replacing the Arab regional system with a Middle Eastern one that incorporates Israel into the region.[20] The liberal New Wafd Party adopted a similar view. In a speech before the Wafd Party's youth congress on 14 March 2004, the Party's leader Noman Goma'a viewed the Euro-American reform projects as an aggression on Arab sovereignty, stressing that their goal is to bring the protectorate back to the Arab world in another form.[21] Further, the Muslim Brotherhood movement – the biggest opposition bloc in the country – rejected the Western projects to democratize the Arab world. On 4 March 2004, the movement issued an official statement in which it denounced Western attempts to dominate the Arab world and impose values that would threaten its security and stability. The statement called upon the ruling regimes, political parties, and civil society groups in the Arab world to adopt a firm stance against such attempts, and emphasized that democracy should emanate from within Arab and Islamic societies and in tandem with their cultural traits and heritage.[22]

A panel study was conducted by the Washington Institute for Near East Policy (Carpenter 2008) on how 'Arab democrats' viewed the role of foreign powers in promoting democracy. Arab participants in that study are liberals and are more or less hostile to the Islamists. They argued that the USA should support Arab democrats by getting behind them, not in front of them, step back and allow local actors to engage Islamists as appropriate, consider linking foreign aid to progress against official corruption, focus on policy reform, which is much more important than funding for programmes, fix the democracy assistance infrastructure, broaden private-sector participation in support of reform efforts, and develop a specific strategy to engage the youth in the region. However, Arab nationalists and Islamists would take an issue with these views arguing that the USA, and any Western power, has no mandate to get involved in the democracy agenda in the Arab world.

17 Interview with Tareq al-Beshri. *Islamonline*, 11 September 2003; at: <http://www.islamonline.net/arabic/arts/2003/09/article10.shtml>.
18 *Al-Ahram* (Cairo), 9 March 2004.
19 *Tishreen*, (Damascus) 11 March, 2004.
20 *The Arab Strategic Report* (Cairo: Al-Ahram Center for Political and Strategic Studies, 2004/2005): 415.
21 *Ibid.*: 414.
22 Ibid.: 415.

17.3.3 Sectarian Rifts in the Arab World

There are a number of sectarian rifts in the Arab world, the most important of which is the one between the two main systems of beliefs in Islam: Sunni and Shiite. Both of them adhere to the five main principles of Islam; however, they differ in their conceptualization of the political-religious leader. Whereas the Sunnis believe that such leader should be freely chosen by the believers and be held accountable to the Muslim Umma, the Shiites believe that such leadership (Imam) is the prerogative of the Prophet's cousin Ali Ibn Abi-Talib and his sons, and in fact the caliphs who succeeded Prophet Mohammad had usurped power (Halm 2001). That conflict had been indelibly imprinted on the history of Muslims, especially after Persia turned to Shiism in 1500. The subsequent three centuries witnessed major conflicts and wars between the various Persian Shiite dynasties and the Ottoman Sunni one.

The Sunni-Shiite political rift was resurrected after the Iranian revolution of 1979, but became a major feature of Middle East politics after the Anglo-American invasion of Iraq. The Americans built a new order in Iraq based on a sectarian quota system, through which the Shiites controlled power by virtue of being the majority of the population, especially after the return of Iraqi Shiite political parties which were based and trained in Iran. This trend spilled over other Arab countries as the Shiites began to emerge as significant political forces especially in Arab countries in which they are a majority (Bahrain), or a significant minority, such as in most other GCC states. The Sunnis were alarmed by that trend, and that was especially felt in Saudi Arabia whose version of Sunni Islam does not consider Shiites as true Muslims. It was also felt in Egypt as the Mubarak regime felt that the rise of political Shiism means the rise of Iranian influence in the Middle East. In fact, Mubarak charged that the loyalty of all Shiites, Arabs and non-Arabs, is to Iran, a statement which outraged the Arab Shiites. Further, King Abdullah II of Jordan warned that a "Shiite Crescent" is emerging, extending from Iran to Lebanon where Hezbollah, a Shiite organization, has been on the rise. The Saudis also subscribed to these perceptions, although they have been more restrained in articulating them. They have intervened in Lebanese politics to support Sunni forces against Shiite ones. These perceptions were shared by many Sunni scholars, the most important of which has been Sheikh Al-Qaradawy, based in Qatar, who warned against the rise of Shiism and its negative consequences on Sunni Muslims.[23] They have also been reciprocated by Shiite religious leaders who deny any Shiite domination in the Arab world (Fadlallah 2008).

Perceptions of threat are mutual among Shiites and Sunnis alike. Whereas the Sunnis believe that their traditional grip on mainstream Islam is being challenged, the Shiites believe that they were being denied their legitimate share in power in most GCC states, and argue that the Sunni governments are out to marginalize their role using repressive tactics. This can be clearly seen in Bahrain where the ruling family is Sunni, and almost 75 per cent of the population are Shiites. Sheikh Ali Selman, the leader of Al-Wefaq Group (a Shiite political organization), has frequently charged the ruling elite of discriminating against the Shiites by establishing a parliamentary system that denied them their fair share in law-making. However, the Arab Sunni civil society views the rise of Shiism from the angle of the political struggle against Israel. As Hezbollah has been the only organization that has been able to stand up to Israel as was seen in the July 2006 War, Arab civil society was more than ready to recognize its role including its leader Hassan Nasrallah, who was viewed as the legitimate leader of Arab resistance to Israel, even though he was a Shiite.

Civil society perceptions were corroborated by the findings of a survey project that was conducted in the Arab world in late 2006 by Zogby International, and designed by Shibley Telhami, a senior fellow at the Saban Centre for Middle East Policy. The survey, which covered a total of 3,850 respondents in Egypt, Jordan, Saudi Arabia, UAE, Morocco and Lebanon, found that around 80 per cent of Arabs consider Israel and the United States as the biggest external threats to their security, whereas only 6 per cent view Iran as a threat. Further, respondents rated Hezbollah leader Hassan Nasrallah as the most admired leader outside of their own country, followed by former French President Jacques Chirac, and Iranian President Ahmadinejad, while they rated US President George W. Bush as the worst world leader, followed by former Israeli Prime Minister Ariel Sharon, former Israeli Prime Minister Olmert, and former British Prime Minister Tony Blair.[24] These findings suggest, according to Telhami, that "the public of the Arab world is not looking at the important issues through the Sunni-Shiite divide. ... They see them rather through the lens of Israeli-Palestinian issues and anger

23 *Al-Masry al-Youm*, (Cairo), 9 September 2008.

24 See at: <http://www.brookings.edu/views/speeches/telhami20070208.pdf>.

with U.S. policy [in the region]. Most Sunni Arabs take the side of the Shiites on the important issues" (cited in Lobe 2007).

17.3.4 Foreign Labour in the GCC States

The issue of foreign labour is strictly related to the GCC states. The oil boom in these countries has resulted in a social and economic expansion and with the shortage of local labour, millions of professionals and labourers were contracted to work in the GCC states. Increasingly, foreign expatriates became a majority of the population in some GCC states, and a majority of the labour force in all GCC states. There are around 10.6 million foreign labourers working in the GCC states representing 37.5 per cent of the population. In the UAE, Qatar, and Kuwait foreign labour represents almost 82 per cent, 58 per cent, and 57 per cent of the total population respectively. These percentages are 39 per cent, 30 per cent, and 24 per cent, in Bahrain, Saudi Arabia, and Oman respectively (Al-Hajry 2008). Indian labourers represent almost 28.3 per cent of the total foreign labourers in the GCC states, but this percentage is the highest in the UAE where it represents almost 36 per cent of the total population (including foreign labourers) and 41 per cent of the foreign labourers. In fact, in that country the percentage of the citizens and Arab expatriates is 26 per cent of the total population which is less than the Indian expatriates (cited in Al-Najjar 2008).

Foreign expatriates have contributed tremendously to the development of the GCC states in virtually all fields. However, foreign labourers are now viewed in these states as an actual and a potential security threat. As 63 per cent of the foreign labourers are Asians, they impacted upon the fabric of the GCC societies in terms of language, culture, and domestic security. Sometimes, regional conflicts among South Asian states were projected into the GCC states through the South Asian labourers. Perhaps the most serious security threat perceived by the GCC in this field is the growing pressures from the labour-exporting countries and international organizations to grant them citizenship after a certain number of years of residence (Al-Hajry 2008). During the Manama Dialogue held in December 2008, the Indians officially asked the GCC states to grant Indian labourers, who have lived in one of these countries for five years or more, citizenship. The GCC ministers, especially the Bahraini Labour Minister Majid Al-Alawi, vigorously rejected the Indian request arguing that it would turn their societies into Indian ones. Many GCC intellectuals also criticized the Indian request and persuaded their countries to pursue a more strict policy towards reliance on foreign labour especially South Asian labour (Hareb 2008). Other Arabs viewed this request in the context of the Indian naval expansion and increasing regional influence which has been reflected in numerous visits by the Indian navy to the GCC states, and in the context of India's quest to isolate Pakistan by cutting off its economic support in the GCC states, as naturalization of foreign labour in the GCC states would work to the advantage of Indian labour and would lead to the 'Indianization' of the GCC states (Selim 2008a). There have also been a number of suggestions to deal with the threat of the domination of foreign labour in the GCC states such as orienting citizens to accept manual work, and shifting to Arab labour which is more oriented towards local cultures of the GCC states.

17.3.5 Environmental Threats

The concept of environmental security emerged in the Arab public discourse in the early 1990's in policy statements and academic writings referring to linkages between environmental concerns and security strategies. Arab perceptions of the environment as a security concern is characterized by its managerial and apolitical paradigm, which views environmental issues as a primary result of processes of industrialization and modernization, and the lack of proper state control and governance. It deals with these issues at the organizational level focusing mainly on relations among various state organizations. The state is seen as the major reference point in dealing with the problem. The essential tools for addressing environmental concerns is improved state management and control, and better coordination between various state organizations. The Arab perceptions of the environment are of a technocratic nature focusing mainly on technical issues related to the environment and do not frame them within its conceptualization of national security. However, some Arab intellectuals articulate a discourse on the environment quite close to the main arguments of the class paradigm. They tend to view environmental issues in political terms and put the responsibility for environmental problems in developing countries on the shoulders of the rich classes and developed countries. They refer to the emergence of a 'new global environmental system' characterized by the dominance of a 'new environmental imperialism'. This system is the main source of most environmental problems of developing countries such as nuclear

waste disposal in developing countries, ozone depletion and global warming.

Three major environmental threats are perceived in the Arab world: water scarcity, desertification, and land degradation (Brauch/Oswald Spring 2009; chap. 47 by both). Water scarcity is the most serious environmental threat to Arab security, as virtually all Arab countries are well below the line of 'water stresses'. The problem is further aggravated by high population increase, the geographical location of Arab countries in the Great Desert belt, and the lack of national programmes to rationalize water consumption. Almost 60 per cent of water resources in the Arab world originate from outside the region which gives rise to tensions in using jointly-shared water. This is acutely clear in the cases of the Nile (Adly/Ahmed 2009: Kameri-Mbte/Kindiki 2009), the Euphrates and Tigris (Aydin/Ereker 2009; Scheumann 1998, 2003). These cases are a source of present and potential conflicts and will be reviewed later. Further, deserts cover most of the Arab world. Almost 11 per cent of Arab lands are suitable for agriculture (with rainfall up to 400 mm), and about 89 per cent of Arab land receives a rainfall below 100 mm. Most of these areas are deserts or desertified sand suitable only for grazing. Most Arab lands are threatened by desertification due to anthropogenic activities including overgrazing of Arab land which is responsible for almost a quarter of the desertification.

There is an increasing awareness in the Arab world at the governmental and non-governmental levels of the urgency of these environmental problems. This has been reflected in establishing national institutions (ministries, or public corporations) on issues related to the environment, issuing national strategies for environmental protection, developing NGOs to support the work of the governmental institutions, issuing various journals to deal with the environmental issues, and establishing academic institutions to major in the study of environmental issues. Arab countries have also signed and ratified most international and regional governmental conventions and agreements on the protection of the environment. At the Arab regional level, there has been a concerted effort within the framework of LAS to co-ordinate Arab environmental strategies. A *Council for Arab Ministers Responsible for the Environment* (CAMRE) was also established in 1989. CAMRE meets annually to review common environmental issues. There have also been various regional initiatives to combat desertification such as the *Sub-Regional Action Programme* (SRAP) for West Asia and the Arab Maghreb Union (Selim 2009).

17.3.6 Energy Security

Arab perceptions of energy security passed through two main stages (Selim/Sahar 2009). The first stage extended from the second half of the twentieth century. The question of energy was viewed from a dominantly technical perspective. The emphasis was on securing world markets for Arab oil exports, and comparing the economics of various sources of energy, oil, natural gas, coal, solar, hydro, and nuclear energy. Perceptions were dominated by references to oil as the main energy source. Other sources were viewed as residual. The main exception was Egypt's emphasis on hydro-electric power as a main source of energy, which led to the establishment of 'the High Dam' in Aswan in the 1960's. After the October 1973 War, Egypt moved in the direction of building an ambitious nuclear programme, with a view of generating electricity, and there was a genuine debate in Egypt over the merits and de-merits of such a programme. However, the Egyptian programme abruptly ended in 1986 and the debate subsided. Further, Arab states established a regional organization, the *Organization for Arab Petroleum Exporting Countries* (OAPEC) to coordinate their oil policies.

By the beginning of this century, the discourse on energy expanded towards the integration of other dimensions such as alternative energy sources, rationalizing the use of energy, diversifying global partners in marketing and producing oil and other energy sources, and injecting into that concept the pan Arab cooperation dimension. Further, as Arab countries joined the Kyoto Protocol, they became mindful of the environmental consequences of energy (especially oil) production and consumption which led to an assessment of the impact of the Protocol on the continued access to global markets in the light of the necessity to reduce carbon dioxide emissions. This trend in Arab discourse on security began in 2003 with the convening of a conference in Abu Dhabi on 'Energy and Environment'. The main themes discussed in the conference were the impact of energy on environment, the social and economic impacts of energy policies, and the development of sustainable energy sources. Under these themes, the main issues for discussion were, the implications of energy related policies on the environment, fossil fuels for economic development and security, energy policies and their implications for sustainable development, socio-eco-

nomic aspects of energy policies, promoting participation in developing sustainable energy policies in the Arab countries, environmental management systems as tools for energy management, and compliance with energy related environmental standards in the Arab countries. The Conference also issued "the Abu Dhabi Declaration", which recommended the development of a new strategy that deals with the environmental consequences of energy production and consumption. The *Council of Arab Ministers Responsible for the Environment* (CAMRE) issued a document entitled "Action Plan on Environment and Energy for Arab Countries" in 2004. For the first time, The Action Plan put the question of energy into the larger framework of the environment. The Abu Dhabi Declaration and the following Action Plan represent a noticeable shift in the Arab discourse on energy in the direction of linking the issues of energy and environment.

In 2006, Egypt and the *Gulf Cooperation Council States* (GCC) began to advocate a nuclear option to generate electricity. This came in the context of the global debate on the Iranian nuclear programme and the revelations that Iran has succeeded in building an elaborate programme for uranium enrichment. After twenty years of the abandonment of the nuclear energy option, Egypt re-introduced the question of nuclear energy claiming that its traditional energy sources are fast declining. Surprisingly, GCC states followed suite as the 27th summit of the GCC held in 2007 resolved to embark on a GCC nuclear programme and these states approached the *International Atomic Energy Agency* (IAEA) to help in developing such a programme. Until that time, the GCC states used to criticize Iran for embarking on a nuclear programme as it has plenty of oil resources. We have argued earlier that the actual objective of these programmes is to justify the signing and ratification of the Additional Protocol of the *Nuclear Non-Proliferation Treaty* (NPT) rather than to launch real nuclear programmes as these countries had no expertise in the area of nuclear energy.

A number of security threats have been articulated by Arab intellectuals and energy experts. It is interesting to note that these threats have not been reflected in the official Arab discourse on energy which implies the existence of a gap between actual threats and perceived ones. These threats are the emergence of new oil producers in global markets, over-dependence on oil which has become the rationale to develop nuclear energy, over-dependence on foreign markets in the utilization of oil, the decline of the global demand for oil, the inefficiency in the energy utilization in Arab countries, and the environmental consequences of energy production and consumption in the Arab world. It is interesting to notice that, with few exceptions, Arab policy-makers tend to downgrade these threats in their public discourse.

Recently, Arab policy-makers began to articulate some non-traditional security threats emanating from the energy sector. The first is the threat of terrorist attacks on Arab oil fields. This has happened in Iraq after the Anglo-American invasion in 2003. On average, there are eight attacks a month, mostly pipeline bombing which kept Iraqi oil production 27 per cent below its pre-invasion level. There was also a failed attack on Saudi oilfields in February 2006. The last attack led to an increase of about 4 per cent of the price of the barrel of light crude. Osama bin Laden, the leader of Al-Qaeda, has persuaded his followers in December 2004 to attack oil fields in order to "stop the greatest theft of (Arab) oil in history."

As for the perceived strategies to deal with these threats, one can detect an emphasis on improving the efficiency of the oil sector and promoting the natural gas option, diversifying partners, and resort to alternative sources of energy such as the nuclear one. At the regional level, the countries of the Arab Orient and the GCC states have devised strategies of integration in the energy sector. Egypt, Jordan, Lebanon, and Syria have already begun connecting their electricity grids, and buildings natural gas pipelines that connect these countries to supplying them and Turkey with the Egyptian surplus natural gas. The GCC states have also approved a plan to connect their electricity grids. In 2001 these states formed "The Electricity Grid Authority of the GCC states" based in El-Dammam, Saudi Arabia to supervise the linking of their electricity grids.[25] The gas networks, through which Algerian gas is exported to Europe, also connect with Tunisia and Morocco.

At the international level, the main emphasis is to reduce reliance on Western markets and to diversify oil-importing partners by going east. This is mainly the strategy pursued by some GCC states. It evolves around creating partnerships with Japan, China, South Korea and India through which Arab countries would secure oil importers. Sometimes this takes the form of joint ventures, as with China, South Korea, and India. China seems to be the main long-term reliable partner upon whom most Arab countries are counting to secure oil partners.

25 *Al-Siyassa*, (Kuwait), 8 May 2007.

Arab energy analysts have recommended certain strategies to boost energy security such as rationalizing energy consumption, developing new and renewable energy sources, improving the quality of local industries so as to reduce the 'domestic elasticity' of energy consumption, and building inter-Arab networks for the exchange of electricity in emergency cases. Arab governments are partially pursuing these strategies. The main trend is to reduce, if not eliminate, state subsidies for electricity consumption which mostly hurts the underprivileged classes in Arab countries and those who need access to electricity. Recently, the electricity grids of Egypt, Jordan, and Syria were connected so as to exchange energy in cases of emergency. Also Egypt has built a trans-Arab Mashreq pipeline to sell natural gas to Jordan, Lebanon, Syria, Israel, and possibly also Turkey. The natural gas pipeline became operational in 2003. The main objective was to secure continued access in this part of the world to energy supplies.

The dramatic increase and decline of oil prices between 2005 and 2009 has increased the sense of vulnerability among Arab oil-exporting countries. As the prices of oil sky-rocketed they draw ambitious plans for future development which were quickly dashed as the oil prices fell sharply. To make matters worse, the global financial crisis has inflicted heavy losses on Arab countries which were estimated by Sheikh Mohammad A-Sabah, the Foreign Minister of Kuwait, to be around US$ 2,500 billion. He added that almost 60 per cent of the construction projects in the GCC states came to a halt.[26] Although policy makers in most Arab countries, especially the GCC states, claim that these developments will not seriously influence their economies, there are signs that they are beginning to acknowledge that the decline of oil prices and the global financial crisis represent serious threats to Arab economies (Abdel-Hamid 2007).

17.4 Conclusion

The concept of soft security is not known to be a central component of the Arab conceptualizations of security, as the Arab region is still plagued by hard security issues. It is not used by politicians and remains as a limited and elitist concept mostly used by civil society groups. Those who use it argue that Arabs should focus on soft security issues rather than hard security ones as the former are essential to create a solid Arab security structure and at the same time more manipulable by the Arabs. They also agree that soft security is mostly related to non-territorial and non-military issues. However, they differ on the issues subsumed under that label of soft security. For example, whereas some Arabs would categorize food security under the label of soft security, others would not necessarily agree, and whereas some Arabs would use the concepts of soft and human security interchangeably, others would prefer to distinguish between them.

The label aside, the issues of soft security have been widely debated in Arab literature on security, although the debate is not as central or intensive as the one on hard security issues. In other words, the limited employment of the concept did not necessarily mean that its components have not been perceived, and conceptualized. Traditionally, the issues of the environment and energy were the main soft security issues perceived by most Arabs. During the first decade of the twenty-first century other issues were added such as those related to terrorism, Sunni-Shiite rifts, the threat of Asian labour dominating the GCC states, and the threat of foreign powers using a heavy hand to promote their values in the Arab world under the guise of democracy promotion. In fact, some of the new issues, such as terrorism, have become more central than some of the traditional ones. With the exception of the two traditional soft security issues, environment and energy, and the newly-introduced question of terrorism, the Arabs do not seem to have devised any strategies to deal with the new soft security issues, because of the newness of these issues and their control by external powers.

26 *Bahrain News Agency*, 17 January 2009.

18 Military Challenges and Threats in West Africa

Kwesi Aning and Andrews Atta-Asamoah

18.1 Introduction

Much of the violent and protracted conflicts characteristic of sub-Saharan Africa in the post-Cold War years occurred in West Africa,[1] particularly in countries of the *Mano River Union* (MRU).[2] Apart from the fourteen years of intermittent conflict in Liberia, the West African sub-region also witnessed civil war in Sierra Leone; instabilities in Guinea-Bissau, Côte d'Ivoire, Niger and protracted rebellions in the Southern Cassamance Province of Senegal; resource-related conflicts in Nigeria, ethnic conflicts among the Nanumba and Konkomba in northern Ghana; and political instability in Togo.

Owing to these instabilities, innumerable human lives have been lost, massive property and natural resources destroyed, millions displaced, national economies shattered and untold human rights abuses have been meted out to non-combatants particularly women and children. In addition, the region has witnessed phenomenal spill-over of violence across boundaries. These happenings made West Africa globally famous in the 1990s for violent intra-state conflicts which provided the basis for some analysts to perceive the sub-region as representing the 'coming anarchy' and to describe it as a 'real strategic danger' requiring a re-colonization by former colonial masters in order to stabilize it (Cohen 1995: 95; Pfaff 1995: 4–6; Kaplan 1994: 44–76).

Insecurity in the individual states of the sub-region became closely linked together sufficiently so that the national security of individual states could hardly be considered independent of each other. The inter-relatedness of threats, which became known as the West African security complex, fundamentally highlighted the commonality of vulnerabilities and threats among states in the sub-region and the need for a sub-regional response to prevailing challenges.

Consequently, the *Economic Community of West African States* (ECOWAS), an organization of 15 West African states, metamorphosed from its initial focus on economic development, cooperation and integration to embrace security as an indispensable part of its remit. The Organization subsequently created structures and frameworks with which it has attempted to deal with the security challenges of the region. In addition to individual state efforts and the support of regional and global organizations particularly the *African Union* (AU) and the *United Nations* (UN), ECOWAS has been able to restore relative peace to the sub-region. In this regard notable hot-spots such as Liberia, Sierra Leone and Guinea have in recent times witnessed peace and stability.

Despite the achievement of relative peace and security, however, the sub-region has been far from eliminating threats to its peace and security. It is still bedevilled with myriads of security threats many of which are direct or indirect fallouts of previous security challenges or threats emerging from transnational challenges. These include intra-state armed conflicts; proliferation of small arms and light weapons; child soldierism; mercenarism; cross-border criminality; refugees and internally displaced persons; spread of deadly diseases especially HIV/AIDS; and exacerbating forms of poverty.

Within this panoply of threats in West Africa, this chapter examines existing military challenges and threats and their associated sub-regional responses. It thus provides responses to important questions such as: What are the military challenges, threats and vul-

1 West Africa (figure 18.1) is made up of Benin, Burkina Faso, Côte d'Ivoire, Cape Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. Apart from Mauritania, all West African countries are members of the Economic Community of West African States (ECOWAS).

2 The Manor River Union (MRU) comprises Guinea, Liberia and Sierra Leone. The Union was formed to promote sub-regional economic integration and the implementation of development projects among the three member states.

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_18, © Springer-Verlag Berlin Heidelberg 2011

Figure 18.1: Map of West Africa. **Source**: The UN Department of Peacekeeping Operation (UNDPKO), Cartographic Section, Map No. 4242, February 2005, at: <http://www.un.org/Depts/Cartographic/map/profile/westafrica.pdf>.

nerabilities in West Africa? What are the military implications of the identified security threats in West Africa? And what is the sub-regional response to the military challenges? The chapter first reviews military threats and challenges in West Africa together with empirical cases of individual country responses. It then identifies prevailing vulnerabilities upon which the threats thrive and then analyses the sub-regional response before concluding on the way forward.

18.2 Conceptual Clarifications

Certain terms used in social theory are essentially contested concepts. Nevertheless, it does not imply that it is difficult to agree on a definition of a concept, but that there are some concepts whose meanings are inherently a matter of dispute because no neutral definition is possible. This is classically true of the key concepts involved in this chapter. As a result, this section clarifies the concepts of military challenge, threats and vulnerability in the context of usage in the West African sub-region and particularly below.

18.2.1 Security

Security is herein perceived as the preservation of a state from external aggression, protecting its territorial integrity and internal cohesion (Giacomo 1989: 151). In the context of the international system, security is perceived as the ability of states and societies to maintain their independent identity and their functional integrity whilst pursuing freedom from threats. International security is determined basically by the internal and external security of the component individual states (Bellany 981: 102).

18.2.2 Threat

According to a United Nations study, a *threat* is any event or process that leads to large-scale death or lessening of life chances and undermines states as the basic unit of the international system. These are listed to include economic and social threats such as poverty, infectious disease and environmental degradation; inter-state conflict; internal conflict; nuclear, radiological, chemical and biological weapons; terrorism, and transnational organized crime (UN 2004: 2).

Threats are generally relative and evolve in nature. For example, if the immediate threat to global peace and security was nuclear war and its accompanying

possible use of *Weapons of Mass Destruction* (WMD) earlier in history, today it combines with the threat of terrorism as the greatest. In its relative sense, however, what constitutes a threat to individual states, sub-regions and regions and their intensities differ: Whereas to the United States terrorism could be the major threat, to Africa, it may be HIV/AIDS.

A brain-storming session of West African scholars, however, defined a threat as any phenomenon that may cause human society to be vulnerable to deprivation, misery, and/or annihilation such as intra-state armed conflicts; proliferation of small arms and light weapons; child soldierism; mercenarism; cross-border criminality; refugees and internally displaced persons; spread of deadly diseases especially HIV/AIDS; and exacerbating forms of poverty.[3] This chapter discusses threats in West Africa against the backdrop of the latter definition.

18.2.3 Military Challenge

Responses to security threats at the national and sub-regional levels in West Africa are as diverse as the list of threats. Whilst poverty and HIV/AIDS, for instance, have required civil society and government engagement rather than military intervention, other threats particularly the proliferation of small arms and light weapons, child soldierism, mercenarism and cross-border criminality have required the direct involvement or active participation of the security apparatus of states to contain. On the basis of the nature of responses, threats in West Africa can be categorized broadly into two: (a) those that require military response such as intra-state armed conflicts, the proliferation of small arms and light weapons, child soldierism, mercenarism, and cross-border criminality especially drug trafficking, and (b) threats that do not require direct military involvement such as poverty and the spread of diseases. Against the background of this categorization, this chapter discusses those threats that have required or require the active involvement of any of the state security apparatus as the primary response at the national and sub-regional level as the military challenges of the sub-region.

3 This definition emerged from a brainstorming session of West African scholars on the United Nations High Panel on Threats, Challenges and Change organized by the *Legon Centre for International Affairs* (LECIA) and UNDP-Ghana at the Cresta Royal Hotel, Accra, Ghana-West Africa, 18 August 2004.

18.3 Military Challenges in West Africa

18.3.1 Intra-state Armed Conflicts

West Africa's history of violent armed conflicts in the post-Cold War era started in 1989 when the *National Patriotic Front of Liberia* (NPFL) led by Charles Taylor launched an uprising against the leadership of Samuel Doe. Since then Sierra Leone, Guinea and Cote d'Ivoire have all encountered different intensities of armed conflicts. Even countries such as Ghana, Mali, Niger, Nigeria, Senegal and Togo that have not encountered full-blown conflicts have variously grappled with internal unrests resulting from economic, political, cultural and structural factors such as corruption, age-old animosity among different ethnic groups, quest to control natural resources by different warring factions and the abuse of the concept of citi-zenship (Brown 1996: 12–13).

During the Cold War these factors were held under control by superpower rivalry and support for authoritarian regimes. Following the end of the Cold War, therefore the lid on simmering tensions, hatreds and economic hardships in the sub-region was lifted providing an avenue for the exploitation of the region by:

- Sub-regional economic networks that directly and indirectly fuel insecurity through the exploitation and sale of natural resources particularly diamonds;
- Regional political and economic networks that provide support mechanisms and facilitate economic predation;
- Networks that comprise illicit smuggling activities and cross-border family ties that facilitate trade in valuable goods; and,
- Regional military networks that supply weapons and training facilities to combatants who are willing to destabilize countries, conflicts subsequently became prevalent in the sub-region as these networks exploited the emerging political, economic, structural and ethnic fault-lines to satisfy parochial interests (Aning 2007: 2–5).

West Africa has since witnessed about a dozen major intra-state armed conflicts that have had untold effects on the population and development strides of the sub-region (table 18.1; chronology: box 18.1).

Table 18.1: List of major conflicts in West Africa (1990-2006). **Source:** Marshall (2006: 45-48).

Begin	End	Country[a)]	Type	Major actors[b)]	Estimated deaths[c)]
1990	1995	Mali	Ethnic Violence (Tuareg)	• Tuareg rebels, • Government forces	1,000
1990	1997	Liberia	Civil war	• RUF, • Government forces	40,000
1990	1997	Niger	Ethnic violence	• Azawad • Toubou	1,000
1991	2001	Sierra Leone	Civil-Ethnic warfare (RUF, Mende)	• RUF, • AFRC, • Kamajors • Government forces	25,000
1992	1999	Senegal	Cassamance separatism	Movement of Democratic Forces of Casamance (MFDC) rebel movement	3,000
1994		Ghana	Ethnic Violence	• Nanumba ethnic group • Konkomba ethnic group	1,000
1997	2004+	Nigeria	Communal Violence	Delta province; Ijaw, Itsekeri, and others	1,500
1998	1999	Guinea-Bissau	Civil war	• Government forces • Senegalese army • Ansumane Mané • Guinean army	6,000
2000	2003	Liberia	Civil violence	• LURD guerrillas • Government forces	1,000
2000	2004+	Cote d'Ivoire	Civil war	• Patriotic Movement of Ivory Coast (MPCI) • Ivory Coast Patriotic Movement (MJP) • Ivorian Popular Movement of the Great West (MPIGO) • Forces Nouvelles	3,000
2001	2004+	Nigeria	Ethnic Violence	• Christians • Muslims • Plato and Kano regions	55,000

Notes:
a) Only countries with major armed conflicts are listed. Minor clashes are not listed.
b) Only the main actors in the conflict are listed. In some cases splinter groups exist apart from what has been listed.
c) Casualty figures for most conflicts in West Africa vary widely. In this compilation only estimates available in the public domain are used.

Notwithstanding their typically intra-state nature and dynamics, conflicts in West Africa assumed perturbing international dimensions that posed unprecedented challenge to their management and resolution.

First, neighbouring countries sometimes meddled in conflict situations by covertly supporting belligerents waging war against government forces. In the Liberian conflict, for instance, Charles Taylor is alleged to have been introduced to Muammar Gadaffi of Libya by Blaise Campaore of Burkina Faso and was subsequently trained, conditioned and equipped in Libya for the uprising. In 1991, Taylor also lent support to Foday Sankoh's *Revolutionary United Front* (RUF) to launch a similar uprising in Sierra Leone.[4] He is again alleged to have supported rebel forces in Guinea and Ivory Coast. Similarly, Lansana Conte of Guinea is also alleged to have provided military support to *Liberians United for Reconciliation and De-*

Box 18.1: Brief chronology of the major armed conflicts in West Africa (1990-2006). **Source:** Based on authors analysis of the region.

	Begin	Brief description of actors and international dimensions
1990	Tuareg Rebellion	This conflict was between the Tuareg separatists and the Malian army after the former attacked government buildings in Gao over complaints of marginalization by the Malian government. After reparations by Alpha Konare's government the conflict subsided. It was however re-ignited in 1994 following the Tuareg attacks in Gao. The Tuaregs are alleged to have been trained and armed in Libya. The situation has since remained a protracted conflict in Mali to date.
1990	Liberia civil war	The Charles Taylor led invasion of Liberia escalated into a bloody civil war. The main actors were the *National Patriotic Front of Liberia* (NPFL), the Independent National Patriotic Front of Liberia led by Prince Johnson and government forces loyal to the Samuel Doe regime. The NPFL forces were broadly supported by Cote d'Ivoire and Burkina Faso, both of whose leaders harboured family grudges against Doe, and Libya where Taylor trained for the invasion.
1991	Sierra Leone civil war	The *Revolutionary United Front* (RUF) launched an attack to overthrow the government of Sierra Leone. The initial attacks were launched from bases in Liberia with the support of Taylor and the NPFL. The main contenders in the conflict were the RUF and government forces. Other groups such as AFRC and Kamajors were also involved. Apart from Charles Taylor, the uprising was also supported by Guinea which supplied arms to the RUF.
1992	Cassamance separatism in Senegal	The *Movement of Democratic Forces of Casamance* (MFDC) begins violence in demand of the autonomy and independence of the Casamance region in Senegal. The MFDC wages the war against government forces. The situation has remained protracted and persists to the present (July 2009).
1994	Konkomba-Nanumba Violence in Ghana	Longstanding enmity between the Konkomba and Nanumba ethnic groups in Ghana erupted into violence in the Northern Region of Ghana. Government forces were sent to contain the situation.
1998	Guinea-Bissau Civil war	Troops led by Ansumane Mané begin an uprising to topple the government of João Bernardo Vieira. With the support of Senegalese and Guinean soldiers, troops loyal to the government attempted unsuccessfully to regain control of rebel held areas of the Bissau and heavy fighting subsequently ensued.
2000	Cote d'Ivoire Civil war	Troops mainly from the northern parts of Cote d'Ivoire started a mutiny by launching attacks in many cities, including Abidjan over the ivorite question. The contenders in the conflict are the *Patriotic Movement of Ivory Coast* (MPCI), *Ivory Coast Patriotic Movement* (MJP), *Ivorian Popular Movement of the Great West* (MPIGO), and the Forces Nouvelles. There has been a general ceasefire but the situation still remains volatile till date.

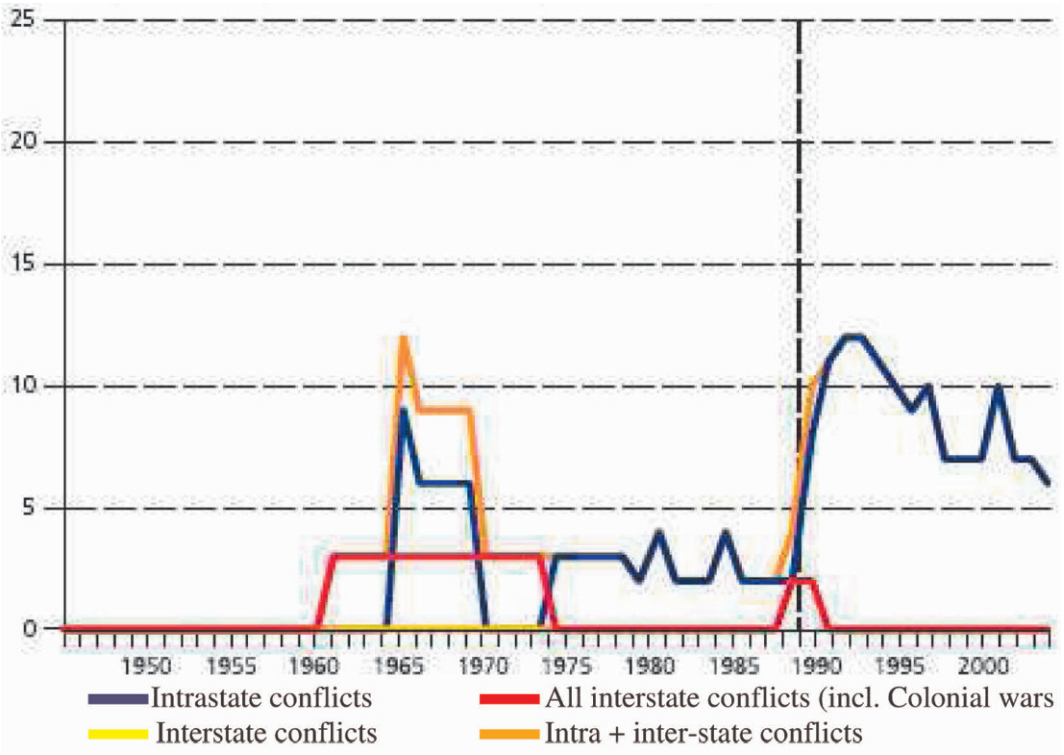
mocracy (LURD) to fight against the Taylor regime (Ero/Ndinga-Muvumba 2004: 228). Different reasons explain the readiness of external actors to support belligerents in such situations: Apart from ideological, political, or economic reasons as was the case in Taylor's support to the RUF, such support can also be understood within the rhetoric that "my friend's greatest enemy should rather become my friend." The covert support some rebel movements got from certain states granted rebels access to safe-havens, combat training and continued supply of weapons with which they sustained combat against regular armies.

The complexity of the Liberian uprising and the accompanying multiplicity of connected international actors enabled the uprising to thrive and eventually spill-over into neighbouring states; a feature which highlighted the *second* international dimension of conflicts in the sub-region.

The *third* dimension was the regionalization of the effects through refugee outflows and rippling economic effects. Conflicts in West Africa produced thousands of refugees into neighbouring countries. As

4 Taylor's support for Sankoh can be explained from two perspectives: For ideological purposes of supporting Sankoh who shared a similar revolutionary conviction and had also been trained in Libya. Secondly, it was to enable Taylor to have access to diamond as a critical resource with which he could fund the protracted war he was waging.

Figure 18.2: Trends in West African Armed Conflicts (1946-2004). **Source:** Marshall (2006: 45-48).



of 2006, for instance, the sub-region still had about 273,050 refugees after about 115,950 had been returned (UNHCR 2006: 12).

Apart from the international dimension of the conflicts, the mutilation of civilian non-combatants as part of counter-insurgency has since become characteristic of West African conflicts. Consequently, warfare in the sub-region since the 1990s have recorded untold violence against civilians. In Sierra Leone, for example, Foday Sankoh's RUF in the name of 'Operation No Hands' and 'Operation Pay-for-Yourself', committed untold atrocities against civilians. In 'Operation No Hands', victims were made to choose either 'long sleeve' or 'short-sleeve'. Based on the choice, a victim lost either a limb at the elbow for the former or a severed wrist for the latter (Aning 2005: 3). Child soldiers, particularly, under the influence of alcohol, drugs, Hollywood action movies and tyrannical interests of warlords committed grievous atrocities to children, women and aged people.

The deterioration of security in West Africa during the 1990's required a sub-regional response, besides efforts by individual states. Following the worsening of the Liberian civil war, the Heads of State and Governments of ECOWAS met in August 1990 in Banjul, Bamako and set up ECOMOG with the mandate to get the parties in the Liberian conflict to stop all military activities, surrender weapons, stop the importation of weapons, release prisoners, and respect the authority of the interim government of national unity.[5] This decision and its subsequent implementation by ECOWAS made the organization an emerging regional security actor and ECOMOG became the first African-led peacekeeping operation to deployed in sub-Saharan Africa after the Cold War (Nivet 2006: 15).

Although ECOMOG suffered setbacks in Liberia due to poor definition of its mandate, inadequate funding, organizational difficulties, uncertain legitimacy and over-reliance on Nigeria, the lessons learned from the deployment of ECOMOG in Liberia helped in the second deployment of the force in Sierra Leone (Olonisakin 2000: 100–144). The deployment of ECOMOG in Guinea-Bissau to help form a transitional government, organize elections and disarm combatants in 1998 was the third deployment of the force in the sub-region. ECOWAS reacted with an *ECOWAS Mission in Cote d'Ivoire* (ECOMICI/

5 Decision A/DEC. 1/8/90 on the Ceasefire and Establishment of an ECOWAS Ceasefire Monitoring Group for Liberia, ECOWAS.

MICECI or ECOFORCE). Despite been harshly criticized as ineffective and weak, the use of ECOMOG by ECOWAS has no doubt highlighted the commitment of its member states to the quest for peace in the sub-region. Through ECOWAS the sub-region has established an appropriate framework for realizing security through the adoption of protocols and declarations, notable among which are:

- The Revised Treaty of ECOWAS (1993);
- The Declaration of a Moratorium on Importation, Exportation, and Manufacture of Light Weapons in West Africa (1998);
- The Protocol Relating to the Mechanism for Conflict Prevention, Management, Resolution, Peacekeeping and Security (1999), and
- The Supplementary Protocol on Democracy and Good Governance (2001).

These documents provide a sub-regional framework that expresses the determination of West Africa's leaders to contain emerging security vulnerabilities, threats and challenges after the Cold War period.

18.3.2 Proliferation of Small Arms and Light Weapons

The West African sub-region is awash with *small arms and light weapons* (SALWs) primarily from years of legitimate purchases, local manufacture and illicit transactions by European arms merchants who traverse the sub-region. During the Cold War, many African countries benefited from arms transfers from the United States and the Soviet Union principally motivated by ideological or geopolitical considerations such as fuelling proxy wars. After the Cold War, remnants of these weapons found their way through the covert activities of economically motivated arms dealers, private military companies and local smugglers across the continent.

As a result, out of the 600 million SALWs currently estimated to be circulating globally and which account for the about 300,000 arms-related deaths yearly, an estimated 7–8 million are circulating within the boundaries of the sixteen countries of West Africa. Though this practically constitutes a minute fraction of the entire global challenge, the real threat it poses to West Africa can be understood against the background of the already existing instability and volatility in the sub-region. The proliferation of small arms and light weapons cannot be wholly blamed for the trendy violent conflicts in the region. Notwithstanding, the ease of weapon acquisition in the region poses dire security threats since weapon availability is a significant factor in the willingness of individuals and groups in conflict to consider peaceful alternatives. Where weapons are cheap and accessible, peaceful alternatives to dispute resolution are least considered. This contributes to the creation of abjectly insecure social settings typified by violence, destruction of life, property and an eventual strain of development efforts.

West African societies even in times of peace are still threatened by armed robbers, bandits and elements who employ violence to settle social and political scores. A notable example is the ongoing unrest in the Niger Delta region of Nigeria in which young people have employed the use of arms in registering their grievances against oil companies and government policies in the region. From this perspective, the proliferation of small arms and light weapons is practically related to societal insecurity.[6] The proliferation of SALW has therefore continously undercut efforts at combating crime, conflict resolution and management, disarmament, demobilization and re-integration efforts which are indispensable for the attainment of peace in West Africa.

Individual countries have made strides to contain this phenomenon by formulating policies and instituting projects towards curbing the challenge. Mali's efforts date back to 1993 when the country decided to tackle the small arms challenge as part of efforts to confront the instability posed by cross-border rebel activities in the country. In partnership with the United Nation various programmes were launched most remarkable of which was the March 1996 *La Flamme de la Paix* (The Flame of Peace) which saw the destruction of about 3,000 weapons handed over by the Tuareg rebels (Ero/Ndinga-Muvumba 2004: 228). In Ghana after a two-week arms retrieval amnesty granted by the government for individuals to hand over illegal SALWs without prosecution in February 2001, a joint police-military operation named 'etuo mu ye sum' forcibly retrieved unregistered weapons from owners.[7] In some West African countries, particularly Ghana, the response has been institutionalized into a Small Arms Commission to ensure effec-

6 Many West African countries particularly Nigeria, are noted for small arms-related high profile political assassinations and armed attacks. The Small Weapons Project (Prof. Keith Krause, Geneva) with support by the Swiss government has analysed this challenge critically and the Human Security Network has tabled these issues to the UN among others.

7 *Daily Graphic* [Accra], 6 February 2001: 1.

tive implementation, monitoring and evaluation of programmes. There are also commendable civil society involvements in confronting the situation. Particularly the *West African Action Network on Small Arms* (WANSA) which is a network of civil society organization in the individual countries is actively involved in confronting the challenge in the sub-region.[8]

At the sub-regional level, the realization of the devastating effects of the proliferation of SALWs led to the October 1998 Declaration of the *ECOWAS Moratorium on the Importation, Exportation and Manufacture* of SALWs. The Moratorium, among other things, basically seeks to confront the phenomenon through a *Plan of Action* under the *Programme for Coordination and Assistance for Security and Development* (PCASED) and the *ECOWAS Small Arms Project*. Despite the active involvement of various UN agencies especially the UNDP and many civil society organizations in the implementation of the programme which has resulted in many situations in the retrieval and destruction of SALW, the phenomenon has been far from curbed. Despite wide publicity, many of the initiatives aimed at retrieving SALWs merely succeeded. Many of the programmes despite the publicity merely succeed in retrieving old weapons many of which are out of use.

One of the critical challenges to the control of the phenomenon is that many states routinely flout the sub-regional restrictions on the importation, exportation and manufacture of small arms. Coupled with lax arms export controls in supplier countries, the activities of profit-motivated transnational arms traffickers and the presence of regional allies ready to provide cover and funds arms importation by belligerent groups, the sub-region still grapples with small arms and light weapons. In mid-2003, for example, the government of Guinea imported arms from Iran some of which finally ended up in the hands of members of LURD who were at the time waging an offensive in Monrovia. Our argument is that until the individual member states of West Africa unanimously pool their political will to implement and to respect the provisions of the sub-regional provision, the entire sub-region will continue to grapple with the phenomenon for a long time to come.

Besides the huge importation and subsequent trafficking across the lax borders of the sub-region, West African local manufacturers are increasingly improving in their arms manufacturing efficiency. Therefore even if the sub-region is finally able to institute stringent measures against small arms importation, the lack of a reduction in the demand will only put more pressure on local manufacturers to manufacture more. Given any correlation between increased manufacture and improvement in efficiency, the sub-region could then begin to churn out substitutes for imported arms and thus perpetuate the threats associated with SALW in the sub-region. Our argument is that West Africa's greatest threat related to SALW in the future will emerge around local manufacture. This is because unlike imported SALW that can be contained by improved border security and political will, local manufacturing is surrounded in secrecy in underground economies sustained by social structures and family allegiance thus making it difficult to contain.

18.3.3 Child Soldierism

The popularity of SALWs is due to the widespread availability, accessibility, durability, relative low-price, transportability and simplicity of use. Due to these characteristics, warlords in West Africa, particularly Charles Taylor and Foday Sankoh, found it an incentive to engage the services of children in their armies. Even though other factors such as the ease of recruitment and conditioning, and reduced proclivity to boredom are other factors, the ability of child soldiers to handle weapons and to subsequently use them in combat are important considerations in recruiting them.

About 300,000 child soldiers are currently estimated to be fighting in about 41 countries around the world with up to 120,000 of them in Africa. In post-Cold War West Africa, significant populations of the fighting forces that have waged the many intra-state wars have been children below age 18. In the Liberian civil war alone, an estimated 15,000 children engaged in combat and were largely culpable for offences such as rape, killings and other unimaginable human rights abuses (Doyle 2004: 1–2).

Children from West African cultures are noted for strict adherence to commands from adults. Conditioning them to transpose this disposition into combat therefore produces child soldiers with sharp obedience to combat command. In the hands of tyrannical warlords, such children are easily conditioned into professional killing machines that retaliate minor offences with excessive violence. Their involvement partly account for the trend of unparalleled vio-

8 WAANSA aims, among others, to work for the reduction of demand and supply of small arms and light weapons in West Africa. See for details <http://www.iansa.org/regions/wafrica/waansa.htm>.

lence and terror against non-combatants especially children, women and elderly people characteristic of West African warfare.

As reported by a journalist of the French *Le Figaro* a Liberian child soldier stated that

> at 2 pm, they gourge out two eyes, at 3 pm, they cut off one hand, at 4 pm, they cut off two hands, at 5 pm, they cut off one foot and ... at 7 pm it is the death which falls down.[9]

In a similar scenario, a young Liberian commander is quoted to have described a regular ritual of his armed group as:

> Before leading my troops into battle, we would get drunk and drugged up, sacrifice a local teenager, drink their blood, then strip down to our shoes and go into battle wearing colourful wigs and carrying dainty purses we'd looted from civilians. We'd slaughter anyone we saw, chop their heads off and use them as soccer balls. We were nude, fearless, drunk and homicidal (Weiss 2005: 2).

The involvement of children presents a military challenge in terms of strategy and confrontation. The lack of combat training and conventional warfare theories lead children to employ strategies that satisfy the interest of warlords but which draw warfare away from conventionality into practically murky and barbaric forms incompatible with conventional military strategy.

In post-conflict societies in West Africa, efforts are being made by UN agencies and civil society organizations to demobilize, disarm and reintegrate child soldiers into society. However, the lack of professional skills for lawful occupational opportunities seriously undermines efforts in many countries. In some cases, the combat experiences of child soldiers provide them with the skill to rob or involve in criminal activities. In the absence of substantial jobs, therefore, some children have found their way back into combat as veteran soldiers simply to enable them 'live by the gun' by pilfering, robbery and looting (Ball 1997: 85ff.; Malan 2000: 35ff.).

18.3.4 Mercenarism

Mercenarism in Africa is traceable to the early post-independence era when European soldiers of fortune such as 'Mad Mike' Hoare and Bod Denard had presence on the continent (McNeil 1997; Dumont 1997; McKinley 1997). In West Africa, the alliances between warlords, mercenaries, traffickers and marauders especially in the *Mano River Union* (MRU) countries, have been a notable factor in the dynamics of instability in the sub-region.

Executive Outcomes, a South African corporation that was established in 1989, for instance, has since its official closure in 1998 operated in the sub-region. During the Sierra Leone civil war, the corporation was hired by Valentine Strasser's government in 1995 to help defeat the *Revolutionary United Front* (RUF) rebellion, and to establish peace and order in the country through the provision of basic training, intelligence information, combat assistance and radar for night attacks (Winslow 1995: 36; Aning 2001). Their operation is argued to have assisted in the recapturing of the vital diamond-mining region of Kono and the retreat of the RUF from some of its bases (Rubin 1997: 44–45).

Executive Outcomes was officially disbanded following South Africa's promulgation of the Military and Foreign Assistance Act which banning its citizens from taking part in mercenary acts abroad. Yet, it is doubtful if the establishment has not simply relocated to Eastern Europe and metamorphosed into another corporation and still meddling in the security affairs of the sub-region. Such an argument is tenable in that even after reports of its official closure; the cooperation was still operating with the Angolan rebels in 1999 (Rubin 1997: B17).

Sandline International, like the Executive Outcomes, has also played very important roles in the security situation in West Africa.[10] In Sierra Leone, Sandline international is reported to have played a central role in the reinstatement of ousted Ahmed Tejan Kabbah as President by providing intelligence, logistic and air support. In the Ivorian crisis, reports of Sandline's involvement alongside European, South African and Angolan mercenaries fighting on the side of the government have been denied. Notwithstanding, the British Foreign Ministry warned United Kingdom companies against recruiting mercenaries to meddle in the situation.[11]

Despite arguments that the involvement of private corporations helped in stemming the tide of instabilities in the sub-region, it is notable that non-indigenous

9 See: Stuart Maslen, Coordinator of the Coalition to Stop the Use of Child Soldiers: "The Use of Children as Soldiers in Africa. A country analysis of child recruitment and participation in armed conflict", 15 May 2002; at: <http://www.reliefweb.int/library/documents/chilsold.htmt>.

hired military assistance sometimes distorted the smooth operations of legitimate government forces in countries such as Sierra Leone. In many cases their continued presence and operation have only led to further insecurity and instability.

The activities of foreign mercenaries can be predicted to reduce in the sub-region with increasing stability. Yet is important for the sub-region to pay attention to veteran combatants or roving fighters whose allegiance can be bought by state and non-state actors on the basis of financial gains. Examples of such roving fighters have been recorded in the Liberia, Sierra Leone, Guinea and Cote d'Ivoire conflicts.[12] The West African security environment is such that such combatants easily cross existing porous borders to fight in other countries where they are needed or to pilfer across borders. Such actors are more deadly because apart from the lack of professional regard for conventional warfare, they are familiar with the local terrain and conditions of the sub-region and therefore present dire challenges for any military action against their activities.

With the advent of roving fighters in West Africa, mercenarism is far from disappearing from the sub-region. This is because worsening economic hardships, failure of disarmament and reintegration efforts and the protracted cycle of unrests in other parts of the continent such as Chad, Democratic Republic of Congo, Sudan and Somalia implies that there would be plenty of places for veteran combatants to fight and new wars that produce continued supplies of hireable weapons and fighters in Africa some of whom could end up in West Africa.

18.3.5 Underlying Vulnerabilities

About 15 of the world's 50 less developed countries are in West Africa where large fractions of the population live below the poverty line and survive on less than a dollar per day. Apart from worsening human development indices (table 18.2), societies in the region are in their early stages of demographic transitions and thus are exhibiting rapid population growth, very large number of children and adolescent dependents, and a relatively few working age adults per dependent (Concitta/Engelman/Anastasion 2003: 32).

Given the prevailing economic non-performance, corruption, and inept leadership, West African countries have large populations of poverty-stricken young people who are literally coping with life and expect only a bleak and uncertain future. This has led to the creation of young desperadoes who have been ready-made cannon fodder for exploitation by individuals who recruit them for criminal activities or as child soldiers.

In an interview conducted by Human Rights Watch with some sixty former West African combatants, all respondents unanimously identified crippling poverty and hopelessness as the fundamental factors which motivated them to participate in armed conflicts across the boundaries of their countries. Many of them recounted the extent to which they battled daily against abject poverty and the hallucinations of hellish daily survival. Given the difficult present, unpredictable future and unlikely fulfilment of their dreams, many of them thought that going to war was their best option for survival. The surrounding psychological and physical complexities then aided their recruiters – mainly the warlords (HRW 2005).

Once these situations got them into combat, many of them willingly crossed borders as veteran combatants or roving fighters into other wars in neighbouring countries. To them, warfare always provided an avenue for survival by looting and pillage of property

10 See its website at: <http://www.sandline.com/site/>. It describes itself as: "Sandline International is a Private Military Company (PMC) which specializes in problem resolution and the provision of associated consulting services. The business was established in the early 1990's to fill a vacuum in the post cold war era. Our purpose is to offer governments and other legitimate organizations specialist military expertise at a time when western national desire to provide active support to friendly governments, and to support them in conflict resolution, has materially decreased, as has their capability to do so. Sandline is a privately owned and independent business. It is incorporated in the Bahamas and maintains representative offices in London, England and Washington, DC in the United States." On 16 April 2004 Sandline closed its operations and its website: "The general lack of governmental support for Private Military Companies willing to help end armed conflicts in places like Africa, in the absence of effective international intervention, is the principal reason behind Sandline's decision. Without such support the ability of Sandline (and other PMCs) to make a positive difference in countries where there is widespread brutality and even genocidal behaviour is irretrievably diminished." Sandline was a member of: International Peace Operations Association, 1900 L Street, NW | Suite 320 | Washington, D.C. 20036, at: <http://ipoaonline.org/php/index.php>.

11 See: BBC News: "Ivory Coast Mercenary Warning", 2 April 2003; at: <http://news.bbc.co.uk/1/hi/world/africa/2909769.stm>.

12 See BBC, 2005: "Mercenaries 'fuel West African Wars'", at: <http://news.bbc.co.uk/2/hi/africa/4438497.stm> (22 January 2008: p.2 of 2).

Table 18.2: 2005 Human Development Ranking for West African States. **Source:** UNDP (2007); at: <http://hdrstats.undp.org/buildtables/rc_report.cfm#> (22 January 2008).

Human Development Index Rank		Human development index value 2005	Life expectancy at birth, annual estimates (years) 2005	Adult Literacy rate (% aged 15 and older) 1995-2005	GDP per Capita (PPP US$) 2005	Life expectancy index	GDP index	GDP per capita (PPP US$) rank minus HDI rank
Low Human Development								
102	Cape Verde	0.736	71	81.2	5,803	0.766	0.678	-7
135	Ghana	0.553	59.1	57.9	2,480	0.568	0.536	-8
137	Mauritania	0.55	63.2	51.2	2,234	0.637	0.519	-5
152	Togo	0.512	57.8	53.2	1,506	0.547	0.453	-1
155	Gambia	0.502	58.8	..	1,921	0.563	0.493	-9
Without HDI Rank								
156	Senegal	0.499	62.3	39.3	1,792	0.622	0.482	-9
158	Nigeria	0.47	46.5	69.1	1,128	0.359	0.404	4
160	Guinea	0.456	54.8	29.5	2,316	0.497	0.524	-30
163	Benin	0.437	55.4	34.7	1,141	0.506	0.406	-2
166	Côte d'Ivoire	0.432	47.4	48.7	1,648	0.373	0.468	-17
173	Mali	0.38	53.1	24	1,033	0.469	0.39	-8
174	Niger	0.374	55.8	28.7	781	0.513	0.343	-1
175	Guinea-Bissau	0.374	45.8	..	827	0.347	0.353	-4
176	Burkina Faso	0.37	51.4	23.6	1,213	0.44	0.417	-17
177	Sierra Leone	0.336	41.8	34.8	806	0.28	0.348	-5
	Liberia	..	44.7	51.9	..	0.328	..	..

(HRW 2005). One of the most important underlying vulnerability to West Africa's security is the prevalence of exacerbating poverty among young adults. This communicates that realistic development efforts should be made inevitably part of conflict prevention and management processes since economic hardship is a function of resort to arms by ex-combatants.

West African countries have long borders which are poorly controlled due to inadequate resources, corrupt border officials and the existing ECOWAS mechanism for free movements among West Africans which makes it relatively easy for West Africans to cross borders into neighbouring countries. The ease with which individuals and covert networks are able to traverse the sub-region makes the regionalization of security threats easy. The smuggling of SALW, human and drug trafficking, mercenaries and illicit trade of minerals are able to flourish. For example, the illicit trade of Sierra Leonean diamonds that funded the RUF uprising involved cross-border smuggling through Liberia and Guinea to the world market. Through these the weak borders of West Africa becomes a critical vulnerability to the stability of the sub-region and the containment of all forms of military challenges.

The military capacity of West African states, compared with other parts of Africa, is one of the most tested in Africa due to the sub-region's experiences in intervention initiatives. However, military composition predisposes many of them to internal weakness. Some West African armed forces are endemic with divisions resulting from politicization, religion, clientelism and, most of all, ethnicity which are fallouts from both colonialism and of the extent of military participation in politics. As a result, whereas some officers of the army are capable by all standards, others became members of the army through neo-patrimonialism without regard to capacity and competence. The result is that whereas some West African armies are efficient and professionally capable, others are

grossly incompetent with inherent weaknesses and combat unpreparedness that render the state vulnerable to armed rebel activities (Metz 2000).

The Ivorian army, for instance, was created in 1960 and was primarily involved in political and development activities including administration, health care, and diplomatic representtation rather than the preservation of the territorial integrity of the state. The combat readiness and response of the army was thus weak or at best limited. About 80 per cent of its budget was meant for salaries of military personnel rather than for materiel and training. Under President Bedie the army's role, was changed towards its utilization as a political tool to suppress anti-government protests. The army's inherent weaknesses and unpreparedness became instantly evident when it was put to test by the uprising which plunged Cote d'Ivoire into civil war.

18.4 Military Implications of the Challenges

The complex security environment created by these threats and challenges in the sub-region has diverse military implications, particularly in terms of combat strategy or tactics, deployment of troops and security spending. The phenomena of child soldierism, warlordism, the proliferation of SALW and the oscillatory motivation for conflict in West Africa have murkily influenced the dynamics of warfare in the sub-region. Consequently, warfare in West Africa is typically unconventional and thus employs fluid combat strategies including the gross mutilation of civilian noncombatants and displacements as strategies of insurgency. These present crucial challenges for conventional combat strategies as is evidenced by the ability of rebel armies to sustain combat against government forces for decades, as was the case in Liberia, without being immediately quashed.

Since the deployment of *ECOWAS Ceasefire Monitoring Group* (ECOMOG) in Liberia, peacekeeping deployment has become a norm in ECOWAS's response to armed conflicts in the sub-region. So far the organization has deployed four key peacekeeping missions – Liberia, Guinea-Bissau, Sierra Leone and Cote d'Ivoire. Such deployments have financial implications and also stretch the military capacity of participating countries. In deploying the ECOMOG in Liberia, Nigeria had to bear the larger fraction of the cost of funding because Nigeria was economically better than the other countries that had contributed troops for the operation. Concurrently, however, West African economies are recovering from years of economic non-performance and debts since the early 1970's and 1980's. Defence spending, therefore, competes with many other national development goals leading to a relatively low and austere funding for the military. Given the need for a constant deployment in a volatile region like West Africa, apart from over-stretching the army, also puts undue financial pressure on governments to fund armies from the already over-stretched budgets readiness in response to crisis or an eminent insecurity.

18.5 Sub-regional Responses and the Evolution of ECOWAS

ECOWAS has since the deployment of ECOMOG in Liberia continued with efforts towards the establishment of permanent institutional and legal structures for the realization of peace and security in the sub-region. Notable among these efforts is the December 1997 extraordinary summit of the Authority held in Togo. The summit, among other things, sought to shift emphases from the ad hoc conflict resolution procedures that guided ECOWAS's response to crises in the sub-region to more permanent structures by establishing a mechanism for conflict prevention, management and peacekeeping. A technical document that outlined the modalities for such a mechanism formed the basis for an expert meeting in July 1998. Its conclusions resulted in a *Mechanism for Conflict Prevention, Management, Resolution, Peacekeeping and Security,* which was adopted in 1999.

In the area of conflict prevention, management and resolution, some of the established institutions include the *Mediation and Security Council* (MSC) which harmonizes decision-making regarding deployment and operates at the level of the Heads of State, Ministers of Foreign Affairs, and Ambassadors. ECOWAS also established an early warning system and an Observatory with threat perception analysis. Since it is increasingly being realized that the nature of new conflicts have deep roots, the Observatories have the duty of examining the root causes of impending conflicts and forwarding reports to an *Observation and Monitoring Centre* (OMC) at the ECOWAS Secretariat where such reports are analysed. The reports are then synthesized and expedited immediately with suggestions concerning the appropriate strategy to be applied by the MSC and the countries concerned.

ECOWAS's response mechanism is based on such reports upon which the Executive Secretary devises response strategies. Based on the reports forwarded to the Executive Secretary and subsequently to the CMS, four options may be opened to diffuse any potential conflict. These are: (a) to set up a fact-finding commission; (b) employ the services of the Executive Secretary; and (c) call on a Committee of Elders; or (d) recommend military intervention.

Three major circumstances warrant community intervention and these are spelt out as situations or event that:

- threaten to trigger a humanitarian disaster;
- pose a serious threat to the peace and security in the sub-region; and
- erupt following the overthrow or the attempted overthrow of a democratically elected government.

The operationalization of the response mechanism to the diverse security challenges in West Africa has set the ECOWAS apart as a sub-regional body with a peacekeeping and peace enforcement apparatus. It has also resulted in the transformation of the organization from a purely economic entity to one with security as one of its primary priorities.

18.6 Conclusion

The West African sub-region has grappled with myriads of security challenges in the post-Cold War era that have required military response and involvement. Despite commendable strides by individual countries and ECOWAS to contain them, the sub-region is still pragmatically bedevilled with intra-state armed conflicts, the proliferation of small arms and light weapons, child soldierism, mercenarism, and cross-border criminality especially drug trafficking. Even though they pose individual challenges, the threats are practically interwoven and are mutually reinforcing of each other. The armed conflicts of the sub-region, for instance, are sustained by the proliferation of SALWs, yet SALW proliferation is also worsened by the existence of armed conflicts in which combatants get weapons to use for combat. Similarly child soldiers, whilst contributing to the insecurity, are also recruited because of their ability to handle weapons.

Practically, however, the combined effects of all the challenges determine the security situation in the sub-region. Commendable strides have been made towards the realization of peace and stability in the sub-region, yet the region is practically far from what citizens of the region's individual countries expect. Whilst many of the countries cannot be said to be at war presently; they can equally not be said to be at peace. This has led to the existence of what can best be described as a 'no peace and no war situation' in which the above discussed military challenges are key in the calculus of the sub-region's peace presently and in the future. Underlying the situation, however, is the prevailing exacerbating forms of poverty which is critical in maintenance of peace and the resolution of conflict.

It is thus important for the ECOWAS to step-up the various programmes and projects that target the above discussed challenges. This is because given the extent of easy regionalization of the effects and implications of the challenges a sub-regional response will be more comprehensive than individual state initiatives. The efforts of the ECOWAS therefore require support and commitment from ECOWAS member states and the international community as a whole.

19 Weak States and Security Threats in West Africa

John Emeka Akude

19.1 Introduction

Since the late 1980's, repeated cases of breakdown of states' institutions and the concomitant internal wars in West Africa have called the attention of observers to the abysmal level of insecurity in this sub-region. Images of wanton killings, of mutilations and displacement of thousands of people alerted the world to the orgy of violence in the wake of states' incapacity to protect its institutions. Endemic insecurity in West Africa is not restricted to state institutions but pervades almost all aspects of citizens' lives. Political instability with a high degree of violence has accompanied these states since the post-colonial period. A calculation showed in 1991 that 485 post-colonial African rulers were threatened with a 60 per cent chance of being killed, imprisoned or exiled as a consequence of holding office (Wiseman 1993: 657–660). Restricted to the West African region, this percentage may dramatically increase.[1] Prior to the series of state collapse and the attendant internal wars, most West African states have experienced military coups, civil wars or violent secession attempts involving thousands of civilian casualties. In most West African states, internal political struggles are sometimes akin to wars. Thus, internal sources of insecurity by far exceed external sources. In general, peoples and states in West Africa are confronted with a constant state of fear.

How do we define (in)security and state weakness and how are they linked? Why is insecurity common place in West Africa? What constitute threats, risks and challenges to security in West Africa and why are the states vulnerable to them?

This chapter seeks to provide answers to these questions by conceptualizing security and insecurity as well as state strength and weakness (19.2). It then theorizes state weakness in West Africa in a historical context (19.3). Finally, the challenges to security and vulnerabilities to insecurity in West Africa are reviewed with policy recommendations regarding the improvement of the situation.

The hypothesis of this chapter is that the historic trajectory of the emergence of the modern state in Africa precluded the imperatives for creating strong bureaucratic state structures with the consequence that the states remain weak, dependent on the international system (superpower politics) and incapable of securing themselves as well as their citizens. This specific historic trajectory equally obliterates the necessity of pursuing economic development among the political elite, who instead, concentrated their energies on using state power to accumulate private wealth. Decades of economic underdevelopment left the youths with fewer prospects for decent lives and drove a majority of them into violence, crime and prostitution. The considerable decline in economic and military support from international sources at the end of the Cold War resulted in the collapse of some states and thereby increased the level of insecurity for states and citizens in the sub-region. As states collapsed and civil wars arose, the youth became willing tools for warlords to spread insecurity, deaths and chaos on West African states and citizens.

19.2 Clarifying the Concepts of Security and State Weakness

The study of international relations has a (realist) tradition that considers security primarily from the perspective of the state. The state is the subject as well as the object of security. Only it has the right to securitize an issue.[2] The protection of the state thus has priority over all other issues. This is understandable due

1 Apart from Senegal and Cape Verde, all West African states have witnessed violent military coups. This does not imply that Senegal is more secure than other West African states, as there have been violent skirmishes between the Senegalese government and Casamance separatists for some decades.

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to the fact that today's international relations started in Europe where, as Adam Smith (1776) points out, the defence of the realm is the state's *raison d'être*. This naturally includes the defence of citizens. It was superfluous to consider other dimensions of security – the human dimension for example - because the states protected their citizens as a survival imperative. The survival logic in the development of the modern state in Europe automatically disposed the state to have an interest in protecting the lives of citizens within its territories. The goal was to pre-empt external aggressors exploiting the disgruntlement of some sections of the citizenry to attack and possibly dismember the state (Jackson 1990; Tilly 1992). In view of the credible sources of insecurity being external, it was understandable for the realist version of international relations theory to be mainly concerned with the external dimensions of a state-centred security concept. For example, Stephen Walt (1991: 212) considers security as dealing with the threat, use and control of military force with states being the actors that prepare for, prevent or engage in war. This implies that states have to, first of all, perceive something (real or imagined) as a threat to their existence and then act on it. The significance of perception led Arnold Wolfers (1962a) to see security as consisting of two dimensions: objective and subjective. Objectively, security implies the absence of threats to acquired values and subjectively, it implies the absence of fear that such values will be attacked.

Conversely, the development of the modern state in West Africa took an opposite logic in which the state's protection of citizens is not obligatory – at least from the point of view of states' political elite (Akude 2008). It is a logic that, now and again, induces the endangering of the lives of citizens within the state's territory by the state itself. In West Africa for example, anti-democratic and dictatorial rulers have often hidden behind the cloak of state security to victimize, torture and even kill political opponents. Victimizations and discriminations could even be extended to the ethnic origins of those opponents in an atmosphere of politicized ethnicity and have sometimes led to civil wars.

The warning of Barry Buzan (1991: 102) regarding the unqualified application of the concept of state security to weak states is therefore appropriate. He maintains that "the weaker a state is, the more ambiguous the concept of national security becomes in relation to it" and warns that an unqualified application could be dangerous because the logic of state security could be exploited by factions in control of the state to legitimize the factional use of force.

International relations study was reluctant to acknowledge these facts due to the dominance of superpower politics in international relations during the Cold War. The termination of the Cold War removed the barriers to the acknowledgment of the dangers associated with the state-centric definition of security and coupled with analyses of states preying on their societies; attempts were made to alter that. Furthermore, globalization and the increasing salience of economic, environmental and identity issues in international relations contributed enormously to a demand to altering the state-centrism of the security concept. These developments culminated in a widening of the spectrum of security discourse. One could therefore identify two schools of thought: the post-modern 'wide' and the traditional 'narrow' (Buzan/Wæver/de Wilde 1998: 1ff; Brauch 2003, 2005, 2005a, 2008, 2008a, 2009). Current concepts of security therefore ramify all dimensions of human life, albeit with a danger of being analytically unclear.

Of all these new dimensions of security, the concept of human security is the most comprehensive and happens to be the most appropriate to West African states because it goes to the heart of the dangers associated with and neglected by the state-centred concept of security. It also calls attention to the amelioration of such social problems associated with less-developed states and which feature prominently on the development policy agenda as the general poor quality of life, abuse of citizens' rights and their denial of political liberties among others. Furthermore, if the protection of the realm is the main reason for states' existence as Adam Smith claims, then the concept of human security should be prioritized over state security because the best real protection of the state is the protection of its citizens. One of the lessons to be drawn from the collapsed states of West Africa is that unprotected citizenry could (in the search of self-help

2 For a detailed discussion of the concept of securitization, see Wæver (1995, 2008, 2008a) and Buzan/ Weaver/ de Wilde (1998: 23–33). The usage of the term in this chapter is limited to expressing the necessity of emergency in dealing with an issue which if not done, could sooner or later; threaten the existence of either the state or its citizens. This should not be misconstrued to indicate a plea for increasing the powers of the state against the society. Of course, a humane, democratic and socially cohesive state, based on the rule of law and interested in the economic well-being of its citizens is preferable than other types of states in the securitization of issues.

protection mechanisms) facilitate the collapse of states which invariably increases the level of insecurity of the citizenry. Taking cognizance of this fact means that neither 'state' nor 'human' security should be pursued at the expense of the other. How is human security to be understood? Although the concept still suffers from analytical clarity which makes it problematic for research purposes, a certain consensus could be gleaned out of the definitions offered by different experts.

The *United Nations Development Programme* (UNDP 1994: 23) defined human security as safety from such chronic threats as hunger, disease and repression as well as protection from sudden and hurtful disruptions in the patterns of daily life – whether in homes, in jobs or in communities. Its long list of aspects of human security includes economic, food, health, environmental, personal, community and political security (UNDP 1994: 24–25). This represents a fundamental change in the concept of security by placing human beings at the centre and making their protection the benchmark of security.

The Japan-sponsored *Commission on Human Security* (CHS), for example, sees it as 'freedom from want'. The Human Security Network (involving 12 states) regards human security as 'freedom from fear'. Kofi Annan's (2005) definition stressed the 'freedom to live in human dignity' (including the rule of law, respect for human rights and democratic principles) while the United Nations University's Institute for Environment and Human Security considers it as the 'freedom from hazard impacts' or the aftermaths of catastrophes, emphasizing the reduction of social vulnerabilities through early warning and institutional resilience (Bogardi/Brauch 2005; Brauch 2005, 2005a, 2008a). Thus, the concept of human security drives security beyond the state by stressing the primacy of the protection and empowerment of the individual. Human security is considered in this chapter as the capacity of eliminating, or constantly reducing the vulnerability of individuals and their communities to political, economic, environmental, and socio-cultural threats.

Security in general is considered here as having two main dimensions in West Africa - the state-institutional and the human – and threats to the lives, properties, health, well-being, environment and the community as well as threats to the smooth functioning of state's institutions, including the pursuit of economic and social development and respect for human rights, democratic principles and the rule of law as security threats: They directly or indirectly impinge on the ability of human beings to live in a social condition devoid of threats identified by the definitions above. This demarcation is merely analytic. I would later on demonstrate that there are constant spill-over effects of threats between the two dimensions. Practically, what threatens one, *ipso facto*, threatens the other. Evidently, the concept of human security is automatically linked to the institutional capacity of states because it implies the willingness, readiness and capacity of states to protect their institutions, territories, environments and citizens. Of course, weak states fare worse in these areas than strong states.

The terminology of weak statehood is from its very nature a comparative one as it distinguishes a class of states from others. It is also relative for the fact that there are several stages of weakness. The conceptualization of state weakness demands *ex ante* a conceptualization of the state for the mere fact that a weak state, to paraphrase Clapham (2000: 1), is characterized by what it is not. So what is a state proper? Jean Bodin (1986, 1576) is generally regarded as the founding theorist of the modern state and defines the state on the basis of sovereignty which he sees as "la puissance absolué d'une republique" – absolute and perpetual power vested in a commonwealth. He contends that sovereignty has an impact on the internal as well as the external affairs of a state and is the highest power of dominance immanent to a state. This implies that states with "quasi-sovereignty" (Jackson 1990) are seriously constrained in their exercise of authority internally as well as externally. To Alan James (1986: 39), sovereignty "is a legal, absolute and unitary condition". It is legal; because a sovereign is not subordinate to another sovereign and enjoys equality with other sovereigns in international law, absolute; because sovereignty is either present or absent, and unitary; because a sovereign state is the supreme authority within its jurisdiction (Jackson 1990: 32). Sovereignty is thus the quality on which the equality of all states in international relations rests. Below, this is discussed as being more apparent than real as it often negates international political fact. This aspect of the historical violation of the long-standing principle of sovereignty rather justifies its characterization as "organized hypocrisy" (Krasner 1999).

Max Weber (1968) defines a state, rather from the means at its disposal, as an entity that claims legitimate monopoly of instruments of violence and taxation for purposes of order in a populated territory, using violence if necessary, to achieve its aims. Critical attention should be paid to the word 'claim' due to the fact that the capacity of states to monopolize tax-

ation and violence, maintain law and order as well as the acceptance of this by societies vary. States claim to perform these functions based on the rule of law. A state therefore consists of a territory, a population and a sovereign government that regulates the affairs of the state guided by the law. This corresponds to the definition of state in international law (Montevideo Convention on Rights and Duties of States of 1933: Article 1).[3] However, the state as a human organization has developed further and taken up more assignments to itself since the times of Bodin and Weber.

Rotberg (2004) wants these expanded assignments reflected in the definition of the modern state which he maintains, exists to supply the citizens with political goods. Critical among these political goods are security, law and order, infrastructures, economic well-being, political rights and civil liberties etc. "But it is according to their performances – according to levels of their effective delivery of the most crucial political goods – that strong states may be distinguished from weak ones, and weak states from failed or collapsed ones" (Rotberg 2004: 2). He constructs a hierarchy of political goods with security, especially human security at the apex, proceeded by the provision of law and order, free and open political participation, medical care, educational facilities, physical and social infrastructures etc. in that order. Strong states generally perform well (albeit with variations) across this spectrum but weak states do not. Weak states therefore are those economically poor states that possess negative sovereignty, lack the legitimate means of effective monopoly over instruments of violence and taxation which then impinge on the will or capabilities of providing the society with political goods.

19.2.1 West African Discourses on Security and the State

The end of the Cold War and the collapse of states in West Africa have spawned discussions and academic researches on security issues in that region. Most of these studies have revolved around the the conception of security, the dynamics of security, the sources of insecurity, conflict management and how to improve the security situation in West Africa within the context of the post Cold War order.

The literature demonstrates a consensus on certain issues: They criticize the realist school (Musah/Fayemi 2000; Hutchful 2000; Obi 2006), emphasize the historical trajectory of the states and personality cults as fundamental in precipitating insecurity (Musah 2000; Adebajo 2002: Adedeji 2002), stress the international as well as local dimensions of violent conflicts (Musah/Fayemi 2000; Musah 2000; Hutchful 2000), criticize the conflict management method that conflates cessation of hostilities with peace and conduct of elections with democracy (Adedeji 1999; Musah/Fayemi 2000) and see bad governance as the major causes of insecurity in West Africa (Adedeji 1999; Abdullahi/Muana 1998). There is, however, disagreement on the causes of the conflicts. Some consider conflicts as being caused essentially by poverty and identity-driven (Musah/Fayemi 2000a: 39). Adedeji (1999a: 17) disagrees slightly. To him, identifying tribalism and ethnicity as causalities is a misunderstanding of African conflicts, seen through Western lens. He identified political failures as lying behind economic crises and political conflicts in Africa. He writes, "It is now generally accepted that Africa's persistent economic crisis, severe as it has been, is but a consequence of its political crisis. Civil wars and civil strifes are but violent reactions to the pervasive lack of democracy, the denial of human rights, the complete disregard of the sovereignty of the people, the lack of empowerment and accountability and, generally, bad governance" (Adedeji 1999a: 7). West Africa is home to a critical and radical academic tradition that considers ethnic conflicts as being engineered by politicians jockeying for posts that enables access to state's resources. Ethnic conflicts are therefore essentially class conflicts with the state acting as the arena for class formation (Ake 1996; Nnoli 1978, 1998).

Indigenous West African security pundits are generally critical of the realist, state-centric conception of security and appear to favour the postmodern "wide" variant. Musah and Fayemi (2000) criticize the emphasis on the coercive power of the "established" and "legimitate" State as the primary source of stability and order by international security experts in the search for "quick-fix solutions" to problems of internal conflicts. They state: "By reading violent sub-national challenges to the supreme authority of the nation state as 'irrational', and expressing disgust at the methods used by some belligerent parties and the need to 'do something' about these 'barbaric acts', the potent identity-based factors and wider perceptions of

3 Art. 1 of the Montevideo Convention (1933) reads: "The state as a person of international law should possess the following qualifications: a) a permanent population; b) a defined territory; c) government; and d) capacity to enter into relations with the other states."

economic and social injustice which combine to fuel these conflicts conveniently escape serious attentions" (Musah/Fayemi 2000a: 14).

Working within the "state as an organized crime" paradigm (Tilly 1975), Eboe Hutchful (2000) sees the state-centric concept of security as a racket. He considers security an ideological construct which force is broadened when linked to other normative states such as 'national', thus creating the impression of a common good to which all citizens have access. This illusion is laid bare, if one deconstructs the concept. Thus, "security has always been dispensed very selectively within both national and international community, reflecting socioeconomic status, residency and state of citizenship (...); in other words, differential perceptions of human worth" (Hutchful 2000: 214). National security instruments could even be employed against citizens by the state. Additional to the governance problems of African states, he states, there is a problem with the governance of security; i.e., the effective management of the institutions of violence: The attempt at strengthening the internal security of a state could threaten the position of the ruler by increasing the power of 'strongmen' within these security institutions. This, he calls, the "rulers security dilemma" (Hutchful 2000: 212). Rulers could react by deliberately weakening state security institutions and even creating private armies often known as national guards with long term fatal consequences for the states. This security dilemma goes down the line as it affects managers of security in terms of technical efficiency of the production of force as well as in terms of similar threats from strongmen from within the ranks of the institution. Officers therefore resort to relying on primordial relationships against formal structures of bureaucracy as a basis for trust. This explains the dominance of informal links and structures of power as well as primordial and family relationships over formal hierarchies and chains of command. Thus, the rulers security dilemma increases insecurity through incompentence: recruitment and promotion are based not on merit but on trust out of primordial relationships.

That security is an ideology that could be framed to suit differential purposes, for example, the framing of state collapse and terrorism, is also stressed by Obi (2006). This is his explanation of drawing West African states into the war against terror without a clear evidence of international terrorism in West Africa; an act which he considers a globalization of the region's security. The US has gone ahead to engage militarily in West Africa through establishing an Africa Command and an *African Contingency Operations Training Assistance* (ACOTA) to aid West African states prepare for counterinsurgency. She is already building facilities (air and sea military bases) in West Africa. By so doing, the US is positioning herself to dominate the extraction of West African oil which is supposed to supply 25 per cent of US oil imports by 2020, maintains Obi. Thus, the US disregards her avowed promotion of good governance and democratic principles in order to ease extraction agreements with West African rulers. In this sense, US projection of her interests could reinforce state's high-handedness and consequently insecurity in West Africa. Obi also raised the critical issue of West African states being held captive by external security interests and projects. He further criticizes the state-centrism that emphasizes institutional and military approaches to anti-terrorist arrangements while little attention is focused on providing the national and international resources badly needed for addressing the harsh political and desperate socio-economic conditions that may provide the nourishment for dissent, violence, repression, proliferation of small arms and mobile youth fighters, and possibly terror (Obi 2006: 89).

Thus, foreign interests affect conception and provision of security in West Africa. The security complex in West Africa is therefore driven by the link between security and trade, the historic context of the geostrategic rivalry between Nigeria and France (often appearing as Francophone versus Anglophone), the security and development nexus, international trade interests, US, Chinese and European resource interests and the personal interests of the region's rulers.

Analyses of sources of insecurity in West Africa often stress the international political and economic dimensions. The absence of superpower protection as a result of the end of the Cold war coupled with the emergence of sub-state elements as a result of globalization, budget and military downsizing in the course of neoliberal reforms which left a "security vacuum in Africa" as well as inappropriate conflict management methods based on rebuilding the coercive power of the state have contributed to insecurity in West Africa (Musah/Fayemi 2000). The marginalization of African states in international political economy which produces order at the global centre and disorder at the global periphery (Musah 2000), marginalization of the people by the governments (Adedeji 1999; Abdullahi/Muana 1998) and neoliberal international economic linkages (Nnoli 1998; Hutchful 2000; Nanga 2005) feature as proven sources of insecurity in West Africa.

Internally, they bemoan the state as an agent of insecurity (Obi 2006: 96). "Tyranny and political repression are a fundamental cause of domestic and regional instability (Huchful 2000: 218). Driving this point home, Hutchful (2000: 214) observes that "Africans have too often seen the 'force' than the 'security' in 'security forces'." They mention logistic problems such as poor security planning as being partly responsible for rampant insecurity in West Africa. Kwesi Aning (2006), for example, problematizes the police – population ratio, maintaining that it is too far below the international average of 1–5 policemen for 1,000 citizens.[4]

Generally, West African security experts criticize the involvement of 'mercenaries' – private military companies – in West African conflicts and highlight the availability of light weapons and security advisers (following the demise of Soviet Union and Apartheid regime in South Africa) as having adversely affected the security situation in the subregion.[5] They emphasize the necessity and relevance of a regional approach to the problem by strengthening the subregional body – *Economic Community of West African States* (ECOWAS) – and are proud of the pioneering role of this body as the first subregional organization with conflict management mandate globally (Ogwu 2008). Subregional bodies and the African Union should be encouraged to take care of peacekeeping. They criticize the post-conflict reconstruction that seeks to rebuild the collapsed states in exactly the same pre-collapse form and recommend an innovative and dynamic approach to conflict management which is holistic, bottom-up and transformative of the state.

19.3 State Weakness in West Africa

Not only do West African weak states perform badly in the provision of political goods, they are not really sovereign in the classical (Bodian) sense of the word. Their sovereignty is not empirical, rather derived from an international jurisprudential fiat that outlawed colonization following the Second World War (Jackson 1990). The fact that most of these states are not economically independent – they derive a large part of their national revenues from develop-ment assistance (table 19.1) – is a pointer to their perennial weakness and lack of sovereignty. Klingebiel (2006) calculates that *Official Development Assistance* (ODA) contributes 55 per cent of total financial flows to Africa. They have very low *Gross Domestic Products* (GDP), high levels of unemployment, high infant mortality rates, high levels of illiteracy etc. The weighted averages of the *Human Development Index* (HDI) of these states are the lowest in the world, with 13 out of the 15 member states of the *Economic Community of West African States* (ECOWAS) counting amongst the 27 countries with the lowest scores on the Human Development Index (UNDP 2008).[6] Even though most African states have been making tremendous progress in economic development and management with some recording growth levels of 5 per cent and more since the year 2000 (World Bank 2006) with an average of 5.7 per cent in 2008 (Ruffing 2008), it has to be stated that the general level of global economic development still remains lowest in Africa.[7] The level of industrialization is still very low compared with the global average and the economies remain monocultural. There are wide discrepancies in income inequality; and the neglect of the provision of infrastructure by successive regimes which leave a large percentage of the population hopeless. These, coupled with a fast-growing and unchecked population, rapid and uncontrolled urbanization delineate West Africa (World Bank 2006) and constitute the backgrounds to a thriving culture of crime and violence.

They could hardly claim broad legitimacy or capabbility in their monopoly of violence. Some West African states are under challenges from sub-state actors with particularistic tendencies; e.g. the Casamance in Senegal, MASSOB, Ogoni, MEND and OPC in Nigeria, Ewe in Togo, MPIGO and MPCI in Cote d'Ivoire to mention just a few.[8] They lack the institutional capability and robustness to protect lives and properties of citizens even if they wanted to.[9] The

4 While Singapore has about 1 police officer to 119 citizens, Nigeria has 1:371 and Ghana 1:1421.

5 They are very critical of the exploits of Executive Outcomes and Sandline International in Sierra Leone.

6 The report omitted Liberia due to lack of data.

7 It has to be remarked that this statistic shows the average growth rate and thus masks a reality: there are staggering differences in growth rate across individual African countries. And within the majority of African states, the impact of this growth has not been felt by majority of the citizens.

8 MASSOB stands for the *Movement for the Restoration of the Sovereign State of Biafra*; MEND abbreviates the *Movement for the Emancipation of the Niger Delta* while OPC stands for *Oduduwa People's Congress*. MPIGO refers to the *Mouvement Populaire Ivorie du Grand Ouest* while MPCI stands for *Mouvement Patriotique de Cote d'Ivoire*.

Table 19.1: Ratio of official government's income to income from development aid (ODA) in selected African countries in 1998 (in million US$). **Source:** Calculated by Bierschenk/Elwert/Kohnert (1993: 89).

Country	Income from ODA Absolute	per cent GDP	Current total of central government income per cent GDP	ODA as percentage of central government income
Burkina Faso	298	16.0	17.1	90
Benin	162	9.0	12.0	75
Guinea Bissau	100	13.8	'8.2'	168
Nigeria	120	0.4	18.5	2
Sierra Leone	102	7.3	7.3	100

degree of social cohesion in these states is low. This is extremely significant in the discussion of state weakness/strength for the fact that it directly affects the legitimate exercise of political authority. Barry Buzan (1991: 96–107) writes that the concept of weak and strong states rests on the degree of socio-political cohesion within the states, maintaining that cohesion is the very essence of what makes them states (Buzan 1991: 97). Kalevi Holsti (1996) made similar points by stressing that the lack of horizontal and vertical dimensions of legitimacy is the bane of African statehood.[10] The lack of community feeling is underscored by violent interethnic and inter-community conflicts, coup d'etats, civil wars and states collapse which have constantly accompanied the political history of West African states.[11] A leading Nigerian politician, Chief Obafemi Awolowo, once referred to Nigeria as a mere geographical expression and underscored with that, the blatant lack of community feeling in that country. His statement applies, sadly enough, to most West African states.

19.3.1 Background on State Weakness in West Africa

The basis of state weakness in West Africa is to be found in the historical trajectories of the development of the state in Africa. African states lacked the processes which led other states, mainly European, to develop robust bureaucratic structures. Basically, the international environment under which states develop is critical for state strength and weakness. This becomes clear if one compares the international environment under which the strong states of today developed with the international environment under which the West African states are developing.[12]

Those processes of development imbued those European states with the compulsion of erecting strong bureaucratic institutions. States' strengths are predicated on their institutions and institutions are as strong as state makers make them. Thus, strong institutions have a tendency to develop if state makers are compelled to strengthen institutions for whatever purposes; often of state survival, and vice-versa. The compulsions could be summarily treated as 1) the necessity of the state to sustain itself through taxation, 2) the exigency of the state to maintain internal stability in order to ward off external aggressors, 3) the ability of the state to derive revenue from elastic bases, 4) the separation of economic from political power bases and 5) nationalism or the desire to catch up with the West (with reference to late-late developers (Kohli 2004). These processes may not be sufficient but are definitely necessary for the emergence of strong statehood: robust security and administrative apparatuses and social cohesion.

19.3.2 The Imperatives of State Survival[13]

Charles Tilly (1992) advances the thesis that war and its preparation played a significant role in the emer-

9 The assassination of Nigeria's Justice Minister Bola Ige in 2001 has not been cleared and there has been no conviction up till this day. It is not even clear if the Nigerian justice system is still investigating the issue.

10 Horizontal legitimacy refers to a feeling of community among the constituent parts of the state and vertical legitimacy refers to the acceptance of the state amongst these constituent parts. See Holsti (1996: 84–97 and 102–103 for horizontal legitimacy and 84–97 and 102–104 for vertical legitimacy).

11 The states of Ghana and Chad collapsed in 1981 and 1982 respectively.

12 As argued above, the terminology of a 'weak state' is a comparative one because it implies that some other states are strong It is thus necessary to investigate the reasons for the strengths and weaknesses of states. The participation of these states in the same international system which also constitutes a parameter for judging their strengths or weakness further justifies this comparison.

13 See Akude (2008) for an elaborate development of this analysis.

gence of robust administrative and durable state structures because preparation for war and deployment of coercive means in war saddled warriors with two dilemmas which could best be resolved by regular administration of lands, goods and people in order to maintain the subjugation of conquered people, on one hand, and the erection of an infrastruc-ture of taxation, supply and administration in order to ensure continuity, on the other (Tilly 1990: 2). Robust state structures were thus necessary for the survival of the state.

The fact that other states could exploit the existence of internal recalcitrant elements to attack a state and that states that could not militarily withstand such attacks merely perish made this necessity even more urgent (Jackson 1990). Mearsheimer (2001: 46) postulates that "great economic prosperity invariably means greater wealth, which has significant implications for security, because wealth is the foundation of military power." States therefore involved themselves, for this reason, in the promotion of economic development (in order to optimize taxation) by means of state institutions which get strengthened in the process.

Securing state survival through optimization of taxation has further consequences for economic development and state strength. For example, Robert Bates (1999) states that the ability of states to derive revenue from elastic bases – bases that react favourably to the provision of infrastructure – catalyzed the introduction of democracy in England which invariably strengthened the state by fostering social cohesion. In this vein, Sidney Mitchell Knox (1951) illustrates that the desire to tax movable property (livestock) drove a medieval English monarch to devolve power to owners of large livestock by setting-up a parliament which enabled them have a say in government. This process is largely regarded as the inception of democratization efforts in Western Europe.

The separation of wielders of economic power from the wielders of political power also has a state strengthening implication for the fact that these groups need one another to function smoothly and this smooth-functioning is regulated through state institutions. That is, wielders of economic power (resource bearers) depend on peace and security provided by state makers which is necessary for planning and projecting into the future; and wielders of political power (warriors) depend on finances from this sector to finance security. Thus, a cooperation between the warriors (state makers) and resource-bearing group in the European society (bourgeoisie) created the modern European state as wielders of coercion "drew for their own purposes on manipulators of capital" (Tilly 1990: 16).

Nationalism has been described as the social fabric that held European states together in the match to economic development and strong statehood (Arendt 1951). Late late-developers outside of Europe (East Asia, some former Communist states, Botswana) that have seriously pursued and achieved a modicum of development have been propelled in this direction not only by the desire to survive in a hostile world but also by the desire to catch up with the West and subsequently be in a position to resist Western imperialism (nationalism). The crux of this argument thus far, is that certain processes that midwived the emergence of strong statehood in other parts of the world are lacking in Africa and this is the bedrock of state weakness in Africa as will be argued below.

19.3.3 Deviation in the African Situation

None of the mentioned imperatives of state survival was available in Africa at the inception of the states.[14] It was not imperative for African rulers to encourage economic development because the international state system into which they emerged bankrolled their administrations through development aid, international trade on articles controlled by the state and foreign investment in extractive industry, thereby obliterating the importance of internal sources of revenue. The excessive focus on the economic gains that accrued from relations to exogenous forces (with special reference to raw material extraction) has devastating conesquences for the emergence of the most important imperative of strong statehood in a modern economy: the derivation of revenue from elastic bases. Elastic bases could be positively motivated through the provision of infrastructure, security, investment in qualitative education, economic policies that favour the accumulation of capital by indigenous forces, transparency in government's management of state revenues which facilitates the confidence of society's resource bearing groups in government, forward and backward linkages of production sectors, etc. Furthermore, improving the quality of life through the provision of functional infrastructure in an atmos-

14 The Republic of South Africa presents an exception on two points – separation of political from economic power and the derivation of revenue through elastic bases. The whites still control economic power and the blacks political power.

phere of rule of law and order enables several groups in society to identify with the state project – social cohesion. The efforts at these were rather neglected and thus, nothing prevented them from personalizing power which invariably meant demeaning and abjuring state institutions in the process of personal enrichment via state power. Using state power to accumulate private wealth (corruption) destroyed the social fabric of the society by politicizing ethnic and religious affiliations and making the struggle for political power a violent zero-sum game that threatens national and human security. State weakness that was inherited from colonialism worsened.

The concentration on drawing revenues from natural resources which are inelastic does not promote the development of the imperatives of strong statehood. In fact, it could have the opposite effect whereby the state cordons off the areas rich in mineral deposits with state (or expatriate) security apparatus and uses the extracted resources to enrich top officials while simultaneously neglecting the whole society (Reno 2000). The point here is that the quality of governance does not have much impact on the amount of extractable revenue and disbursable funds at the disposal of governments. And because the rulers and their cronies control these natural resources which constitute the lion shares of overall state revenues, there is no separation between the wielders of economic and political power. As a corollary, there still is no impetus to formal rational-legal institutionalization of state administration in Africa. Rather, personalization of state power for purposes of accumulation spawned a state bureaucracy that is not worth the appellation: neither employment nor promotion were based solely on merit, rather than on cronyism, nepotism and personal loyalty, no respect for institutional hierarchy, payments were made (when at all) not only through fixed salaries but more so through access to national revenues, officials with contacts to the top were not subjected to systematic discipline, etc. It is therefore no wonder that the states remained weak and some even collapsed with the alteration in international politics at the end of the Cold War.

The African postcolonial state system plays a negative role in strengthening African states. African leaders accepted the colonial boundaries and enshrined the inviolability of those boundaries in the first Charter of the *Organization of African Unity* (OAU), a deed that earned the OAU the appellation of Trade Union for African Heads of State by the then Tanzanian President, Julius Nyerere. Thus, there was no need to spread effective administrative structures all over their territories in order to ward off external aggression. The appearance of states remains restricted to cities, often only in capital cities and disappears as one travels inland where societies are still largely regulated by pre-stately institutions.

Furthermore, the class character of the new African rulers – petit-bourgeois elements without a productive or solid financial base – coupled with the illegitimacy of the states they inherited from the colonialists led to a political situation in which the determination to pursue economic development is infinitesimal. They rather tried to compensate their weak resource bases by using state power at their disposal to amass private wealth. In this process, state bureaucratic institutions get emasculated, abjured and or subjected to the goals of private accumulation. Laws get disregarded with impunity leading to a culture of violence and lawlessness. Even state security apparatus becomes instrumentalized in the private accumulation process, a fact which became evident with the end of the Cold War, leading to a widespread threat to national and human security. The increasing intensification of this practice has spawned the concept of "criminalization of the state" (Bayart/Hibou/Ellis 1999). They argued that corruption, the marginalized position of Africa in the international political economy, the mismanagement of this economy coupled with the vagaries of the *Structural Adjustment Programme* (SAP) and the demand for democratization have led to "a noxious cocktail of commerce and violence" in Africa (Bayart/Hibou/Ellis 1999: xiv). Thus, the development trajectory of West African states precludes the emergence of strong state capacity for coping with threats of all sorts, making the states vulnerable to sundry sources of threats. All these constitute security threats for the mere fact that they threaten the very existence of those states and their citizens. The reality of this development in West Africa has led to state collapse in some cases and civil wars in others; all posing clear dangers to the security of the state and humans in this sub-region.

19.4 Security Risks and Vulnerabilities in West Africa

The issue of vulnerability of states and citizens to security threats relates directly to the protective capacity of states in the sense that with a strong state capacity, the number of issues that states could be vulnerable to diminishes. The conception of state strength used here is not limited to bureaucratic and security appa-

ratuses but includes (very significantly) the degree of social cohesion and the ability of the state to constantly legitimize itself through the provision of public political goods including the conduct of free and fair elections. In the context of the new security paradigm, West African states are threatened by issues that an administrative machinery of the state could easily take care of, given normally functioning state institutions. Thus, the prevalence of insecurity in West Africa underlines more the weakness of the states as it expresses less the destructive qualities of the issues in question. Even the implementation of well-intentioned, but flawed programmes could become sources of security threats.[15] In this section, I would examine issues and developments that have become security threats in West Africa while taking the vulnerability of the states to these developments as given due to endemic state weakness.[16]

The greatest threat to 'state' and 'human' security in West Africa is the synergism of endemic state weakness and the accumulative tendencies of the political class. This weakens the state through a reduction of state's financial capacity and enmeshing state institutions in social struggles. Manifest state weakness encourages a disgruntled section of the elite to militarily challenge the state. In the process, mayhem is visited on human beings. In an atmosphere of insecurity, crime thrives, legal businesses lose interest in the region, underdevelopment deepens and qualified professionals leave (brain drain). Thus, the greatest threat in West Africa as an entity in the last few decades has been the subregionalization of the Liberian conflict. The collapse of the states of Liberia, Sierra Leone and Ivory Coast involved civil wars with a total casualty of about 500,000 deaths, not to mention the maiming of civilians and the destruction of state institutions (chap. 18 by Aning/Atta-Asamoah).[17] State collapse thus demonstrates the interconnection between state and human security.

Regionalization of internal conflicts has variously been termed 'contagion effect' or 'spill-over effect'. But these terminologies hide more than they expose because they never delve into the mechanisms of contagion. Furthermore, they make the regional spread seem so natural. Contrarily, research evidence shows that regionalization is appropriate to the political economy of post-Cold War violence that results from a political culture of resource predation. Neoliberal globalization simplifies access to the international market by undermining boundaries and in the attempt to exploit this simplification, actors disregard national boundaries in search of access to raw materials needed in the international market. Warlord rulers and their allies spread insecurity in West Africa through the disruption of authorities across state borders in the process of accumulation.

Using state power for capital accumulation which weakens states also predispose politicians from neighbouring states to establish contacts with warlords: they help warlords with state sovereignty while warlords pay in cash or with resources. Thus, judging by the role played by some social and political forces in Ivory Coast, it is not surprising that the Liberian conflict which became the West African conflict by engulfing Sierra Leone and Guinea had later on to spread to Ivory Coast. One researcher notes that covert support was given to the Taylor rebellion by Ivorian officials. This involved providing the rebellion with a rear base and a route for weapon smuggle. The intention of Ivorien officials was to use the access to tropical woods and mineral resources in Liberia to compensate for the decline in proceeds from the plantation economy that Ivory Coast experienced at the time (Johnson 2001: 82). Another researcher estimates that diamond exports routed through Ivory Coast vary from US$ 300 to US$ 500 million (Atkinson 1997: 10). One Abidjan daily newspaper at the time commented that the "consequence of all this for Cote d'Ivoire is the rise of crime rates thanks to the weapons we are supplying to Liberian rebels, and which are in turn sold on the Ivorian black market by these very same Liberians" (quoted in Reno 1998: 98). Reports also indicate the involvement of unpaid Guinean soldiers in the lucrative but illegal cross-border trade in small arms and light weapons which is condoned by the Guinean authorities in order not to further destabilize an already weak state (International Crisis Group 2005: 14ff., 2007: 12). Thus, in the attempt to satisfy their accumulation tendencies, high-ranking military personnel and politicians endanger the lives of citizens and operational efficiency of state institutions. This tendency has become worse since the end of the Cold War and the collapse of states in West Africa.

15 This was the issue with the *Structural Adjustment Programme* (SAP).

16 Vulnerability refers to the inability or considerably low ability to react to unpleasant stimuli.

17 See Piero Scaruffi: "Wars and Genocides of the 20th Century"; at: <http://www.scaruffi.com/politics/massacre.html>.

19.4.1 End of the Cold War and Insecurity in West Africa

For a long period, (apparent) security in West Africa hung on a precarious balance of superpower conflict and elite accommodation. This arrangement was disrupted at the demise of that conflict with grievous consequences for security in the sub-region. It has been noted that the end of the Cold War and the demand for economic and political reforms from international capital led to a fragmentation of elite networks in West Africa, extension of clandestine commercial channels and new conditions of external patronage (Reno 1998). One of the effects of neoliberal globalization in West Africa was to shift accumulation operations from reliance on access to state power to establishing connections with global economic actors including criminals.[18]

Charles Taylor, whose rebellion in Liberia catalyzed the West African conflict and states collapse, therefore harnessed these conditions in combination with the availability of portable or lootable raw materials (alluvial diamonds, timber, iron ore etc.) to launch his rebellion. Because his rebellion (and rule) was tied to commerce, he could not restrict his politics to rigid boundaries.[19] "The invasion of Sierra Leone in part followed the NPFL's sharp business practices and efforts to add to Taylor's profits from regional trade in diamonds, timber, and cash crops beyond Liberia" (Reno 1998: 98).[20] Taylor was alleged to have earned about US$ 450 million during the Liberian and Sierra Leonean civil wars between 1989 and 1996 and this sum gave him an electoral war chest which his opponents could not rival and thus paved the way for his electoral 'victory' in 1997 (Adebajo 2002: 65).

The triumph of neoliberalism as the guiding principle of international political economy which coincided with the end of the Cold War equally has devastating consequences for security in West Africa: it eased and quasi-legalized the smuggle of small arms which flourished in the sub-regional black market via already porous borders. These weapons emanated from the demise of the Soviet Union and the concomitant plundering of her military arsenals. As a result, West Africa was awash with cheap light and small weapons which sustained the various violent political conflicts that have characterized the sub-region since 1989. The realization of this fact led the Heads of States of West African States under the auspices of the *Economic Community of West African States* (ECOWAS) to declare a moratorium on the importation, exportation and manufacture of small and light weapons in West Africa. This was adopted and signed in Abuja (capital of Nigeria) on the 31 October 1998 and was renewed for a further three years on the 9 July 2001. Despite this declaration, small arms and light weapons continued to flourish and fuel conflicts in West Africa, prompting the ECOWAS Heads of State to replace the moratorium with a Convention on 14 July 2006. All these efforts have been less than fruitful in curtailing the spread of small arms and light weapons in West Africa. This is hardly surprising because nothing has been done to alter the conditions that gave birth to their spread (neoliberal globalization and politics of private accumulation) in the first place.

The end of the Cold War equally reduced the strategic significance of West African states in international politics with the consequence that military support from the great powers was reduced. In practice, this meant a considerable reduction in the strike capability of those military forces. The consequence was that they lost the capability to defeat even rag-tag and underfed rebel forces. The civil wars thus became prolonged and with that, the insecurity of peoples and states.

Further consequences of the end of the Cold War in spreading insecurity in West Africa include the lack of political will on the part of the United States, a long time ally of Liberia, and the international community to intervene in the Liberian conflict. Nigeria therefore mobilized some members of ECOWAS to set up a peacekeeping operation, the *ECOWAS Monitoring Group* (ECOMOG) which tried to put an end to hostilities. But due to personal interests between the then Nigerian president, General Babangida, and Liberian president, Samuel Doe, Liberian rebel forces considered the Nigeria-led ECOMOG a partial arbiter and attacked them as they landed in Liberia. Prior to

18 This should not be misconstrued to indicate the superfluousness of the state in the process of accumulation. Only that it is no longer mandatory. Opportunities have been widened by neoliberal globalization.

19 The state of Liberia collapsed before Taylor's rebellion while the states of Sierra Leone and Ivory Coast collapsed in the course of the conflict. However, the terms of state collapse and violent conflict are used interchangeably, *nota bene* that although the two concepts must not accompany one another theoretically, in the empirical study of West Africa, they do.

20 NPFL is the acronym for *National Patriotic Front of Liberia*, Taylor's rebel group. It is necessary to state that decades of bad governance gave birth to the rebellion, not necessarily accumulation tendencies.

the landing of ECOMOG-forces in Monrovia, Taylor's NPFL have commenced the killing of innocent Nigerians in the streets of Monrovia. Thus, the intervention increased, rather than decreased the level and duration of insecurity in the region and partially contributed to extending the Liberian conflict to Sierra Leone and other West African states.

Additional to the political, logistic and organizational inadequacies, the misuse of official positions for private accumulation (corruption) bogged down ECOMOG's assignment (Adebajo 2002). ECOMOG commanders (mostly Nigerians) scented accumulation opportunities in their conflict management assignment and proceeded to partake in the war economy which extended the duration of the war and concomitantly, human insecurity in the region. For example, as the conflict engulfed Sierra Leone, the Indian and Jordanian contingents of the *United Nations Mission in Sierra Leone* (UNAMSIL) once gave notice of their intention to withdraw from the operations because a secret document in which the Indian general accused the Nigerian Chief of Staff of being involved in diamond businesses with the rebels was made public (McGreal 2000: 2).

19.4.2 Conflicts and Insecurity in West Africa

Other factors that have influenced insecurity in the context of the conflicts in West Africa include the interests of several West African rulers in the conflict, the method of conflict management, the failure of disarmament, demobilization and reintegration of combatants (DDR) and Taylor's insecurity.

The Liberian conflict displayed a complex web of family connections and private interests which underline the lack of the institutionalization of the state as well as the personalization of state power, often a prelude to its criminalization. The killing of Tolbert's son (Houphouét-Boigny's son-in-law) by Samuel Doe in the course of his military putsch despite pleas from Houphouét-Boigny to spare him drove the then Ivorian president to swear revenge against Doe.[21] He therefore supported Taylor's rebellion logistically and otherwise (Ellis 1999; Adebajo 2002). Taylor, on his part, was related to Quiwonkpa by marriage and the murder of Quiwonkpa by Doe contributed to his resolve to rebel against Doe (Ellis 1995: 57)[22]. Thus, politicians and military officers do not shy away from endangering the lives of innocent citizens in the course of protecting family and private commercial interests.

The method of conflict management whereby rebel groups are accepted as negotiating partners and apportioned political posts in the interim governments contributed to the dynamic especially as the expansion of the area under a rebel's control was a criterion for the invitation to participate in the interim government. This was the case in Liberia. The message to the protagonists was clear: spread as much mayhem and terror as possible in order to take control of an area and use the control to obtain participation in the conflict management and membership of the governments of national unity. Rebels were therefore not discouraged in any form, they were rather encouraged. Rebel groups were converted to political parties and their leaders appointed ministers in the interim government. The wars were therefore profitable. One of the major consequences of this method was the spawning of rebel groups as ambitious individuals sought to partake in the loot. Thus, the NPFL that was the sole rebel group in Liberia disintegrated continuously, and in the course of conflict management, the number of rebel groups rose astronomically.

The failure of *disarmament, demobilization and reintegration* of combatants in to normal life (DDR) programme contributed to the extension of insecurity in West Africa. The DDR was an essential pillar of the conflict management with the aims of cementing the end of hostilities and most importantly, pre-empting their repetition. Subsequently, combatants were requested to give up their arms and ammunitions to the ECOMOG or UN soldiers, receive remunerations and depending on age, be sent back to (non-existent) schools or be advised to learn a trade. This practice failed and gave birth to a form of lucrative 'arms race' in West Africa: This author received reports that the UN conflict management missions were paying about US$ 100 to 150 for an AK-47 which cost about US$ 22 in the West African black market at the time (2002–2004). A majority of the combatants gave up their old AK-47s and with the money collected from the conflict management missions bought new weapons for which they gave up for more money. Furthermore, most combatants were disappointed as the promises

21 William Tolbert was the president of Liberia from 1971 until he was killed in a military coup by Samuel Doe in 1980. Houphouét-Boigny was the president of Ivory Coast from independence in 1960 till his death in 1993.

22 General Quiwonkpa, a popular military general who led the military coup against Tolbert in the course of which Doe declared himself president was murdered by Doe in 1985.

made to them were not met. In a well-researched publication, Human Rights Watch (2005a: 2–4) reports that the majority of the combatants who participated in the 2000–2003 UN-sponsored Sierra Leonean DDR programme received only partial benefits, were kept out of the skills training component of the programme or failed to receive any benefits at all. Similar complaints were heard from participants of the UN-sponsored 2003–2005 DDR programme where a severe shortage of US$ 39 million left some 40,000 combatants at the risk of missing out training on the job and education. Corruption and inadequate grievance-treatment procedure within the DDR programme were mentioned as serious problems. As a result of their helplessness and hopelessness, the young men had to continue to risk their lives in order to earn a living by offering their services to other conflicts. The result was that the same group of desperate-young men-turned-combatants were patrolling the coast of West Africa as an itinerant labour force armed with weapons of war. The report continues:

> since April 2004, well over two-thirds of the Liberian ex-combatants interviewed, in addition to several of the Sierra Leoneans, had been asked to join fighting 'missions' in Guinea and Cote d'Ivoire. Among those approached to fight in Guinea about half had been approached by commanders claiming to represent a fledgling Guinean insurgency, and the other half by those claiming to be supporters of the Guinean President Lansana Conté. Aid Organizations and United Nations officials working in Liberia say that hundreds of recently demobilized combatants, including children, have since at least November 2004 been re-recruited to fight in Cote d'Ivoire. The majority have, according to the reports, gone to fight alongside militias associated with the Ivorian government (Human Rights Watch 2005a: 4).

This conclusion confirms the views expressed in an interview with an erstwhile Commander of the United Nations Forces in Sierra Leone in early 2003, General Daniel Opande, who estimated that only 25,000 to 30,000 out of the 75,000 militia men that were supposed to be disarmed, demobilized and reintegrated in the Sierra Leonean conflict actually underwent the process. He went on, "if these people could not be kept busy for a relatively long period of time, they will shift into the next troubled area to foment further conflict." And this they did.

Closely allied to the above point is the issue of insecurity for Charles Taylor who has built up a war machine (a collection of unemployed youths) that had to be kept busy with war and booty so that they don't constitute a security nuisance to him. According to Ibrahim Abdullah, a Sierra Leone born professor of history at the University of Cape Town, South Africa, while referring to the conflict in his motherland, "if you can't give Taylor what he wants from Sierra Leone, you can give him anything and he won't stop. What he is getting from Sierra Leone is jobs for his boys and diamonds."[23] There is another sense in which insecurity for Charles Taylor has led to geographical escalation of the Liberian conflict. After becoming President of Liberia in 1997, he created an unwieldy security apparatus that dangerously slipped out of his control.

> While continually feeding the ego of his Anti-terrorist Unit and Special Security Service forces with vehicles and money, his inability to pay his militia and army has led to severe competition for looting. With guns plentiful and competition for loot, Taylor's ability to control the chaos is in doubt (ICG 2002: 14).

These unemployed youths are products of several decades of irresponsible and negligent governance by successive regimes of West African states with fewer prospects of getting good education and meaningful employment. In the midst of poverty, crime, a mode of accumulation that has been facilitated by neoliberal policies and state failures, becomes an option. Decades of bad governance and undifferentiated application of neoliberalism have thus resulted in the criminalization of the West African youth. The problems associated with youth unemployment and insecurity in West Africa led the *United Nations Office in West Africa* (UNOWA) to publish a special report (UNOWA 2005). Its statement reads that "youth unemployment - and its corollary, underemployment – has become a central political security issue in West Africa", maintaining that unemployment fuels conflict and crime. The threat posed by crime to human and state security is not restricted to West Africa. The UN has in a report published in 2004, indicated the increasing threat that transnational organized crime poses to individuals and states (UN 2004). However, the effects become pressing in West Africa due the abysmal weakness of the states. In his address to the France-Afrique Summit in Bamako (Mali) in December 2005, the then Secretary-General of the United Nations, Kofi Annan said that "tens of millions of youths across the continent lack prospects of decent work. This is not only a precious waste of human resource. It can also have security implications for almost every country in the continent, since despera-

23 See: Douglas Farah: "Al-Qaida tied to African Diamonds", in: *Washington Post*, 30 December 2002: 1.

tion often leads young people to fall prey to warlords, criminal gangs or illegal migration syndicates." With specific reference to West Africa, Ahmed Ould Dada, the Special Representative of the UNO-Secretary General in West Africa, estimates the level of youth unemployment in most West African states at about 50 per cent. He emphasizes that this is the background to profound and rampant insecurity in West Africa, dangerous escape to Europe, drug trade and related crimes, prostitution and human trade (UNOWA 2005: iv). Similarly, Mazzitelli (2007) argues that corruption and criminalization of the state reduce risks to criminal operations while increasing profits and has therefore made West Africa a safe haven of operation for transnational organized criminal syndicates whose operations endanger the lives of West Africans.

These criminal activities include drug trafficking, trafficking in people (especially women and children), stolen vehicles, natural resources, smuggling of firearms and contraband, counterfeiting and intellectual piracy, and cybercrime (Mazzitelli 2007: 1074). Statistics show sharp rises in the quantity of narcotics seized in West Africa. In 2005, 1,200 kilograms of cocaine were seized; in 2006, the quantity rose to 2,000 kilograms and within the first seven months of 2007, it rose to 4,300 kilograms (Mazzitelli 2007: 1075). In 2001, the *International Labour Organization* (ILO) estimated the number of children trafficked each year for sexual exploitation and forced labour at between 200,000 and 300,000 (UNICEF 2001). West African women and girls are regularly smuggled to Europe for prostitution. Recruiters collude with corrupt government officials to facilitate such operations and could make profits of up to US$ 10,000 after having spent about US$ 2,000 on bribes and transportation for one woman (Mazzitelli 2007: 1079).

Economic hardships occasioned by underdevelopmental governance has driven frustrated West Africans in the search of a modicum of meaningful livelihood to risk their lives by crossing the Mediterranean with shanty boats en route to Europe via Spain and Italy, a journey for which they have to sell all valuables in order to foot the bills. About 36,000 (mostly) West Africans arrived in the Canary Islands in 2006 and about 7,000 people are estimated to have died in the dangerous odyssey (Mazzitelli 2007: 1080). A 2006 report of the United Nations Office on Drugs and Crime puts the volume of such transactions at above US$ 300 million annually (UNODC 2006). There have also been reports of West African transitionally organized criminal networks including rebels groups (the RUF of Sierra Leone) collaborating with Al Qaeda in the smuggling of diamonds and other precious stones. These reports state that the Al-Qaeda-RUF-Taylor connection began after the US freezing of US$ 240 million Taliban and Al-Qaeda assets given intelligence information that Al-Qaeda was involved in the bombing of US embassies in East Africa in 1998 (Farah 2002, Gberie 2002).

West African criminal syndicates smuggle everything from fake CDs to fake drugs. Smuggling fake drugs is a phenomenon that is very pronounced in Nigeria and has cost a host of lives. And they stop at nothing to protect their businesses. On 26 December, 2003, drug smuggling syndicates tried to assassinate the Director of the *Nigerian National Food, Drug Administration and Control* (NAFDAC) after several unsuccessful attempts at bribing her (WHO 2006).[24]

In Nigeria, decades of corrupt and negligent governance has driven the hopeless youth of the Niger Delta region to resort to crime and violence out of desperation.[25] Environmental pollution in the course of crude oil extraction and gas-flaring has damaged agricultural and aquatic life (the bases of livelihood) in the region. As decades of complaints and protests did not elicit appropriate response from the Nigerian government and the oil companies, the youth was left with no credible option than to take the issue in its own hands. Crime and violence (including blowing up of oil pipelines) in the region arose out of disappointment of the youth with the chiefs that have often colluded with the Nigerian federal government to enrich themselves at the expense of their communities.[26] 'Oil bunkering' (illegal tapping of oil pipelines for sale in West Africa and international market) was the initial response of the youth.[27] Ken Saro Wiwa (once a collaborator with the Nigerian government) made efforts to put a stop to the environmental pollution and pau-

24 Prof. Dr. Dora Akunyili was resolved and incorruptible in her fight against fake drugs in Nigeria because she lost her sister as a result of fake drugs administered to her.

25 The focus on Nigeria is necessary because Nigeria happens to be the giant of the region. Experts and observers have expressed the opinion that a major political crisis in Nigeria will definitely engulf the whole West African region (US National Intelligence Council' 2020 Report on Sub-Saharan Africa, May 2005).

26 See: "Niger-Delta wants direct Allocation to Host Communities", in: *Vanguard Newspapers Online Edition*, 31 March 2006: at: <www.vanguradngr.com/articles/2002/cover/march06/310306> (31 March 2006).

27 This is a dangerous activity that has cost thousands of lives in cases of pipeline explosions that often accompany bunkering.

perization of the region through a radicalization and internationalization of the protest and thus, increasing the pressure on the Nigerian federal government. The military dictator at the time (1997), General Abacha, charged him and 8 other members of MOSOP to court, found them guilty and killed them by hanging.[28] The consequence was a splintering and spawning of protest groups all over the region. The groups and freelancers became increasingly violent and developed their own economy of violence: oil bunkering and kidnapping. Incidences of oil bunkering have therefore increased and so have the financial losses to the Nigerian state and the oil companies. The size of bunkered oil has been estimated at about 10 per cent of annual production with a market cost of about US$4 billion (Shell 2003). Since 2004, there have been threats and cases of vandalizing oil pipelines as well as kidnap of oil companies' expatriate workers and ransom in millions of US dollars paid to regain their freedom.[29] Part of this money has been used to finance the purchase of weapons to foment further insecurity in the region.[30]

19.4.3 Human Rights Violations in Conflicts in West Africa

The Liberian Civil War and the proximate conflicts in West African featured several human rights violations. These include forced labour, robbery, killing and maiming of innocent civilians and raping women. As a result of scarcity of combatants, children, as young as 10 years old, were conscripted into wars without military training.[31] Several agency reports confirm the widespread use of child soldiers by almost all rebel groups. The children were said to be permanently on drugs which leads to erratic and incalculable actions and therefore makes them more dangerous. Young girls were kidnapped and converted to 'wives' by several commanders of various rebel groups. These children were often victims of abuse. Having lost their parents and guardians during the war, they were often left at the mercy of the rebel commanders who did all they wished with them, including using them as looters of the civilian population or as porters and labourers.[32] The number of casualties in the war (civilians inclusive) is estimated at about 150,000 people; and about 500,000 internally displaced persons between 1989 and 2004.[33] Another report claims that direct and indirect casualties vary between 60,000 and 200,000 (Ellis 1999: 316). In Sierra Leone, the rebel group (RUF) once launched an orgy of violence, mutilating innocent citizens apparently to deny them participation in the billed elections or the pursuit of normal farming business (Richards 1996).

Insecurity has been on the increase in West Africa as a result of governments' inability and unwillingness to provide security. This situation has worsened the area boys' phenomenon whereby a group of young men arm themselves and extort the society in the pretence of providing security.

19.5 Conclusion

The issues sketched above that are associated with security in West Africa could have been taken care of by functioning state bureaucracies. It is principally the absence of such that makes them intractable security issues. After all, some of these issues ramify the globe but do not constitute security issues in other states. The international community seems to have realized

28 MOSOP stands for *Movement for the Survival of Ogoni People*. Ogoni is an ethnic group in the Niger Delta region.

29 See: Associated Press Service: "Nigerian Oil Region Insurgents Prepare for Armed Battle", 28 September 2004; at: <http://www.globalpolicy.org/security/natres/oil/2004/0928oilbattle.htm> (16 January 2008): "Hostages: US, UK, Militants in Fresh Parley", in: *Vanguard Newspapers Online Edition*, 22 March 2006, at: <www.vanguardngr.com/articles/2002/cover/march/06/22032006/> (22 March 2006); Polgreen, Lydia: "Gang Blamed as 10 are killed in Nigerian Oil Port", in: *New York Times*, 1 January 2008; UN-IRIN [Integrated Regional Information Network], 2004: "Fresh Militia Attack Kills Two, Threaten Truce in Oil Region" (5 November); UN-IRIN, 2006: "Nigeria: Gunmen Seize 8 Oil Workers in Latest Violence in Impoverished Delta Region" (2 June): UN-IRIN, 2007: "Nigeria: Sharp rise in hostage taking may be linked to upcoming Elections" (7 March).

30 See: "Disarray among Nigeria's Armed Militants", in: *Jane's Intelligence Digest*, 10 August 2007.

31 See: Human Rights Watch: "Sowing Terror: Atrocities against Civilians in Sierra Leone", in: *Human Rights Watch Report*, 10,3A (July 1998); at: <http://www.hrw.org/worldreport/Africa-07.htm> (2 April 2007) for details.

32 See: Human Rights Watch: "How to Fight, How to Kill: Child Soldiers in Liberia", in: Human Rights Watch (February 2004), 16,2 (A); at: <http://hrw.org/reports/2004/liberia0204/> (2 April 2007).

33 See: US National Intelligence Council 2020 Report, 2005: "Report on Sub-Saharan Africa", May 2005; at: <http://www.umsl.edu/services/govdocs/wofact2005/fields/2194.html> (2 April 2007).

this fact by making the building and strengthening of state institutional capacity one of the bedrocks of development policy since the 1990's. However, rampant cases of abuse of state power against the societies have driven donor community to go beyond the state and try to strengthen the society against the state. Recently, this has been criticized as denying the state the means (qualified manpower and funds) of fulfilling its traditional role in society. Apparently, the donor community finds itself in a state of confusion as to how to handle the issue. This confusion results from the dominant mental frame of state vs. society. A better approach could be that of state and society: looking at the intersections between the two in order to elicit a complementarity of interests between them. Credible solutions lie in correcting the anomaly in development trajectory of the African state. My point of departure is that in a global system still regulated by an international sovereignty regime, there is a limit to the effects of the corrective actions of the international community if the rulers of West Africa do not see any existential sense in running good (developmental) governance. The guiding principle of development policy should be to reward states that run developmental governance. This could be the avenue to a secure West Africa for the fact that the pursuit of economic development necessitates the utilization of state bureaucratic institutions which get strengthened in the process and develop the capacity to secure itself as well as citizens.

This analysis result sin the following recommendations:

1. To the *international and donor communities*: Support good governance and respect for human rights and democratic principles. Don't let this be sacrificed for economic and strategic interests. Make the performance of states and the needs of the citizenry the criteria for development aid.
2. To the *African Union*: Continue the efforts towards the erection of a credible and independent peacekeeping force. Most critically, intensify the relaxation of the sovereignty concept as applied to African states through intervention in cases of abuse of power. Seize this opportunity to harmonize the emerging unilateral, bilateral, multilateral, formal and informal, regional and subregional peacekeeping arrangements.
3. To the *West African States*: Respect human rights and democratic principles. Increase the sources and mechanisms of internal revenue by promoting economic development and providing infrastructures. Create national economies and middle classes that could sustain democratization.

Part III Economic, Social, Environmental Security and Human Threats, Challenges, Vulnerabilities and Risks in the Near East, North and Sub-Sahara Africa and in Asia

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20 Environmental Challenges and Risks in North Africa

Béchir Chourou

20.1 Introduction

On 18–20 November 2007 the International Solidarity Conference on Climate Change Strategies for the African and Mediterranean Regions was held in Tunis (Tunisia). It was attended by some 40 Ministers of the Environment and other government members from the European Union, Africa and the Mediterranean region, the Chairman of the Intergovernmental Panel on Climate Change (IPCC, co-recipient of the 2007 Nobel Peace prize), representatives of United Nations agencies and regional organizations, representatives of funds, donor states and funding institutions, and scholars and experts on climate change. According to a Conference's Working Document, the purpose of the event was to examine, first, the challenges that Africa and the Mediterranean region will face in trying to ensure that the impact of climate change does not hamper the economic and social development of people living there and, secondly, the efforts made by the concerned countries to improve their peoples' living conditions, ensure their food security and wipe out the blight that still haunts the region both as regards human health and as regards the environment.[1]

The President of Tunisia, in a message addressed to the Conference and read by the Prime Minister at the opening ceremony, recalled that various international reports and scientific studies agree that Africa in general and North Africa in particular are among the most exposed regions to the nefarious effects of climate change, and called on participants to make practical proposals and recommendations to make all stakeholders better aware of the consequences of climate change and of the need to coordinate efforts aimed at reducing the impact of climate change and ensuring the sustainable development of threatened societies. At the conclusion of its work, the Conference adopted a declaration (the Tunis Declaration) underlining the need to put the fight against climate change and adaptation to that change among the top priorities of the international community, national governments and civil society at large, recognizing the existence of synergies between adaptation to climate change and efforts to combat other environmental problems such as desertification and degradation of biodiversity, and calling on the international community to extend assistance to vulnerable countries so that they can anticipate and adapt to risks arising from climate change.

Concurrently, an ad-hoc expert group meeting on "Sustainable Development in North Africa: Experiences and Lessons" was held at the initiative of the North Africa Office of the *United Nations Economic Commission for Africa* (UNECA) to examine in greater detail the impact of climate change on North Africa and to make practical recommendations for achieving sustainable development in the region.

These are only the latest of a long series of events dealing with environmental issues that have been held in North Africa in the last 15 years, indicating that policy makers and analysts are well aware of, and concerned about, the seriously and rapidly deteriorating state of the environment in the region. This chapter will review the present state and future evolution of environmental security in the North African region (with a focus on Algeria, Morocco and Tunisia, for which data are more readily available). It will concentrate on three major problems: land degradation/desertification, water scarcity and extreme weather events. This does not mean that other environmental problems are inexistent or irrelevant, but for the sake of policy relevancy the decision was made to focus on those areas where urgent action is most needed and is most likely to have rapid beneficial effects.

The chapter will be organized as follows: After this introductory section, section 20.2 will deal with conceptual and theoretical considerations related to

1 The author attended the conference and was able to obtain privately a copy of the document. The document indicates no author, publisher or date of publication.

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Table 20.1: Evolution of the concept of security. **Source:** Brauch (2005a: 19, table 3).

	Referent object (Security of whom?)	Value at risk (Security of what?)	Source(s) of threat (Security from whom or what?)
National Security [political, military dimension]	The State	Sovereignty, territorial integrity	Other states, terrorism (sub-state actors)
Societal security	Nations, social groups	National unity, identity	(States), Nations, migrants, alien cultures
Human security	**Individuals, humankind**	**Survival, quality of life**	**State, globalization, GEC, nature, terrorism**
Environmental security	**Ecosystem**	**Sustainability**	**Humankind**
Gender security	Gender relations, indigenous people, minorities	Equality, identity, solidarity	Patriarchy, totalitarian institutions (governments, religions, elites, culture), intolerance

environmental security, environmental threats, risks, challenges and vulnerabilities (20.2.1), the views of Islam on environmental questions (20.2.2) and the current status of research on environmental security in the Maghreb (20.2.3); it will also give an overview of the region's main physical, social and economic features (20.2.4). Section 20.3 will discuss these three environmental challenges and risks. Finally, section 20.4 will give an overview of on-going and additional adaptation and mitigation measures to deal with those challenges and risks and evaluate the prospects of environmental rehabilitation in the region.

20.2 Concepts and Theories

20.2.1 What is Environmental Security?

In a seminal work Brauch reviewed the evolution of the concept of 'security' from Cicero's era to the present (Brauch 2005a). He points out that the concept has evolved from referring to protection of the state against threats to its physical and political integrity (war, occupation, absorption) to protection of human beings against threats to their physical, social and psychological integrity. That evolution is summarized in table 20.1.

Brauch further indicates that when the concept of human security was introduced in the 1990's it was broadly defined as 'freedom from fear and freedom from want' but he advocates that a third 'pillar' be added to this definition, that of 'freedom from hazard impact'. Such an extension of the concept of human security is justified by the fact that societies have become aware that their security is becoming increasingly affected not just by military power but also by such factors as watersheds, croplands, forests, genetic resources and climate, and that these may become sources of international conflicts (Brauch 2005a: sect. 8). Prior to that Kofi Annan, who was then UN Secretary General, suggested that 'freedom of future generations to enjoy a healthy environment'' should be an element of human security (Brauch 2005: 23).

Several definitions have been proposed for environmental security. One that has the advantage of being short and concise is that proposed by Glenn, Gordon and Perelet (1998): "Environmental security is the relative safety from environmental dangers caused by natural or human processes due to ignorance, accident, mismanagement or design and originating within or across national borders" (table 20.2 for examples of environmental security threats). Myers proposed another one which is more precise: "The environmental security issue can be defined as the relationship to established security of those environmental factors – water, soil, vegetation, climate, and whatever others are prime components of a nation's environmental foundations – that ultimately underpin all our socioeconomic activities and hence our political stability. Conversely, when these environmental resources are degraded or otherwise depleted, so our security declines too."[2]

The Millennium Project, conducted under the auspices of the *World Federation of UN Associations* (WFUNA) proposed to a panel of scientists a number of definitions and asked them to rank those definitions according to their pertinence and usefulness. The definition that received the highest score (3.2) on

2 Myers, Norman, 2004: "Environmental security: What's new and different?"; at: <http://www.envirosecurity.org/conference/working/newanddifferent.pdf>.

Table 20.2: Some Examples of Environmental Security Threats. **Source:** Adapted from Millennium Project (Glenn/Gordon/Perelet 1998).

	By Ignorance and/or Mismanagement	By Intention	Mix of Natural and Human Actions
Within a Country	C.1 Oil spills in Ogoniland Nigeria Aral Sea depletion in Russia Indonesian fires Ground water contamination and fresh water scarcity Hazardous wastes Soil erosion Human settlement and development patterns	C.2 Sarin gas attack in Tokyo subway Chemical attacks and draining marshes in Iraq Poisoning or diversion or misuse of water resources	C.3 Floods Famines Salinization Earthquakes Introduction of exotic species
Trans-border	C.4 Rain forest depletion River usage in (Jordan, Nile, Tigris, Euphrates) Chernobyl nuclear accident Diminishing biodiversity Ozone depletion Fisheries depletion Global climate change Acid rain and air pollution Poverty Radioactive waste	C.5 Burning oil fields in Kuwait Poisoning water Dam construction and water diversion Biological weapons	C.6 Solar radiation changes Global warming New, emerging, and drug resistant diseases such as AIDS and others affecting plants and animals Desertification Population growth Rich-poor gap

a scale of 1 (excellent) to 5 (not useful) was the following: "Environmental security is the relative public safety from environmental dangers caused by natural or human processes due to ignorance, accident, mismanagement or design and originating within or across national borders" (Glenn/Gordon/Perelet 1998).

The international panel that participated in the project identified the following (without rank order) as the most important environmental security threats over the next ten years:

- Human population growth and loss of biodiversity;
- Climate change – not for its manifestations but for the momentum or lack of action;
- Water scarcity and pollution including ground water contamination;
- Food security;
- Environmental refugees (or environmentally-induced migration);
- Deforestation;
- Industrial contamination of air and oceans;
- Soil conservation/erosion;
- Nuclear safety issues;
- Ozone depletion;
- Global warming.

Brauch provides a "heuristic compilation of possible linkages between environmental causes, stressors, impacts or outcomes that may pose security threats, challenges, vulnerabilities and risks for human beings or humankind within their respective natural environment" (Brauch 2005a: 64). That compilation is partially reproduced in table 20.3 where only the environmental factors and their impacts that are most relevant to North Africa are included.

The *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b, 2007c) in its fourth assessment report (AR4) on climate change identifies the same problems as likely consequences of climate change in Africa, and predicts that this will delay or even prevent the realization of the *Millennium Development Goals* (MDGs) on the continent (see box 20.1).

Table 20.3: Aspects of Environmental Security Relevant to North Africa. **Source:** Adapted from Brauch (2005a: 64).

Environmental problems: they cause: ➔	Threats for ⬇	Challenges affecting ⬇	Vulnerabilities for ⬇	Risks for ⬇
Climate change: Temperature increase	• human health • agriculture (yield decline) • biodiversity • desertification	• tourism • food security • fisheries • government action • economic action	• infectious disease • damage to crops • natural systems • water scarcity	• human populations • the poor, old people and children
Extreme weather events – floods	• habitat, technical infrastructure and people	• flood-prone areas	• peoples living in those areas	• human life and property
Soil erosion, drought desertification,	• water scarcity • agriculture • habitats	• food security • human livelihood (forced migration)	• Arid and semi-arid zones • Rural areas • agriculture	• peasants and livestock in affected areas
Water scarcity & degradation	• agriculture, food, security, people	• economic behaviour • human health	• poor in slums • [people in rural & arid zones]	• Elderly, children, poor
Forced migration	• Resident population, clash over water & food	• Overgrazing on marginal soils • Environment	• Fragile ecosystems • People on the move	• Migrants & their animals

Box 20.1: Potential impacts of climate change on the Millennium Development Goals. **Source**: Excerpts from Boko, Niang, Nyong, Vogel, Githeko, Medany, Osman-Elasha, Tabo and Yanda (2007: 458).

Climate Change (CC) may reduce poor people's livelihood assets, for example health, access to water, homes and infrastructure. It may also alter the path and rate of economic growth due to changes in natural systems and resources, infrastructure and labour productivity. A reduction in economic growth directly impacts poverty through reduced income opportunities. In addition to CC, expected impacts on regional food security are likely, particularly in Africa, where food security is expected to worsen.

Other expected impacts include:

- declining quantity and quality of drinking water, which worsens malnutrition, since it is a prerequisite for good health;
- reduced natural resource productivity and threatened food security, particularly in sub-Saharan Africa.

Direct impacts:

Climate change may alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged, and these changes may also decrease biological diversity and compound existing environmental degradation.

Climate change would alter the ecosystem-human interfaces and interactions that may lead to loss of biodiversity and hence erode the basic support systems for the livelihood of many people in Africa.

Indirect impacts: links to climate change include:

- • Loss of livelihood assets (natural, health, financial and physical capital) may reduce opportunities for full time education in numerous ways.
- • Natural disasters and drought reduce children's available time (which may be diverted to household tasks), while displacement and migration can reduce access to education opportunities.

One of the expected impacts of climate change is that it could exacerbate current gender inequalities, through impacting on the natural resource base, leading to decreasing agricultural productivity. This may place additional burdens on women's health, and reduce time available to participate in decision-making and for practicing income-generation activities. Climate-related disasters have been found to impact female-headed households, particularly where they have fewer assets.

Global climate change is a global issue, and responses require global co-operation, especially to help developing countries adapt to the adverse impacts of climate change.

20.2.2 Environmental Issues in Islam

It may appear that attention to the environment and concern about its degradation under the effect of human actions have appeared only recently, but in fact the two fundamental sources of laws and rules that regulate the behaviour of Muslims, the Holy Koran and the *Sunna* (the words and deeds of the Prophet Mohamed which serve as references for questions that the Koran does not treat in detail) contain numerous references to such concepts as environmental preservation, interdependence of ecosystems, scarcity of resources, etc. It is not the purpose here to give a full description of the extensive treatment of environmental questions in Islam, but a few examples will show that more than 14 centuries ago Islam had already taken up many current concepts and issues related to the environment. Consequently, Muslim should – in principle – have an environment-friendly behaviour as a matter of faith and religious obligation and not merely as a matter of civic duty or legal obligation. However, as it will be argued below, if more and more citizens in the Maghreb and other Arab and Muslim countries appear to deliberately destroy their environment, it is not because they are unconcerned about the environment or because they reject some of Islam's teachings, but because they consider that behaviour as a form of protest against authoritarian rule.

It is commonly acknowledged that the environment is one and indivisible – what we call the ecosphere – and that its several components constitute a well-balanced but delicate system, and that the system will be adversely affected every time one or more components are disturbed. In this respect the Koran says:

> Verily! In the creation of the heavens and the earth, and in the alternation of night and day, and the ships which sail through the sea with that which is of use to mankind, and the water *(rain)* which Allah sends down from the sky and makes the earth alive therewith after its death, and the moving *(living)* creatures of all kinds that he has scattered therein, and in the veering of winds and clouds which are held between the sky and the earth, are indeed Ayat *(proofs, evidences, signs, etc.)* for people of understanding (Koran 2: 164).[3]

Elsewhere it is stated:

> Those who break Allah's Covenant after ratifying it, and sever what Allah has ordered to be joined, and do mischief on earth, it is they who are the losers (Koran 2: 27).

Thus, Muslims have been told that the universe is a complex system of interconnected components and have been admonished not to interfere with nature's workings (disturb what has been designed to function as a unit). The Koran further states that everything in nature (including the living creatures that Allah has scattered on earth, i.e. biodiversity) has been designed to make life possible. There are two notions in particular that deserve to be underlined because they are gaining wider and wider acceptance: the first is that all natural resources have been created in carefully designed and finite quantities, and the second is that no one can claim ownership over these resources since they all belong to Allah. These themes are found in different parts of the Koran, e.g.:

> And the earth We spread out, and placed therein firm mountains, and caused to grow therein all kinds of things in due proportion. And We have provided therein means of living, for you and for those whom you provide not *[moving (living) creatures, cattle, beasts, and other animals]*. And there is not a thing, but with Us are the stores thereof. And We send it not down except in a known measure. And We send the winds fertilizing *(to fill heavily the clouds with water)*, then caused the water *(rain)* to descend from the sky, and We gave it to you to drink, and it is not you who are the owners of its stores *[i.e. to give water to whom you like or to withhold it from whom you like]* (Koran 15: 19–22).

If natural resources (such as water) are the common property of humankind, it follows that humankind is collectively responsible for their management, including their preservation against waste and degradation. In this regard the Prophet Mohammed has repeatedly enjoined Muslims not to pollute water (so that Muslims can be ensured that water they use for ablutions is pure) or spaces that the public does use (such as roads, mosques, marketplaces...) or may use (such as shaded areas where travellers may rest). The Prophet also has urged Muslims not to use too much water for their ablutions even when the supply seems plentiful (such as rivers). Of course, it is quite natural that Islam – which appeared in the arid lands of Arabia – attaches a particular attention to water (water is mentioned 63 times in the Koran), but what it teaches about water applies equally to all other natural resources inasmuch as Muslims are expected to show moderation and wisdom in the use of all resources.

Nowadays many Muslims try *individually* to abide by the teachings of Islam (at least as far as the environ-

3 In references to the Koran the first number refers to the number of the *sourat* (chapter) in the order in which it appears in the Koran, and the second to the number of the *aya* (verse) within that *sourat*.

ment is concerned), as it can be seen e.g. in the way nomads live in the deserts of the Mashreq and the Maghreb. However, Muslim societies (especially urbanized ones) have been unable – or unwilling – to live in harmony with nature and to respect its laws. Such deviancy is not peculiar to our era and the Koran has forewarned about its consequences:

> Evil has appeared on land and sea because of what the hands of men have earned *(by evil deeds, etc.)*, that Allah may make them taste a part of that which they have done, in order that they may return *(by repenting to Allah, and begging His Pardon)* (Koran 30:41).

Because man has disobeyed divine law, Allah inflicted punishment upon him while he was still on earth, and that punishment, dire as it may be, is only a mild foretaste of what is awaiting him on the Day of Judgement.[4]

In sum, Muslims should be keenly aware, in principle, of the duty to respect nature so that they and future generations have a safe environment in which to live. In practice, however, Muslims – or, for that matter, other segments of humanity – have not consistently behaved in a friendly manner towards the environment. The consequences of this behaviour are becoming more evident and more numerous every day. They may vary in kind and intensity from one region to another, but they are present everywhere.

The concluding section will propose some explanations for this behaviour which is seemingly inconsistent with Islam's precepts and values. In the meantime, two points may be worth mentioning. First, governments in the Maghreb have attempted to appeal to people's attachment to Islam to convince them to show greater respect for nature and the environment. However, this approach does not necessarily stem from any deep concern for the environment or a desire to enlist popular support for measures designed to protect the environment. Rather, it is part of campaigns waged in the Maghreb to stem the rise of Islamist/Fundamentalist movements in the region and that include such measures as increasing the number of new mosques built, or giving greater visibility to the celebration of religious holidays, or making it easier for citizens to meet their religious obligations (Hajj, Ramadan...). The overall message that governments want to convey is that people do not need the Fundamentalists to promote and protect their Muslim identity. In fact, most messages that governments attempt to transmit are couched in religious language, including respecting the environment and ... being faithful and obedient to one's ruler.

The second point is that Fundamentalist movements in the Maghreb have – surprisingly – failed to include the environment in the list of issues about which they have expressed an opinion. There are many aspects of official environmental policy that can be easily criticized but few Fundamentalists have taken advantage of that. This does not mean, however, that they will continue to do so in the future.

Having confirmed that interest in and knowledge about environmental issues are present in Islam and Arab culture, we can now turn to their status in academic research.

20.2.3 Research on Environmental Security in the Maghreb

Scientific interest in the environment in general and environmental security in particular is of recent origin in the Arab world (Selim 2009). The first book dealing with the environment written in Arabic was published in 1976. It was followed by other books that discussed various environmental issues without any specific reference to the Arab world or to environmental security. This was followed by a series of studies published in the 1990's dealing with the relationship between the environment and development, and a few books dealing with two issues relevant to the Arab world: water scarcity and desertification. It should be noted that most of these studies tend to be technical, focusing on identifying environmental problems and approaches for resolving them. Only a small number of Arab scholars have attempted to identify actors responsible for the emergence of environmental problems or assign responsibilities for resolving such problems. Furthermore, the environment has not been a topic of public debate until recently, except for the highly sensitive issue of water resources which is a major element of the Middle East conflict. As one study points out,

> While there is an interest in and concern about the environment (*bi'a*) – perceived generally by those surveyed as their social as well as physical surroundings – only a few equate the environment directly with pollution (*tallawuth*). ... Air and water pollution were noted in their more visible aspects (dust and turbid water), while more concern was expressed for the health effects of air than of water or noise pollution. Issues such as global warming, nuclear radiation and the depletion of the ozone layer attracted very little attention. Respondents seemed

4 For more details on the treatment of the environment in the Koran and Sunna see, *inter alia*, Jamil (1999), Lahlou (2000), ISESCO (2002) and ISESCO (2005).

> largely unaware of lead pollution.... (Hopkins/Mehanna 1996: 1).

In the Maghreb scientific interest in environmental issues has existed for a number of years and is expanding. In Algeria, Morocco and Tunisia there is a number of research centres and institutes that have acquired an international reputation, especially in such fields as desertification, dryland agriculture and the mobilization and management of water resources. Furthermore, the environment has become a major topic of public policy: Most governments have a ministry of the environment and play an active role in various international fora dealing with environmental questions. However, the general public does not effectively participate in the debate of environmental issues in general and environmental security in particular, the reason being that public policy in any field is rarely submitted to a public debate and decisions are taken by decision makers with, in the best of cases, only a perfunctory consultation of the public. Of course, the absence of the participatory approach from the process of defining and implementing public policy is likely to lead to the failure of that policy, but that is an issue that falls outside the scope of this study.

After a brief overview of the main features of the region under consideration an examination of the main environmental risks and challenges that confront it will be offered.

20.2.4 A Profile of the Maghreb

The five states to be studied are Morocco, Algeria, Tunisia, Mauritania and Libya (inclusion of the last two in some sections being tributary of data availability). The region covers an area of about 5.7 million km² and is bordered by the Atlantic Ocean to the west and the Mediterranean Sea to the North. The mountain range of the Atlas stretches in a south-westerly to north-easterly direction across Morocco, Algeria and Tunisia and separates the coastlines from the Sahara Desert (figure 20.1). Only a small portion of the area is actually or potentially useful for agricultural use.

In Mauritania, aside from the northern bank of the Senegal river (which constitutes the natural border with Senegal) where agricultural activity is possible, the totality of the country is desert. Libya is in a similar position, with about 98 per cent of its area being totally barren, and so is Algeria where the Sahara covers nearly 97 per cent of the territory. In Morocco an area of about 95,000 km² (or about 20 per cent of the country's total area) is used or can be used for agricultural production. As for Tunisia nearly 85 per cent of its area is totally barren or classified as savannah / grassland / rangeland, the remaining 15 per cent being more or less fit for some agricultural production (see table 20.4). In addition, a growing proportion of the arable land in this region is suffering from various environmental problems (degradation, erosion, pollution...) or is being taken over by urban growth.

In the coastal zones the climate is Mediterranean, with hot dry summers and mild (and intermittingly) wet winters. Rainfall is irregular in occurrence and in quantity. It increases as one moves from the coast to the mountain ranges where it may reach 2000 mm per year in the Moroccan Atlas, then decreases as one moves towards the Sahara where no more than a few millimetres of rain may fall every few years. Most often rain falls in large quantities over short periods of time, causing flash floods and a great deal of erosion. The entire region is subject to recurrent and extended droughts and it suffers from water scarcity – a problem to be discussed in greater detail below.

The five countries have rather contrasting economic situations. In 2005 per capita GDP ranged from $ 603 for Mauritania to $ 6621 for Libya and stood at $ 3112 for Algeria, $ 2860 for Tunisia and $ 1711 for Morocco. To a large extent national income is related to each country's endowment in natural resources. Algeria and Libya have vast resources of oil and gas and both of them derive most or all of their income from the export of these products. Morocco and Tunisia, on the other hand, have little or no energy products – hence their lower income. However, they both have major phosphate deposits which are an important source of revenue, as well as small deposits of other minerals (coal, lead, silver, iron...). As for Mauritania, the poorest of the five countries, its main mineral resource is iron ore (it is the world's 13th producer of this commodity) from which it derives 95 per cent of its revenues. However, some oil has recently been discovered and the country started exporting it in 2006, which should improve its economic situation.

The region's total population, estimated at 82 million, is unevenly distributed; Algeria and Morocco have over 30 million inhabitants, Tunisia has 10 million, Libya 6 million and Mauritania 3 million. Average demographic growth for the period 1975–2005 was 2.4 per cent in Algeria, Libya and Mauritania and moderate 1.9 per cent in Morocco and Tunisia. Youngsters under the age of 15 represent about 40 per cent of total population in Mauritania, about 30 per cent in Algeria, Libya and Morocco and 26 per cent in

Table 20.4: Profile of North African Countries. **Sources:** *FAO, TERRASTAT[a]; **UNDP (2007). All figures are for 2005 unless otherwise indicated.

	Algeria	Libya	Mauritania	Morocco	Tunisia
Physical*					
Total area (1000 km²)	2 381	1 760	1 025	447	164
Of which					
per cent soils without major constraints	7	2	-	34	14
per cent actual/potential arable land	3	1	-	19	14
per cent desert, arid, semi arid land	97	97	100	90	88
per cent degraded	21	39	-	19	77
Social**					
Population (Millions)	32.9	5.9	3.0	30.5	10.1
Growth rate 1975-2005 (per cent)	2.4	2.9	2.7	1.9	1.9
Urban population (per cent)	63.3	84.8	40.4	58.7	65.3
Population under age 15	29.6	30.3	40.3	30.3	26.0
Adult illiteracy rate 1995-2005	30.1	15.8	48.8	47.7	25.7
per cent population with access to – improved sanitation (2004)	92	97	34	73	85
– improved water source (2004)	85	-	53	75	93
Economic**					
Per capita Gross Domestic Product (US $)	3112	6621	603	1711	2860
Parity Purchasing Power (US $)	7062	-	2234	4555	8371
per cent labour force unemployed (1996-2005)	15.3	-	-	11.0	14.2
Human Development Index (HDI)**					
Value	0.733	0.818	0.550	0.646	0.766
Rank (out of 177 ranked countries)	104	56	137	126	91

a) FAO, "Land and Water Development Division, Land resource potential and constraints statistics", in: TERRASTAT; at: <http://www.fao.org/ag/agl/agll/terrastat/#terrastatdb>.

Tunisia. Adult illiteracy rates averaged during the 1995–2005 period 16 per cent in Libya, 26 per cent in Tunisia, 30 per cent in Algeria and 48 per cent in Mauritania and Morocco. Unemployment is high in all five countries, especially among young people and university graduates for whom unemployment rates exceed 25 per cent and may be as high as 40 per cent (reliable unemployment figures are not available). On the basis of the *Human Development Index* (HDI) all five countries are considered as having a medium human development. Out of 177 countries ranked in 2005 according to their HDI values Libya ranked 56th, Tunisia 91st, Algeria 104th, Morocco 126th and Mauritania 137th (table 20.1). As it will be seen, many of these features are simultaneously causes and consequences of the environmental problems that beset the region.

20.3 Environmental Risks in North Africa

It has been established that industrialization and the modes of production and consumption associated with it have caused severe environmental problems that are either irreversible or difficult to resolve. Pollution of the atmosphere, oceans, rivers and land, global warming, destruction of the ozone layer and degradation of ecosystems are but a few of the consequences of industrialization. North Africa has been affected, to one extent or another, by most of these problems but the discussion will, as already indicated, focus on those that most observers consider as critical and requiring immediate attention. Scientists from the region as well as international organizations such as the *United Nations Food and Agriculture Organization* (FAO) and the *United Nations Environ-*

Table 20.5: Climate change impacts and vulnerability of Maghreb countries. **Source:** Adapted from FAO (2008: 9)

	Vulnerable sectors and possible impacts of climate change	Common climate-related disasters	per cent of total population under desertification risk 1997	Total actual renewable water resources per capita (m^3/inhab/yr)	Per cent of potential arable land actually in use 1997
Algeria	Vulnerable to natural hazards such as floods and drought	Floods	53	443	63
Libya	Recurrent droughts and dependence on rain-fed agriculture. Possible desertification of Jeffara Plain in northwest	None	97	106	88
Mauritania	Decreased water resources. Dependence on water originating outside border. Degradation of arable land. Degradation of pasture and loss of livestock.	Drought, floods	98	3826	15
Morocco	Ouergha watershed will likely see changes in runoff. Sea level rise vulnerability index = 0.24	Drought, floods	80	934	76
Tunisia	Mediterranean coastline vulnerable to sea level rise. Increased water stress.	Floods, drought	38	459	150

ment Programme (UNEP) agree that the most critical risks that confront the region are the loss of arable land under the effect of erosion, degradation and desertification, the limited supplies of fresh water and exposure to extreme-weather events such as floods and droughts (table 20.5).

20.3.1 Desertification, Land Degradation and Drought (DLDD)

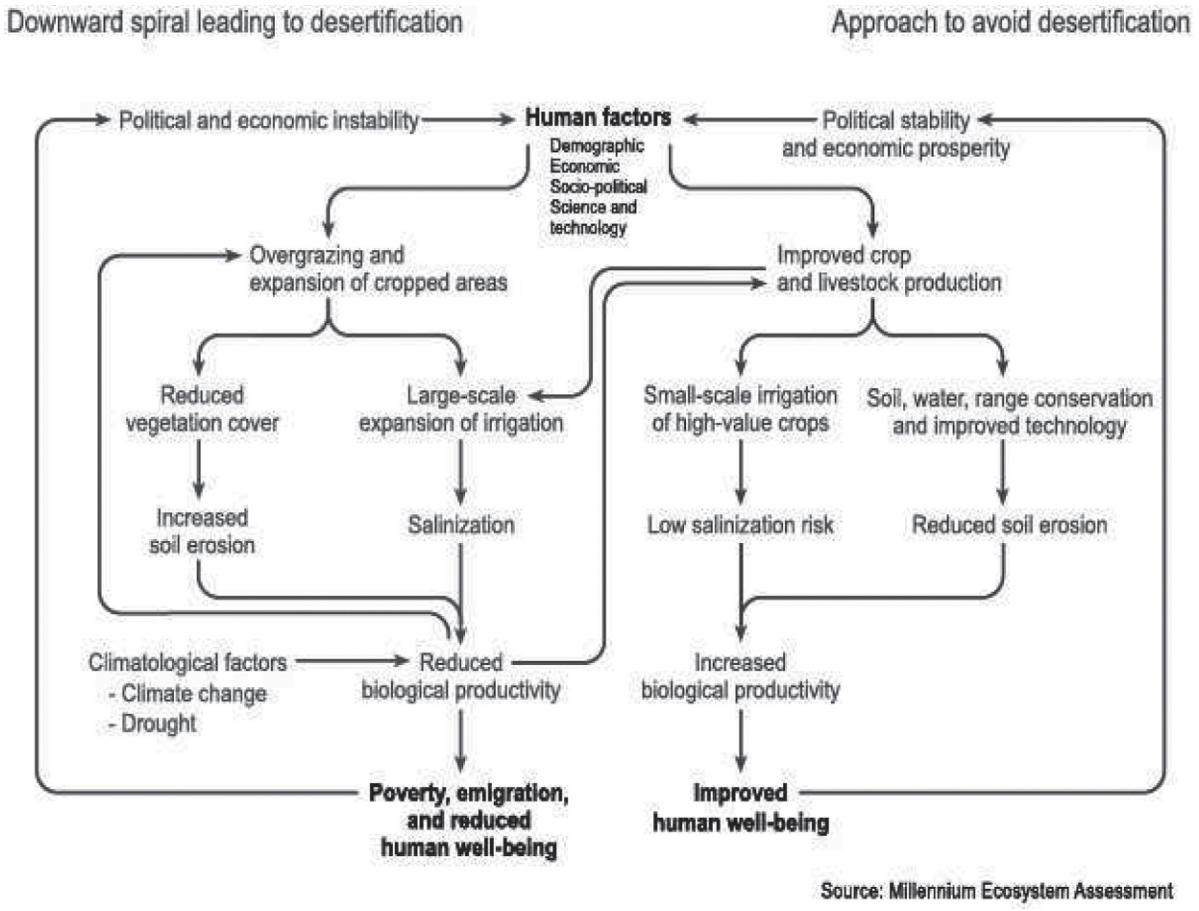
According to the 1994 *United Nations Convention to Combat Desertification* (UNCCD), the term desertification means "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (Art. 1). This definition, which is the result of a political consensus, needs further clarification. Desertification has nothing to do with deserts or advancing deserts. On the one hand, it is now scientifically established that deserts do not move out of their limits to invade neighbouring areas.[5] On the other hand, deserts such as the Sahara and Kalahari are extreme environments that offer little productive potential and where no one lives permanently. Rather, desertification is the transformation of productive arid or semi-arid areas into unproductive, sterile desert-like lands. In the words of the authors of the Millennium Ecosystem Assessment:

> Desertification is a result of a long-term failure to balance demand for and supply of ecosystem services in drylands. The pressure is increasing on dryland ecosystems for providing services such as food, forage, fuel, building materials, and water for humans and livestock, for irrigation, and for sanitation. This increase is attributed to a combination of human factors and climatic factors. The former includes indirect factors like population pressure, socioeconomic and policy factors, and globalization phenomena like distortions to international food markets and direct factors like land use patterns and practices and climate-related processes. The climatic factors of concern include droughts and projected reduction in freshwater availability due to global warming (Millennium Ecosystem Assessment 2005: 1).

By definition dry zones receive little rain (between 5 and 65 mm a year) and extended droughts are common there, but human beings, animals and plants have been able over centuries to develop strategies to adapt to this situation. Under the impact of various factors those strategies have been disturbed. For example, as population grew new plants or new techniques (mechanical ploughing, use of fertilizers, irrigation...) or new forms of social organization (sedentary living) were introduced to meet new demands. The

5 Cornet, Antoine, 2001: "La Désertification à la croisée de l'environnement et du développement", paper published by the Comité Scientifique Français de la Désertification; at: <www.csf-desertification.org/catalogue/2001_csfd_cornet.pdf>: p. 4.

Figure 20.1: Schematic Description of Development Pathways in Drylands. **Source:** Millennium Ecosystems Assessment (MA 2005: 4).



novelties may have met short-term expectations but in the long run they disturbed the delicate equilibrium of the ecosystems. The new systems proved to be unsustainable and the original ones lost their adaptive capabilities and their resilience. The process of degradation was thus initiated, leading ultimately to the transformation of the arid and semi-arid zones into quasi deserts. This process is schematically described in figure 20.1.

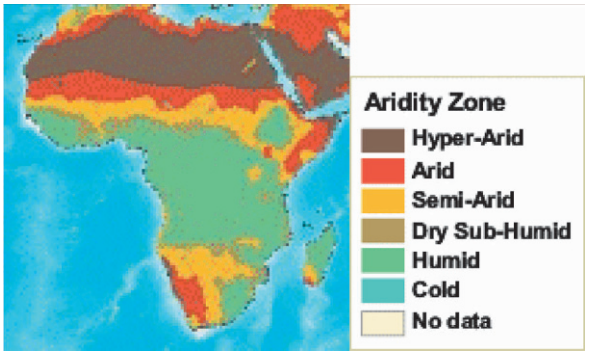
Recent figures indicate that nearly half a billion people throughout the world are already affected by desertification and that one billion are threatened by desertification. At the global level it is estimated that 54 per cent of productive land (61 per cent of Africa's) is drylands, 70 per cent of arid areas are affected by desertification, 130 million ha (1.3 million km²) suffer from severe degradation, 470 million ha (4.7 million km²) from moderate degradation, and some 10 million ha (0.1 million km²) of arable land are degraded annually (figure 20.2).[6]

This is a schematic graphic showing how drylands can be developed in response to changes in key human factors. The left side of the figure shows developments that lead to a downward spiral of desertification. The right side shows developments that can help avoid or reduce desertification. In the latter case, land users respond to stresses by improving their agricultural practices on currently used land. This leads to increased livestock and crop productivity, improved human well-being, and political and economic stability. Both development pathways occur today in various dryland areas.

In the Maghreb arid, semi-arid and dry subhumid areas cover about 700,000 km² (or 13 per cent of the total land area). Historically, these areas have been inhabited by nomads who practiced itinerant agricul-

6 See: CSFD [Comité Scientifique Français de la Désertification]; at. <http://www.csf-desertification.org/desertification/desertification_page2.php>.

Figure 20.2: Drylands: Aridity Zones of the World. **Source:** WRI (2002).



ture and herding, moving from one zone to another according to seasons and climate conditions (and also to escape tax collectors!). As soon as a chosen zone became less productive (i.e. degraded) the tribe would move to another one. Of course, this could be considered as the origin of the degradation process but in reality, there was enough space to move around and people did not come back to a previously occupied spot until it had a chance to recover.

These practices survived for centuries until the modern era when new considerations came into play. During the first half of the 20th century when Algeria, Morocco and Tunisia were under French authority, the administration wanted to exploit local resources and to control the Bedouin population. Consequently, the best lands were given to French settlers, agricultural resources were exploited for maximum profit (e.g. alfalfa growing in arid areas was harvested extensively to produce paper, which led to the disappearance of ground cover and exposure to erosion) and restrictions were imposed on the movements of Bedouins in rangelands (which led to the over-exploitation of the assigned zones). After independence, other requirements came into play. Governments had to ensure that food was available to a growing population, that employment and social services (education, health) were provided and, generally, that poverty was reduced and eventually eradicated.

To increase food production various measures to 'modernize' agriculture were taken, such as the introduction of mechanization, the use of chemicals, irrigation and the exploitation of marginal lands that were used for grazing. Ironically, the decisions taken at the time, and which were to prove ill-advised, emerged in a context where nearly all experts and decision-makers at the national level and in international organizations believed firmly that only industry, and not agriculture, could lead to development, growth and modernization. The ambition of every African country that achieved independence in the 1960's was to produce steel, not wheat. In fact, a country like Algeria decided to just ignore the agricultural sector altogether. Those early decisions were to start a chain reaction that would ultimately lead to the current state of advanced deterioration of lands in the Maghreb (table 20.6 for figures supplied by the FAO; concordant estimates may be found in UNECA 2003: 9).[7]

In a nutshell this is how the degradation process evolved (UMA 1999: 22–25: Le Houérou 2002: 6ff):

- Traditional subsistence agriculture having been declared a backward activity incapable of contributing to development and progress, and modern agriculture being a capital-intensive rather than a labour-intensive activity, peasants who could no longer live off their land left their rural areas to flock to cities to seek factory jobs, housing and social services.
- Cities were not properly equipped to receive this influx of inhabitants. Consequently, shanty towns began to appear on the outskirts of cities but existing urban infrastructure and services, unable to cope with the rapid growth of the population, began to fall apart, creating new environmental problems (e.g. air pollution) or aggravating existing ones (water scarcity, loss of arable land...).
- Food had to be supplied at prices that the largely unskilled (and often unemployed or underemployed) labour force could afford, which meant that governments had to control the prices at which farmers sold their crops and subsidize the prices of basic staple goods (bread, oil, sugar...) so that the average consumer could afford them. In practice, government-set prices proved too low to provide farmers with a decent income and too high for the urban population whose income remained quite limited.
- In an effort to increase the productivity of the agricultural sector, various measures were taken to eliminate what were deemed to be inefficiencies. For example, farmers in Tunisia were encouraged (and sometimes forced) to integrate their small farms into kolkhoz-style cooperatives, or to switch

7 It may be noted that in the last few years desertification has been causing the annual loss of about 22,000 ha of arable land and of $ 1 billion in income in Morocco, and of 8,000 ha of land and $ 100 million in income in Tunisia. In Algeria about 130,000 km² of land have been degraded in the last decade, 4 per cent of which irreversibly.

Table 20.6: Land degradation: Severity of human-induced degradation. **Source:** FAO TERRASTAT[a)]

Country		Land degradation											
		Degree										Cause	Type
Name	Total area '000 km²	None		Light		Moderate		Severe		Very severe			
		'000 km²	per cent	'000 km²	per cent	'000 km²	per cent	'000 km²	per cent	'000 km²	per cent		
Algeria	2319	1048	44	579	24	250	11	445	19	52	2	A	N, C
Libya	1618	941	54	88	5	37	2	593	34	95	5	O, (A)	N, (C)
Morocco	407	20	4	42	9	297	67	63	14	24	5	A,D, (O)	W, (C,N)
Tunisia	154	35	21	0	0	0	0	129	79	0	0	O,A, (D)	N, (C)

a) FAO, "Land and Water Development Division, Land resource potential and constraints statistics", in: TERRASTAT; at. <http://www.fao.org/ag/agl/agll/terrastat/#terrastatdb>.
Legend:
Cause: A = agriculture; O = overgrazing; D = deforestation; I = industrialization; V = over exploitation of vegetation
Type: W = water erosion; N = wind erosion; C = chemical deterioration; P = physical deterioration

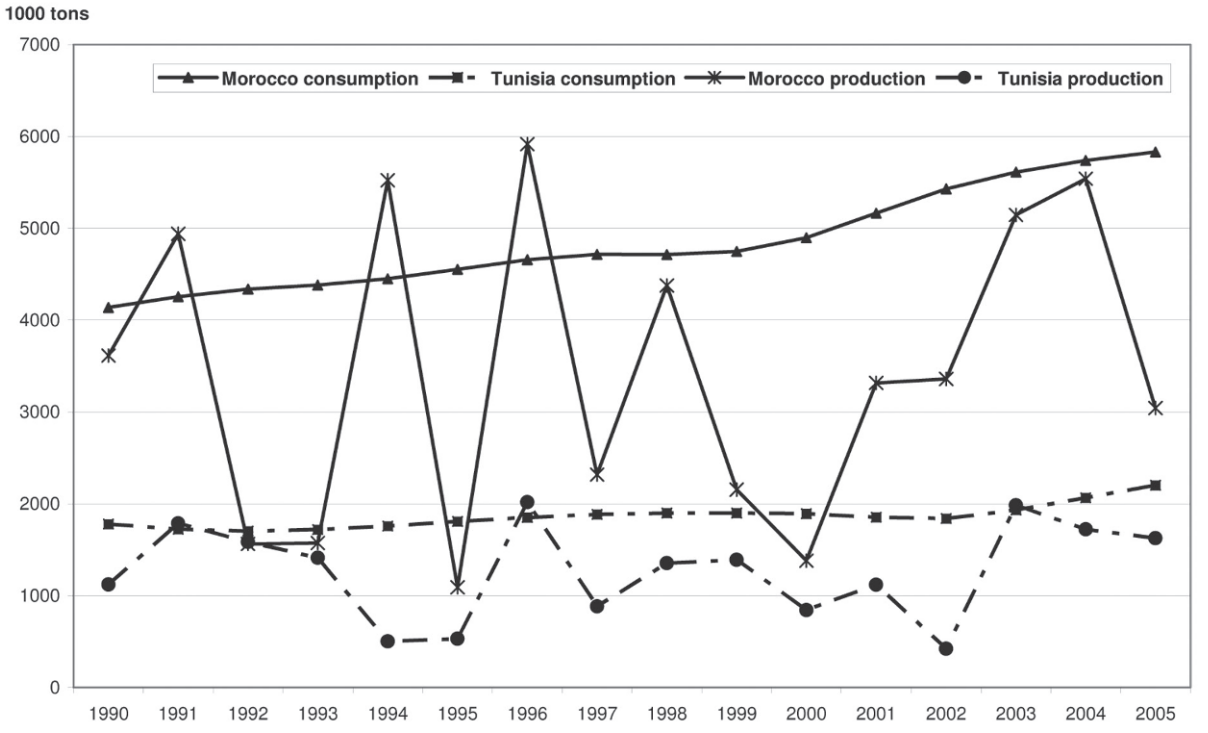
from subsistence agriculture to the production of cash crops for export or for transformation by the nascent food processing industry. Whatever benefits may have been expected from or achieved by such measures, the one consequence that they did have and that was to become a chronic feature of Maghreb countries is the incapacity of those countries to feed themselves (figure 20.3 illustrating the wheat deficit in Morocco and Tunisia).[8]

- The orientations given to the agricultural sector and the deliberate bias in favour of industry rarely took into consideration the impact they could have on the environment.
- This process of land degradation resulting in the emergence of "desert land forms and landscapes [in] areas where they did not occur in a recent past" is then due mostly to a "long-lasting mismanagement of natural resources under the pressure of excessive human and livestock populations" while natural factors such as increased aridity may at best aggravate or accelerate the process: "In an attempt to justify the lack of soil and water conservation policies and the absence of actual action on the watersheds to combat the scourge [of human-induced desert making], degradations are often blamed on climate change towards increasingly arid conditions. In most cases, blaming the climate is a fallacy aimed at providing politicians with good conscience and favourable polls" (Le Houérou 2002: 3).

The manifestations and causes of land degradation in range-land, rain-fed and irrigated areas are summarized in box 20.2. Degradation does not affect just land areas but also littorals and marine ecosystems. In this respect it has been established, *inter alia*, that large portions of the Mediterranean coastline of Tunisia and Egypt have been severely eroded causing, among other damages, the loss of large tracks of land and the infiltration of seawater into aquifers. It is also known that chemical pollution in the Mediterranean has caused the degradation or death of coral reefs, the disappearance of native algae such as *Posidonia oceanica* and the invasion by the 'killer algae' *Caulerpa taxifolia* and other unicellular algae which release toxins that absorb oxygen dissolved in water and thereby asphyxiate native marine fauna. However, space does not allow a discussion of these problems and their environmental consequences.[9] Therefore,

8 Food security is likely to become a critical problem if current trends in the international markets of cereals (tight supply, high prices) persist. Two figures illustrate amply the difficulties that are awaiting the region. During the first seven months of 2008 Morocco spent one billion dollars on wheat imports, which is more than double the amount it spent in 2007, and Algeria's wheat imports during the first semester of 2008 reached $2.26 billion against $1 billion spent during the first 7 months of 2007 (Source: Le Maghreb, 2008a: "Marché des céréales – Une forte demande des pays méditerranéens"; at: <http://www.lemaghrebdz.com/lire.php?id=13111> (15 September 2008). For oil producing countries such as Algeria and Libya the problem may not be acute as long as oil prices remain sufficiently high to finance food imports, but the situation will be very serious for countries that do not produce oil, for they will have to find resources not only to feed themselves but also to purchase the oil they need.

Figure 20.3: Wheat production and consumption in Morocco and Tunisia. **Source:** Figures from FAOSTAT (2007).



Box 20.2: Conceptual framework of the causes of desertification and land degradation in range-land, rain-fed and irrigated areas. **Sources**: Nasr (1999: 59) and Antonie Cornet, 2001: "La Désertification à la croisée de l'environnement et du développement", paper published by the Comité Scientifique Français de la Désertification; at: <www.csf-desertification.org/catalogue/2001_csfd_cornet.pdf>: 7.

- Manifestations
  - Destruction of land cover
  - Decline of productivity
  - Soil erosion
  - Sanding up
  - Silting (of dams)
  - Salinization/alkalinization
- Immediate causes
  - Overgrazing
  - Growing inappropriate crops
  - Overexploitation of ecosystem resources/services
- Underlying causes
  - Increased human pressure
  - Inadequate management techniques and methods
  - Aridity, droughts
  - Fragile ecosystems
- Fundamental causes
  - Demographic growth
  - Inappropriate control of access to resources
  - Economic crises, poverty
  - Nonexistent/inadequate institutional framework and/or development strategies

the next environmental risk that confronts the Maghreb will be discussed: the availability of fresh water.

20.3.2 Fresh Water Resources

Water resources used by humans are divided into two categories: conventional and non-conventional. Conventional resources may be either renewable or non-renewable. Conventional renewable water may be either surface or underground water (Oswald/Brauch 2009). Surface water is found in rivers, lakes, freshwater wetlands or artificial reservoirs (e.g. water trapped behind dams). It is naturally replenished by rain and naturally lost through discharge into the oceans, evap-

9 Invasion of the Mediterranean by alien plants and animals is described in UNEP/MAP/MED POL (2005: 38ff). A thorough discussion of Mediterranean coastline degradation may be found in Benoit and Comeau (2005: 300–350).

Table 20.7: Synthesis of water resources in the Maghreb. **Source:** Extracted from UNECA (2005: 6).

Country	P	CP	IRW	IRUW	IRSW	TRW	POP	POT	DEP	VRW
	mm	km^3/year	km^3/year	km^3/year	km^3/year	km^3/year	million	m^3/hab/year	per cent	km^3/year
Algeria	89	211.5	15.15	2.7	12.35	15.15	32	473	3	8
Libya	56	98.53	0.6	0.4	0.2	0.6	5.6	107	0	0.6
Mauritania	92	94.66	0.4	0.3	0.1	7.4	2.7	2741	96	-
Morocco	346	154.68	29	10	22	29	30	967	0	20
Tunisia	313	51.26	4.85	2.15	2.7	4.56	10	456	9	3.6
TOTAL	-	610.63	50	15.55	37.35	56.71	80.3	4744	-	

P: Average precipitations **CP**: Contribution of precipitations **IRW**: Internal renewable water **IRUW**: Internal renewable underground water **IRSW**: Internal renewable surface water **TRW**: Total renewable water **POP**: Population size **POT**: Volume of renewable water resources/inhabitant/year **DEP**: Dependency ratio on outside water resources **VRW**: Volume of renewable water. The gap between the total amount and the sum of the volumes of surface and underground water results from the overlap between the two types of water.

oration or infiltration through the ground to feed water tables and aquifers. Non-renewable fresh water is usually found in deep underground reservoirs formed millions of years ago; because it is not renewable it is also called fossil water. Non-conventional water is water that is treated to make it fit for human use. It may be obtained by treating brackish water, seawater (desalinization) or wastewater.[10]

At present, existing and potential water resources are insufficient to meet present and future water demand and all Maghreb countries, with the exception of Mauritania, already suffer from more or less severe water scarcity; furthermore, this situation is expected to worsen in the coming years.[11] On the other hand, it is known that

> [T]he availability of adequate, safe water is critical to health, economy and environment. This is not only true for the arid and semi-arid regions of the world, but also for the humid regions. Insufficient water supply will seriously hamper the welfare of people, industrial and agricultural production and the quality of the environment. However, excess of water, resulting in floods and inundation, may cause many casualties and seriously damage property. Our human society depends very much on a timely and reliable supply of water and adequate handling of excess water. In the arid region [of the Middle East and North Africa] water shortage is already a problem. Water is an important limiting factor for ecosystems, agriculture, human settlements and human health. Huge disparities exist between water demand and water availability. [...] Limited water supplies restrict present agricultural productivity and threaten the food security of some countries. Overexploitation of these limited water supplies often results in land degradation problems (van Deursen 2000: 3, 6).

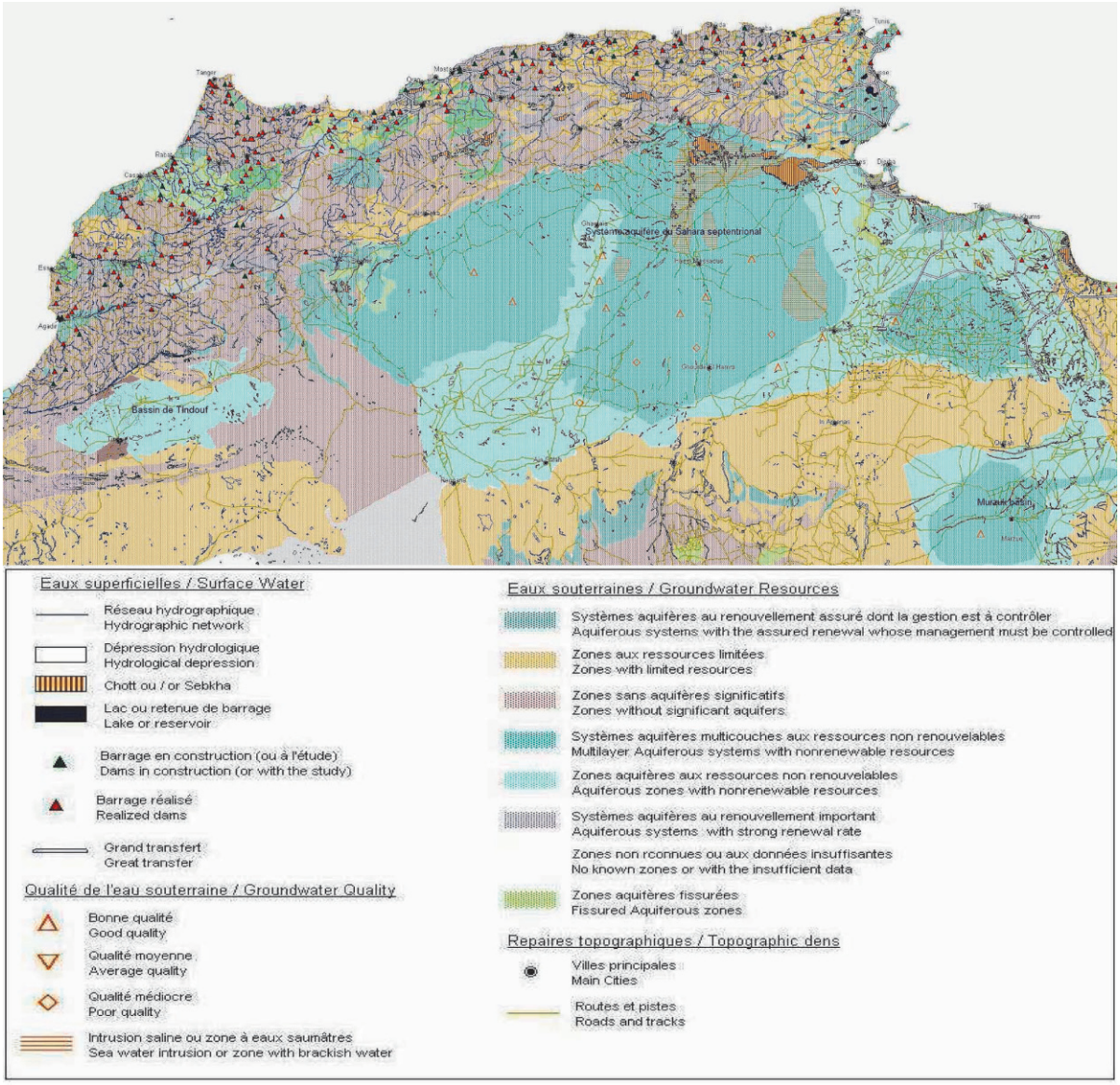
As already indicated, the Maghreb has an arid or desert climate with irregular rainfall (in frequency and amount). This lack of regularity makes it difficult to establish meaningful average precipitation figures. With that caveat in mind, figures provided by national institutions and the FAO indicate that annual precipitations vary from 346 mm in Morocco to 56 mm in Libya, but only a small fraction of that water is or can be mobilized (the inventory and location of surface and underground water resources are given in table 20.7 and figure 20.4). The *total renewable water* (TRW) potential of the region is estimated at 57 km^3 of which 50 km^3 are produced internally (37 km^3 of surface water and 16 km^3 of underground water).

Starting with surface water, Algeria, Morocco and, to a lesser extent, Tunisia have non negligible quantities of *internal renewable surface water* (IRSW) resources. Thanks to a vast programme of dam construction that it had initiated since the 1970's Tunisia

10 For more detailed definitions see e.g. UNESCO 2006: chap. 4 or Rosegrant, Cai and Cline 2002: 23.

11 Water-stressed countries are those with annual water resources of between 1,000 and 1,700 m^3 per person and countries suffering from water scarcity are those with annual supplies of less than 1,000 m^3 per person. Projections indicate that by 2025 per capita water availability will be 47 m^3 in Libya, 288 m^3 in Tunisia, 313 m^3 in Algeria and 751 m^3 in Morocco (Hinrichsen 1997: table 1). It may be noted that the minimum amount of water required to sustain human life is about 10 m^3 per year per capita; a reasonable supply to maintain health may be 40–80 m^3 per year per capita; and the minimum amount to sustain an acceptable livelihood (food production and other uses) is 1000 m^3/year/capita.

Figure 20.4: Water Resources in the Maghreb. **Source:** African Organization of Cartography and Remote Sensing (AOCRS); at: <http://www.oact.dz/oact/sirepan.htm>.



has so far been able to mobilize 90 per cent of its surface water potentials. Morocco's rate of mobilization is estimated at 75 per cent achieved through the utilization of 114 dams of various sizes with a total capacity of 16.3 km^3 (Oubalkace 2007). As for Algeria, it is lagging behind with only a small fraction of its potential surface water being mobilized in its existing 59 dams, but the country expects to have 10 additional dams going into service in 2009 and 50 new ones being completed by 2020 (Le Maghreb 2008b).[12]

However, the usefulness and even the viability of dams are threatened by silting. Because inappropriate agricultural methods and land clearing practices are used in catchments areas and watershed basins, water going into the reservoirs is loaded with sediments and solid material which are deposited in the bottom of reservoirs, thereby reducing the storage capacity of most dams in the region and exposing some of them to structural defects or even collapse. In this respect, a study has estimated the annual loss of capacity of dams in Algeria, Morocco and Tunisia due to silting

12 Le Maghreb, 2008b: "Dix nouveaux barrages à l'horizon 2009"; at: <http://www.lemaghrebdz.com/lire.php?id=5118> (1 November 2008).

for the year 2000 at 133 million m^3 or the equivalent retention capacity of a major dam; the figure is projected to reach 310 million m^3 in 2030 (Lahlou 2000: table 1.8).

In areas where rainfall is insufficient to justify building dams for collecting runoff water, other techniques of water harvesting may be used; some of them are quite ancient and most had been abandoned but they are now being revived as useful tools of sustainable agricultural production in arid areas (these techniques are described in FAO's website dedicated to water harvesting at: <http://www.fao.org/ag/agL/AGLW/wharv.htm>, chap. 52 by Laureano).

Turning now to underground water resources, these include water contained in water tables located at various depths and which comes mostly from rainwater that seeps through the ground or sometimes from artificial recharge. Libya and Mauritania have very small quantities of *renewable underground water* (RUW), whereas resources in the other three countries are more significant (especially in Morocco, with an annual volume of 10 km^3; see table 20.7). The other kind of underground water is fossil water found notably in the *North-Western Sahara Aquifer System* (NWSAS) (*Système Aquifère du Sahara Septentrional* or SASS in French) which covers a total area of over one million km^2: 700,000 km^2 in Algeria, 80,000 km^2 in Tunisia and 250,000 km^2 in Libya. It contains important quantities of water but most of that water is either non renewable or needs a lot of time to be renewed.[13]

Conventional water resources in the Maghreb are confronted with several problems. Practically all available surface water has been mobilized and groundwater is already extracted at rates that are beyond renewal rates. Yet the region is suffering from water stress and will be faced with water scarcity in the near future. The fundamental problem is the need to provide food for a growing population while there are limited areas of arable land and even more limited amounts of water. One of the solutions adopted was to use marginal lands for irrigated agriculture. Thus, agriculture became the main consumer of water (table 20.8).

But resources being scarce, especially in arid zones, it was inevitable that those resources would be overexploited and as a result, what was to be a solution became itself a problem or, more precisely, the starting point of a series of problems. Without going into lengthy technical details, it may be said that overextraction of groundwater leads to a lowering of the groundwater table and a deterioration of the groundwater quality due to sea water intrusion and/or the upward diffusion of deeper saline water. Furthermore, by extracting water from the soil, evaporation and evapotranspiration tend to increase salt concentrations. Also, direct evaporation from the soil surface causes a rapid accumulation of salt in the top layers, and when the volume of rainwater is insufficient to dissolve the salts generated by the soil and provisions for leaching of salt are inadequate, the soils rapidly become salty and sterile.

Table 20.8: Uses of Internal Renewable Water Resources (IRWR) in the Maghreb. **Source:** FAO Aquastat (2005, table 4).[a]

Sector		
agricultural	km^3 per year	21.1
	per cent of total	85
domestic	km^3 per year	2.5
	per cent of total	10
industrial	km^3 per year	1.2
	per cent of total	5
Total (km^3 per year)		24.8
As per cent of IRWR		51
m^3/year per inhabitant		363

a) FAO Aquastat, 2005: web page entitled "General Summary on the Near East and North Africa"; at: <http://www.fao.org/nr/water/aquastat/regions/neast/index.stm>.

Similarly, water storage in reservoirs, where evaporation is intense, tends to increase the salt concentration of the stored water, and using saline water for irrigation may in turn increase soil salinity. In all the countries of the Maghreb as well as in the coastal zones of Libya and Tunisia the salt content of the groundwater used for irrigation has been steadily increasing.

As a result of overexploitation of renewable water resources and excessive withdrawals of fossil water, the index of unsustainable water production is estimated at 22 per cent for Tunisia, 35 per cent for Algeria and 84 per cent for Libya. According to the Bleu

13 The *Sahara and Sahel Observatory* (Observatoire du Sahel et du Sahara – OSS), an intergovernmental organization with headquarters in Tunis, Tunisia, <http://www.oss-online.org> has initiated a major project to study this major aquifer system; it has published a monograph summarizing the results of that project and giving the main characteristics of the system (OSS 2008).

Plan (<www.planbleu.org>) the percentage of unsustainable water supplies derived from fossil sources or from over-exploitation will grow. The rise in the demand for water will be steepest in the least water-rich countries, which will then be exposed to structural shortages. Under these circumstances, some fossil resources will rapidly be depleted and coastal aquifers further destroyed by salt water intrusion. Moreover the silting up of water retained in dams limits their original capacity. Growing quantities of industrial and urban waste and reduced run-off resulting from increased extractions will also affect the quality of water and aquatic systems. These elements further aggravate the factors leading to increasing water vulnerability (costs, health and conflicts).

Various measures are being used or contemplated to mobilize additional water resources, particularly those called unconventional resources derived from the treatment of wastewater and from desalinization of brackish water and seawater. However, the availability of unconventional water is likely to remain limited for most countries in the region. With respect to treated wastewater the main source of supply is urban centres which are generally located far away from the sites of utilization (irrigated perimeters). Furthermore, the quality of treated wastewater needs to be carefully monitored to avoid health hazards and soil contamination. In addition, and on the basis of experiments carried out in Tunisia, the public is not likely to accept that food products be irrigated with treated wastewater. Finally, wastewater treatment creates by-products (solid waste) that are not easily disposed of. Nevertheless, treated wastewater is used extensively in Tunisia (but not for food production) and, to a lesser extent, in Morocco.[14]

As for desalinization, it remains a costly process despite economies achieved in recent years and, more importantly, it requires large amounts of energy. For some countries (Algeria, Libya) the availability of energy resources poses no problems, but this is not the case for other countries in the region.

To summarize (UNEP/MAP/MED POL 2005), the Maghreb is one of the most water-stressed regions in the world. In 2005 the average volume of water available to each inhabitant was 363 m^3. Certain countries are facing a critical situation; e.g. water availability in Tunisia is projected to decline from the current 432 m^3 to 285 m^3 in 2020. The shortage of water is a major constraint for agriculture. Irrigation is the largest consumer of water. National strategies have favoured supply-side policies through the construction of dams and boreholes. However, many dams will lose most of their storage capacity because they are becoming silted up. Aquifers, many of which consist of non-renewable fossil water, are being over-exploited or irreversibly degraded by saline intrusion. Hydrological systems are deteriorating as a result of the degradation and over-exploitation of catchment areas.

Arid areas, by definition, suffer from lack of rain and long periods of dry weather are quite common. However, those periods may at times last for months or even years. On the other hand, when rain does come the quantity of water may reach catastrophic proportions. In other words, arid areas are just as likely to suffer from drought as from flooding – two forms of natural hazards which will be reviewed next.

20.3.3 Extreme Weather Events and Other Natural Hazards

As the UNDP indicates, "[c]limate variability, of which drought is a component, is a normal part of climate. It is a characteristic feature of the drier areas of the globe [...]. Nevertheless, drought is an 'extreme' climatic event or a climate shock: an extended period of unusually low rainfall" (UNDP 2004a). In the Maghreb it is estimated that about 10 per cent of the area receives on average between 100 and 400 mm of rain per year and 85 per cent receives less than 100 mm. In general it has been observed that in the last two decades amounts of precipitation have been decreasing and totally rainless periods have become more frequent and more extended. For example, a study covering the period 1988–1998 shows that in the zones that are considered as semi-arid (annual precipitation less than 600 mm) there have been 4 years of drought in Algeria, 5 years in Mauritania and Tunisia, 7 years in Libya and 8 years in Morocco (UNECA 2001: 54). Other studies indicate that drought frequency after the 1960's increased in Morocco, Tunisia and Algeria. In the specific case of Morocco drought occurred on average once every five years before 1990 but subsequently it occurred once every two years, and of the twenty-two drought years in the twentieth century ten occurred during the last two decades, including the three-year drought of 1999–2001 (Medany 2008: 134).

14 Mohammed S. Matoussi (1996): *Sources of Strain and Alternatives for Relief in the Most Stressed Water Systems*; at: <http://www.crdi.ca/ges/ev-31124-201-1-DO_TOPIC.html>.

Table 20.9: Floods & Droughts in the Maghreb, 1970-2008. **Source:** Compiled from EM-DAT: The OFDA/ CRED International Disaster Database <www.emdat.net>, Université Catholique de Louvain, Brussels, Belgium.

	Floods				Droughts			
	1970's	1980's	1990's	2000's	1970's	1980's	1990's	2000's
Algeria	3	4	7	23	-	1	-	1
Libya	-	-	1	-	-	-	-	-
Mauritania	-	2	3	8	3	1	2	1
Morocco	4	-	5	9	1	2	1 (lasted 3 years)	
Tunisia	3	2	1	4	1	1	-	-

Figure 20.5: Droughts in North Africa (1980-2000). **Source:** Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.

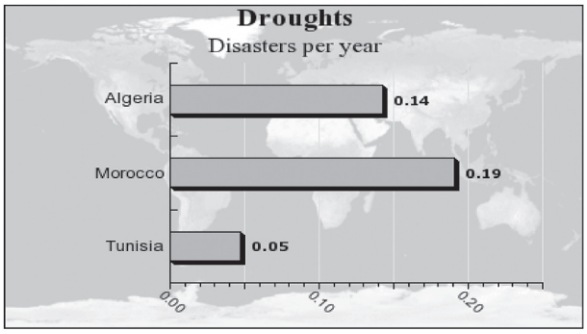
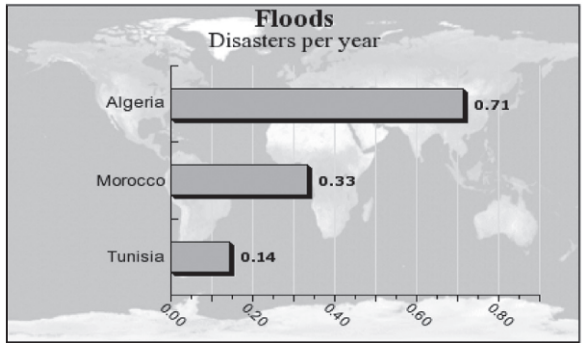


Figure 20.6: Floods in North Africa (1980-2000). **Source:** Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/m>.



Another weather-related risk that confronts the Maghreb is flooding. As already indicated, semi-arid and sub-humid areas are characterized by rainfall which is unevenly distributed in time and space. There may be more or less extended periods during which there is little or no rain, but there may also be periods where large amounts of rainfall during a short period of time. As a study published in 2003 points out, "[h]undreds of millimetres of water can fall on arid regions in a few days with no other precipitation for the rest of the year. Arid soil, erosion, and excessive runoff are characteristic of the [Maghreb] region and promote natural disasters related to strong precipitation and flooding" (Agoumi 2003: 2)

Between 1970 and 2008 there have been 44 flood occurrences in North Africa (table 20.9). It may be noted that floods have become more frequent since the turn of this century, particularly in Algeria. This is probably part of a global pattern of a higher frequency of extreme-weather events attributable to climate change. According to a report published by the Worldwatch Institute, "weather-related disasters around the world have been on the rise for decades: on average, 300 events were recorded in the 1980's, 480 events in the 1990's, and 620 events in the last 10 years."[15]

In addition, the impact of flooding on humans and infrastructure in the Maghreb has worsened with time. This is due to the separate or combined effects of several factors:

- Demographic growth increases the number of people at risk.
- Increased urbanization has led to the use of lands unfit for construction (such as dried riverbeds) or devoid of appropriate installations (rain water sewer system), as well as to the breakdown of existing installations.
- The disappearance of land cover as a result of human action (deforestation, overgrazing), which leaves lands vulnerable to wind/water erosion and landslides, and creates other problems such as the silting of dams.

The *Arab Forum for Environment and Development* (AFED) reports that simulations assessed by the *Intergovernmental Panel on Climate Change* (IPCC) pre-

15 Petra Löw (2008): "Weather-related Disasters Dominate"; at: <http://www.worldwatch.org/node/5452?emc=el&m=152155&l=4&v=b6295aa04a>.

Table 20.10: Algeria: Descriptive Figures per Disaster Types (1980- 2000). **Source**: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.

	Disasters per year [nb/year	Casualties [killed/year]	Physical exposure [nb/year]	Relative vulnerability [killed/mio. exposed.]
Droughts	0.14	0	897,609	0
Earthquakes	0.38	137.2	1,252,109	109.6
Floods	0.71	13.3	741,412	18.0

Figure 20.7: Algeria Average Disasters Per Year. **Source**: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid. unep.ch/undp/>.

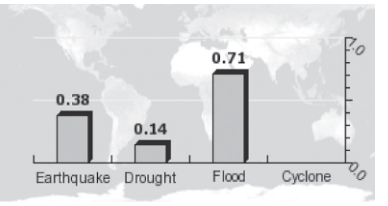


Table 20.11: Morocco: Descriptive Figures per Disaster Types (1980-2000). **Source**: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.

	Disasters per year [nb/year	Casualties [killed/year]	Physical exposure [nb/year]	Relative vulnerability [killed/mio. exposed.]
Droughts	0.19	0	1,483,017	0
Earthquakes	X	X	X	X
Floods	0.33	39.6	384,498	103.0

Figure 20.8: Morocco Average Disasters Per Year. **Source**: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.

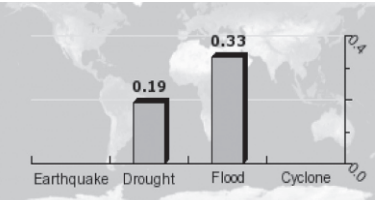
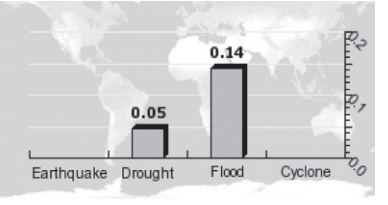


Table 20.12: Tunisia: Descriptive Figures per Disaster Types (1980-2000). **Source**: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.

	Disasters per year [nb/year	Casualties [killed/year]	Physical exposure [nb/year]	Relative vulnerability [killed/mio. exposed.]
Droughts	0.05	0	416,757	0
Earthquakes	X	X	X	X
Floods	0.14	8.4	512,643	16.4

Figure 20.9: Tunisia Average Disasters Per Year. Source: Global Resource Information Database (GRID)/UNEP; at: <http://gridca.grid.unep.ch/undp/>.



dict that surface temperature in the Arab region will increase between 2 °C and 5.5 °C by the end of the 21st century. This warming will have various consequences, including greater climate variability which, in turn, will increase the frequency and/or the intensity of extreme-weather events: "Drought-affected areas will probably increase, and extreme precipitation events, which are likely to increase in frequency and intensity, will augment flood risk" (Medany 2008: 134).

Other natural hazards to which parts of North Africa are exposed include earthquakes (6 occurrences in Morocco between 1999 and 2006, one occurrence in Algeria in 2004), heat waves (a three-month wave in Morocco in 2004), and cricket infestation (most recently in Mauritania in 2004).

20.4 Conclusion

'Freedom from want' and 'freedom from hazards impact' are two fundamental pillars of human security. Human survival depends on the availability of food and water. To produce food humans require productive land, water and good health. Good health, in turn, depends on food and water of acceptable quality being available in sufficient quantities. But physical survival depends also on the absence of various forms of violence – war, repression, poverty, discrimination, verbal aggression, etc. In other words, human security is indivisible.

With respect to environmental security the Maghreb's score card is mixed. On the one hand, the region's contribution to global problems such as climate

change, ozone depletion, loss of biodiversity and degradation of ecosystems is small proportionately to its population. Nevertheless, it could and it should participate more fully in the protection of the environment. On the other hand, the impact of environmental risks is harsher on developing countries than on richer more industrialized ones, mostly because the former often lack the know-how and/or the financial means to deal with that impact. Thus, more frequent and severe extreme weather events have been observed everywhere – in the US, Europe, the Maghreb – but the impact of a minor event (say, heavy rain for a day or two) in Tunisia, e.g. could have an effect that is equivalent to that of major hurricane that hits the United States. Therefore, developing countries need and deserve assistance to mitigate and recover from the adverse effects of environmental catastrophes. Nevertheless, they have the duty and the responsibility to take measures to reduce their vulnerability to such events.

There is little doubt that our environment is at an advanced state of degradation, and scientists have warned that this situation will get worse unless we radically change our behaviour. Most countries, including those in the Maghreb, have made commitments to protect our common planet by ratifying many conventions related to the environment such as the UN *Framework Convention on Climate Change* (UNFCCC), the UN *Convention to Combat Desertification* (UNCCD) and the *Convention on Biological Diversity* (CBD). Some of those commitments are included in the *Millennium Development Goals* (MDGs) as Goal 7: Ensure Environmental Sustainability. This goal includes 3 targets:

- **Target 9:** Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources;
- **Target 10:** Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation;
- **Target 11:** Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers.

Reaching these targets and, more generally, setting the Maghreb on a course of sustainable development requires effective and efficient measures to deal with desertification, land degradation and drought (Brauch/Oswald Spring 2009), water scarcity (Oswald Spring/Brauch 2009) and vulnerability to natural hazards. However, such measures must be integrated in a global strategy that seeks to achieve *simultaneously* economic development, social equity and improved governance (UNEP/MAP 2005: 13). The principle that these three objectives cannot be disassociated must be taken as an axiom and constitute the foundation of any action designed to achieve human security.

Specialists in environmental protection and politicians are well aware of the environmental problems that beset the Maghreb and of the measures needed to resolve those problems. In fact, some countries have initiated actions aimed at achieving specific targets such as providing access to potable water and improved sanitation, rehabilitating degraded lands or protecting ecosystems. However, outstanding problems are numerous and the resources to resolve them remain insufficient. .

This chapter has highlighted some of the problems confronting the Maghreb:

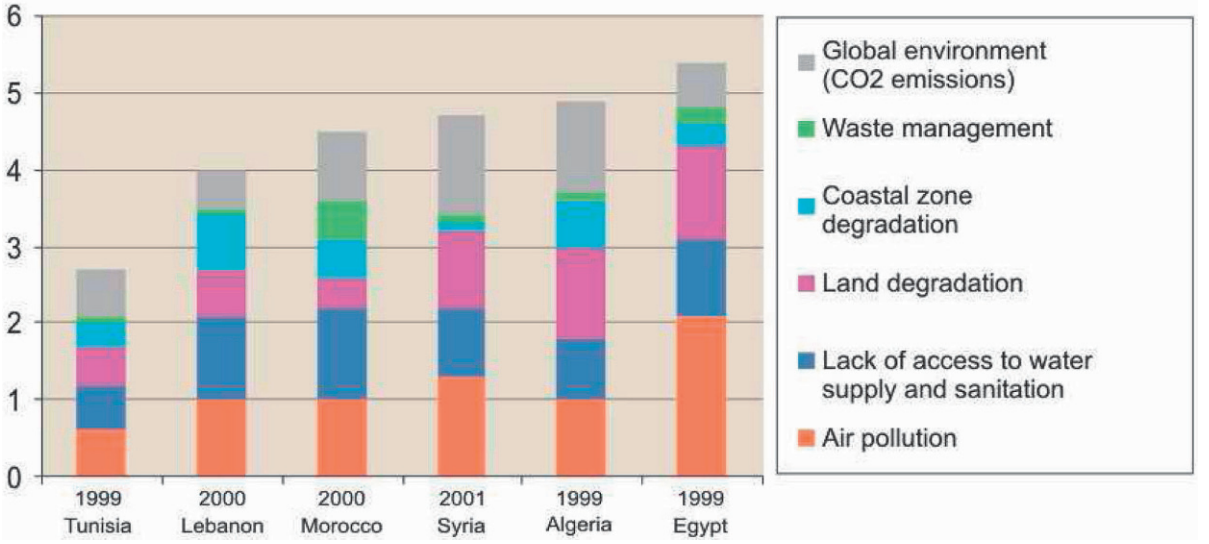
- scarcity, vulnerability and misuse of arable lands;
- scarcity, vulnerability and mismanagement of water resources;
- vulnerability to natural hazards that may or may not be linked to climate change and insufficient preparedness to deal with the effects of such hazards;
- conflict between the need to achieve economic growth to provide prosperity and the pressure to protect the environment.

This last problem is particularly difficult to resolve. On the one hand, social conditions in many Maghreb countries continue to be unsatisfactory, although extreme poverty is rare. Consequently, all countries need to intensify the production and provision of goods and services to meet a growing demand, which pushes them to adopt expedient methods that are not always sustainable or environmentally friendly. For example, marginal lands and scarce water resources are used to grow food; prime land is used for housing, roads, factories and hotels; projects are undertaken without appropriate studies of their environmental impact; etc.

On the other hand, governments are under pressure to incorporate environmental protection in most of their policies. This may be either the result of commitments they have undertaken under various international instruments to which they have adhered, a response to requirements imposed by trading partners, or simply an attempt to pursue enlightened self-interests.

Caught between the need to satisfy immediate and concrete social demands and the necessity of dealing

Figure 20.10: Average annual costs of environmental degradation (per cent of GDP). **Source:** Estimates from World Bank, 2004, cited in UNEP/MAP/Blue Plan (2008: 7).



with long-term environmental concerns, policy makers tended until the turn of this century to either ignore environmental questions or to adopt piecemeal actions that proved ultimately to be ineffective. At present, we see a different approach being used: long-term comprehensive plans are proclaimed to deal with all environmental issues simultaneously. However, and as the editors of the *2008 Report of the Arab Forum for Environment and Development* point out in their introductory chapter, "While looking forward to the future is needed for sound environmental planning, ignoring current problems will not solve them, however noble the long-term goals might be. Problems unaddressed in the present will multiply, creating even bigger challenges in the future" (Tolba/Saab 2008: xxi).

The cost of environmental degradation is too high to be ignored. According to the World Bank, some Arab countries may lose annually between 4 per cent and 9 per cent of their GDP as a result of environmental degradation (figure 20.10), whereas the loss in the OECD is 2–3 per cent. Land degradation and lack of access to water supply and sanitation are major contributors to those losses. It is not clear whether World Bank figures include the cost of infrastructure destroyed by natural hazards such as earthquakes and floods, but that cost is certainly high. Consequently, urgent action is needed to deal with these environmental risks. On the basis of recommendations made to Arab states in general by various institutions such as the *Arab Forum for Environment and Development* (AFED), the World Bank and the *United Nations Environment Programme* (UNEP), Maghreb countries need to focus on the following:

- Preserve and increase water resources through soil and water conservation measures, agricultural and forestry practices, small-scale irrigation, run off and spate irrigation and the mobilization of non-conventional sources of water, as well as the recycling of urban and industrial wastewaters and drainage water, taking into account quality standards.
- Reorient water policies to integrate water demand management in agriculture and other sectoral policies and encourage demand-side approaches with the aim of improving water use efficiency, reducing unnecessary losses, implementing water saving techniques in irrigation and involving industry, tourism and cities in controlling wastewater. It is also necessary to reduce the overexploitation of groundwater and fossil water and promote the artificial recharge of aquifers.
- Promote investment in wastewater treatment systems to prevent and reduce pollution from urban and industrial sources.
- Reduce the vulnerability of rural communities by providing adequate social services (education, health); offering training in sound and innovative practices such as the thrifty use of water, fertilizers and pesticides; promoting organic agriculture, the reintroduction of local varieties and species of plants and animals, the restoration of soil fertility, and the rehabilitation and reintroduction of traditional knowledge and practices. There is also a

need for greater governance through an effective participation of local communities in decision-making and also for encouraging the participation of women in community life.

- Prepare contingency plans to deal with the aftermath of earthquakes and floods. Of course, natural hazards can be neither predicted nor prevented, but it is possible to take measures to provide assistance to their victims and help them reorganize their lives after the catastrophe. It is also necessary to take preventive measures to minimize the impact of natural hazards when they occur. For example, urban land use regulations should be adjusted to prevent construction on lands at risk (such as banks and beds of dry rivers), and building codes applicable in areas at risk should include specifications that make buildings resistant to quakes and high currents.

Implementation of these measures requires technical and financial resources. In the Maghreb resources needed to carry out such complex and costly undertakings as research, training, mobilization of resources, and project design, implementation, monitoring and follow-up may be unavailable or insufficient in some cases, but they are readily available in others. Yet in all countries the current state of environmental security in particular and of human security in general is mostly unsatisfactory and citizens are confronted with threats, risks and vulnerabilities that could have been avoided and that are set to worsen as a result of global phenomena (climate change, ozone depletion, global warming) and prevailing local conditions (demographic growth, unchecked urbanization, overexploitation of resources...).

Clearly, there are certain conditions over which man has no control: climate, geography, geology and the like. But people in the region have lived and even prospered under those same conditions for centuries. Social mores, cultural practices and religious values all show that people are admonished to respect nature and protect the environment. Some of those practices and behaviours have persisted to these days in some isolated parts of the Maghreb that have not been too affected by 'modernization.'

If the environment has suffered in the last fifty or sixty years the greatest and fastest degradation in the region's history, it is partly because of evolutions and changes that were perhaps unavoidable and may have been even desirable, and partly because public authorities failed to take appropriate measures to avoid or reduce the negative impact of those changes. When colonial rule in the Maghreb ended in the middle of the 20th century social and economic conditions were quite bad: educational and health services were limited; income-generating activities were restricted mostly to traditional agriculture and handicrafts; infrastructure (roads, electricity, running water, sanitation...) were concentrated in a few urban centres; the little manufacturing or industrial production that may have existed was in the hands of foreigners...

Under those circumstances it was only natural that governments in the newly independent states set out to pull their societies out of backwardness and underdevelopment. It should be kept in mind that we were at that time in the midst of confrontation between capitalism and communism, two ideologies that made no distinction between politics and economics. For leaders of what was to become the 'Third World' the East (in fact, the Soviet Union) became the model to follow in all matters of public life, although the 'scientific' term used to identify that orientation was socialism. Politicians were not the only ones to espouse socialism. Many economists, including some in the West, advocated the virtues of industrialization as a fast track towards development and modernization, and the need to adopt an industrial approach to agricultural production.

When the Cold War ended with the disintegration of the Soviet Union and the dismembering of the Eastern Bloc, it was claimed that the victory of the West proved the fallacy of socialism and the superiority of capitalism and of the market economy. The former had therefore to be abandoned and the latter became, in the absence of a 'third way', the only theory or ideology to govern public policy.

The critical issue of concern here is that, as far as the Maghreb is concerned (along with other Arab and African countries), regimes continue to adopt policies and decisions without submitting them to public debate. Whenever a policy is adopted, regimes either do not bother to offer justifications for it or present it as the best or only means to achieve the national interest. Any criticism or challenge of official policy is proclaimed to be an act of treason and a clear indicator of irresponsible and unpatriotic behaviour. Thus, retaining certain cultural or religious practices may be deemed at one time as backward and reactionary, only to become at a later stage a sign of authenticity and an indispensable aspect of national identity – neither position being based on any rational explanation.

This type of behaviour is characteristic of authoritarian regimes. Dictators are convinced that they are infallible and come to view any questioning of their decisions as rebellion. The result is that oppression

and arbitrary rule become widespread. In reaction to that, the majority of the population choose to withdraw from the public space, fearing for their safety and security. However, a few opt for confrontation with the regimes; in most Arab countries it is extremist religious groups who choose this course of action. But this does not mean that the majority is as 'silent' as it may appear. Unable to openly challenge their rulers, more and more people try to find a variety of acts which they would undertake as forms of civil disobedience. In general such acts are illegal but they are carried out precisely because they are illegal and would then constitute challenges to the authority. They may range from smoking in buses to vandalizing public property to throwing garbage in the street.

Of course, such behaviour is irresponsible and ultimately self-defeating. At the end of the day, it is the citizens themselves who will be deprived of the public infrastructure or of a clean environment. But we have to consider that in such cases citizens who live in constant frustration and despair may do things that appear pointless and even childish. Just consider the young man trying to stop the advance of a column of tanks on Tiananmen Square, or Palestinian children throwing rocks at Israeli tanks.

The point here is that citizens in the Maghreb are well aware of environmental issues, their culture and their religion having taught them to live in harmony with nature and to respect the environment. But when they find themselves confronted with regimes that strip them of their most fundamental rights and that allow them no form of protest or contestation, they may feel that they have no choice but to act in a manner that an outside observer would consider as irrational.

Clearly, there is at present no scientific method to test the validity of this hypothesis: in the Arab world public opinion surveys are as likely as rain in August. But for anyone who has lived under an authoritarian regime, it would not be difficult to understand how despair may shape human behaviour.

There is no doubt that the Maghreb is confronted with major environmental challenges, risks and vulnerabilities and that these will worsen in the coming years and decades. In some cases, damage suffered by the environment is at present irreversible, but there is still time to protect the environment from further degradation and hence ensure the security of future generations. In terms of environmental security, the fate of the Maghreb is inexorably linked to that of the rest of humanity but there is still room for the Maghreb to inflect the course of events in this area. Governments have been showing concern about the state of the environment and have undertaken many actions to preserve it from future degradation. However, the success and effectiveness of any public policy, whether pertaining to the environment or any other area, will ultimately depend upon the public's commitment to that policy and its active participation in its implementation. At present, any government initiative is received with suspicion – if not hostility, regardless of its intrinsic value; this is becoming a quasi Pavlovian reflex. In some cases, financial and administrative means are used to force compliance or deter infractions, but such measures may sometimes become counterproductive.

The daunting but inescapable conclusion is that for *people* in the Maghreb achieving human security in general and environmental security in particular will depend mostly on two exogenous factors: the goodwill of industrialized countries which need to change theit behaviour that is damaging to the global environment, and the willingness of national governments to become accountable to their citizens.

Come senators, congressmen
Please heed the call
Don't stand in the doorway
Don't block up the hall
For he that gets hurt
Will be he who has stalled
There's a battle outside
And it is ragin'.
It'll soon shake your windows
And rattle your walls
For the times they are a-changin'.

From Bob Dylan's song
"TheTimes They Are A-changin'" (1963).

21 Water Degradation as a Human Security Challenge in Jordan

Bassam Ossama Hayek and Nisreen Daifallah Al Hmoud

21.1 Introduction

Water is vital to sustain lives. Thus, its availability in the appropriate quantity and quality is crucial for a healthy society. The water resources available for use are only three per cent of the total available water. Due to the uneven distribution of usable water, some nations are deprived of the minimum amount, while other nations suffer in handling too much water. People living in areas of scarce water resources became increasingly vulnerable due to the rise in water demand from a growing population and the associated needs for development. In water scarce areas like Jordan, water is a very valuable commodity and water demand management is an essential element in the national efforts for water management. Such concerns are even addressed at the highest level, where His Majesty King Abdullah II defines water in Jordan as forming a strategic challenge that cannot be ignored, and that a balance has to be reached between drinking water needs and the industrial and agricultural needs, while drinking water remains the most essential and the highest priority issue.[1]

Jordan – in the eastern Mediterranean – has an area of about 90,000 km^2 and a semi-arid to arid climate, where temperature ranges from -3°C to 45°C. More than 70 per cent is covered by desert (figure 21.1). Precipitation ranges from less than 50 mm in the Badia to about 650 mm in the Highlands, but only about four per cent of Jordan receives more than 300 mm of rain.

The annual per capita water availability has declined from 3600 m^3/year in 1946 to 145 m^3/year in 2007. Jordan's population has significantly increased during the past five decades, and reached 5.6 millions in 2004 (national census of 2004) compared with less than 0.5 million in the 1940's. The population is expected to grow to over 7.8 million by 2022, where the projected WATER demand is estimated to be 1,673 MCM (Jordan 2009). However, the population growth has greatly been affected by the in-flow of immigrants, refugees, and returnees due to the conflicts in the region (in 1948, 1967, 1991, and in 2003).

Although the Kingdom of Jordan takes its name from the biblical Jordan River, the name hardly reflects the reality of the water situation. Its scarce water resources are the major constraint for development. At present, the per capita water availability puts Jordanians in an absolute water scarcity level; in fact, Jordan is rated the fourth driest country in the world. Jordan's water resources available for use were estimated at 867 MCM in 2007, while the demand reached 1505 MCM; thus, posing a deficit of 638 MCM reflecting a severe challenge for the development and human security. Therefore, the water strategy included measures for resource exploitations and efficient management to counteract the increasing deficit. According to the water strategy the resources are to be developed to 1,632 MCM by 2022. Among the actions are implementing the major water resources exploitation projects like the Red Sea to Dead Sea Project, Dissi Water Conveyance Projects, and the development of reclaimed water (or treated wastewater) as an additional resource that is estimated at 91 MCM in 2007 and will develop to around 247 MCM by 2022 (Jordan 2009).

From the above introduction, it is evident that water availability will be a prevailing problem unless a super cooperative solution is adopted to meet the challenges. Water scarcity in Jordan poses not only a challenge to the development process, but it may also interfere with the quality of life and health status of the people.

1 His Majesty King Abdullah II's introduction on water; at: <http://www.mwi.gov.jo/>.

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_21, © Springer-Verlag Berlin Heidelberg 2011

Figure 21.1: Map of Jordan. **Source:** University of Texas at Austin, Perry-Castañeda Library Map Collection; at: <http://www.lib.utexas.edu/maps/middle_east_and_asia/jordan_rel_2004.jpg>. This map is in the public domain.

21.2 Interpreting Water Degradation as a Human Security Challenge

According to The Universal Declaration of Human Rights,[2] human rights include "the right in a standard of living adequate for the health and well-being of the person and of his family." Although the right to safe water and environment is not mentioned explicitly, however, the authors would interpret that "the standard of living adequate for the health and well-being" implies having safe water in quality and quantity. At present many nations including Jordan are facing water degradation challenges; water demands are increasing, groundwater levels are dropping, surface-water supplies are increasingly contaminated, and delivery and treatment infrastructures are ageing. For Jordan, this is clearly reflected in the water poverty situation where every Jordanian has only 145 m^3 of water per year. For a water-poor country the matter is not only in quantity but also in quality, and the risks would propagate as the quality of available scarce wa-

2 See: <http://www.un.org/en/documents/udhr/index.shtml#a25>.

ter resources deteriorate due to overexploitation of the resource or to the pollution load caused by urban development.

This poses eventually a human security challenge of complex nature where the people have the right of good living including safe water and food, while these resources are not available on one hand and the chain propagates to cause health risks and compromised quality of life. It can also be argued that water security encompasses this inherent duality: without it there is no development, but with it the most vulnerable can leave poverty behind. Thus, water availability is a necessity to reduce poverty which is a prominent human security issue. The challenge would include that poor communities may not have only safe water to drink and safe water for their good hygiene but also sufficient water to operate their production activities, including food production. Thus, a poor society may become poorer and new poor societies may evolve. Here, poverty is interpreted as being poor in income, health, water, and quality of life. Improving water security of poor people will help to eradicate poverty and support sustainable development in direct and material ways.

In his advocacy towards better life for future generations and recognizing water security as part of human security, HRH Prince El Hassan bin Talal has repeatedly called for the need to work and think on the supra and intranational level and independently to be able to address our common problems of scarce resources and thus saving our regional identities. The issue of water and the availability of resources are not limited to a certain identity or country, as HRH said

> if you respect my identity, I respect your identity and we have mutual respect in the context of *Territoriality Identity and Migration* (Movement) (TIM), then we could work towards a carrying capacity for demography in relation to human, natural and economic resources.[3]

It is therefore clear that the security issue of water is not to be addressed solely on a national level; it must become an object of a dialogue at multinational levels as, for example, a drought will not differentiate between one nation and another. During the 21st century, the human drama caused by climate change will evolve globally. Threatening reversals in development gains and blocking further achievements, climate risks will continue to impede opportunities that vulnerable populations can benefit from economic growth. As a direct consequence, inequalities in water access will further intensify as water stocks deplete – in combination with other changes, citizens in the region will directly enter an era of scarcity (UNDP 2006).

Given the wide-ranging importance and influence of these changing contexts, water security requires cooperation among nations to address climate change impacts and associated water and health issues and thus human security. "Ironically, climate change offers humanity an opportunity for a quantum leap in sustainable development and peacemaking."[4]

In the following sections, the authors outline key issues related to water degradation and associated health impacts as a challenge for human security. This analysis is supported by case studies and examples from the field that capture on-the-ground realities, successes, and lessons learned. These actions are also shared to contribute to safeguarding the health of Jordanians and possibly as lessons learned for other nations facing scarce water resources.

21.3 Health Impacts Due to a Low Water Share per Capita

Water consumption varies greatly among regions due to differences in economic development. A total of 284 MCM/year are presently used in Jordan to satisfy domestic uses. Calculating the per capita domestic water use in Jordan shows that it averages around 85 l per capita per day (l/c/d). Compared to the domestic uses in Europe of 150–250 l/c/d., to those of Israel of 280–300 l/c/d., to the Gulf States of 280–450 l/c/d., and to Iraq, Syria and Egypt of 130 l/c/d, Jordanians are using the least of all, not only because they are rationing water use, but also because water is much less available. Concerning domestic water use, especially during summer, 85 per cent of Jordanians live at the hygienic brink. Less water would imply public health detriments.

Water quantity and quality are key elements for good health. Despite the *World Health Organization* (WHO) standards relating to water quantity, the WHO has not previously published specific guidance on the quantities of water as targets for health protection and promotion (Howard/Bartram 2003).[5] This conflicts with the concerted efforts on establishing in-

3 Opening keynote address by HRH Prince El Hassan bin Talal at the 2nd annual CAUX FORUM for Human Security, Geneva, July 2009).

4 HRH Prince El Hassan bin Talal at the 2nd annual CAUX FORUM for Human Security, Geneva, July 2009.

ternational standards and later guidelines for drinking water quality (WHO 1985; WHO 1993). The WHO estimates that nearly two billion people consume contaminated water, experiencing a significant risk of developing water-related diseases. According to Bradley (1977), there are four major categories of water-related diseases; water-borne diseases (diarrhoeal diseases, infectious hepatitis, typhoid), water-washed diseases (diarrhoeal diseases, eye diseases, skin diseases), water-based diseases (schistosomiasis, dracunculiasis, other helminthes), and water-related diseases 'vector-borne diseases' (malaria, dengue, filariasis, onchocerciasis, trypanosomiasis, yellow fever, etc.). Some suggest that water-washed diseases should be restricted only to skin and eye infections that solely relate to the quantity of water used for hygiene (e.g. Cairncross/Feachem 1993). However, Howard and Bartram (2003) recognized the particular value of Bradley's original classification as its focus is on the potential impact of different interventions.

Studies concluded that an increase in water consumption (quantity) is as important as or more important than water quality for the prevention of diarrhoea (van der Hoek/Feenstar/Konradsen 2002; Kirchhoff/McLelland/Pinho 1985). There are several studies that indirectly discuss water quantity and diarrhoeal incidence using the type of service level and geographical and temporal access to water sources (e.g. Gorter/Sandiford/Smith/Pauw 1991; Prost/Negrel 1989). Yet, there are few published studies that directly address water quantity in relation to the prevention of diarrhoea.

Those published attributed lower diarrhoeal incidence realized through consumption of larger quantities of water to personal hygiene activities. Washing hands particularly after defecation and before eating and cooking are effective timings to prevent diarrhoea (Curtis/Cairncross/Yonli 2000; Birmingham/Lee/Ntakibirora/Bizimana/Deming 1997; Stanton/Clemens 1987). Yet, hygiene education is of limited value unless water supplies are improved and larger quantities of water are readily available (Gilman/Marquis/Ventura/Campos/Spira/Diaz 1993).

Hepatitis, a broad term for inflammation of the liver, has a number of infectious and non-infectious causes. Two of the viruses that cause hepatitis (hepatitis A and E) can be transmitted through water and food; hygiene is therefore important in their control. Both hepatitis A and E are found worldwide. Hepatitis A is particularly frequent in countries with poor sanitary and hygienic conditions (in Africa, Asia, and Central and South America). Countries with economies in transition and some regions of industrialized countries where sanitary conditions are sub-standard are also highly affected, e.g. in Southern and Eastern Europe and in some parts of the Middle East.

The vulnerability and adaptation team of the *Second National Communication* (SNC) on climate change conducted an epidemiological study to assess the health status in Jordan. Monthly data on water-borne diseases 'hepatitis A, typhoid fever and diarrhoea' and vector-borne diseases such as 'cutaneous leishmaniasis' were obtained from the Directorate of Communicable Diseases of the Jordanian *Ministry of Health* (MoH). The vulnerability assessment was designed as an ecological study, where the unit of observation is the population or a community. The disease rates and exposures are measured in populations to identify correlations between them (Jordan 2009a). The annual diseases incidental rate between 1996 and 2007 (table 21.1) shows that the *incidence rate* (IR) has significantly been reduced for hepatitis A and typhoid fever, while it is still very high for diarrhoea that results from gastroenteritis caused by viral infections, parasites or bacterial toxins (Wilson 2005).

Although the data are not explicit enough to relate the diseases to its cause, but water-borne diseases are being considered as a major root cause. Many cases of hepatitis A outbreaks in small towns were attributed to a lack of hygiene; however, such a disease should rather be classified as a water shortage disease in communities that lack sufficient quantities of water for their basic daily use.

21.4 Risk of Microbial Diseases due to Reclaimed Water Reuse

Reuse of reclaimed water is a necessary component of water resources management in Jordan where the supply of water is very limited and the demand is rapidly increasing (Carr/Blumenthal/Mara 2004). Yet, water recycling presents some risks for public health and the environment, and it is perceived negatively in the public eye.

Worldwide, it is estimated that (18 per cent) of cropland is irrigated, producing about (40 per cent)

5 In 2000, WHO and UNICEF proposed 20 l/c/d as a part definition of 'access to improved water supply' in their recent joint work *Global Water Supply and Sanitation Assessment 2000*. However, it does not refer to ensuring health protection and/or promotion such as less diarrhoeal incidence (WHO/UNICEF 2000).

Table 21.1: Selected diseases in Jordan (1996-2007). **Source:** Jordan (2009a).

Years	Population	Typhoid and para typhoid		Hepatitis A		Cut. leishmaniasis		Diarrhoea	
		Number	IR*	Number	IR*	Number	IR*	Number	IR*
1996	4,444,000	141	3	1,486	33	18	0	120,559	2713
1997	4,600,000	109	2	1,612	35	53	1	109,555	2382
1998	4,755,750	97	2	1,083	23	113	2	100,957	2123
1999	4,900,000	96	2	969	20	16	0	106,114	2166
2000	5,039,000	46	1	947	19	5	0	102,768	2039
2001	5,182,000	69	1	754	15	86	2	105,433	2035
2002	5,329,000	44	1	506	9	19	0	110,864	2080
2003	5,480,000	32	1	552	10	7	0	103,737	1893
2004	5,350,000	155	3	342	6	192	4	104,434	1952
2005	5,485,000	78	1	266	5	162	3	106,164	1936
2006	5,600,000	21	0	482	9	181	3	133,200	2379
2007	5,723,000	16	0	387	7	354	6	141,210	2467

* IR: Incidence Rate = (no. of cases per 100,000 persons),

of all food (Gleick 2000). A significant portion of irrigation water is wastewater. Hussain, Raschid, Hanjra, Marikar and van der Hoek (2001) report on estimates that at least (20) million hectares in (50) countries are irrigated with raw or partially treated wastewater. In many developing countries, wastewater used for irrigation is often inadequately treated. WHO and UNICEF (2000) estimates the median percentage of wastewater treated by effective treatment plants to be 35 per cent in Asia, 14 per cent in Latin America, 90 per cent in North America, and 66 per cent in Europe. The use of untreated wastewater in agriculture implies a high actual risk of transmitting intestinal nematodes and bacterial infections. Moreover, the quantitative microbial risk analysis has suggested that low levels of virus in irrigation water can result in a significant risk of infection to consumers (Petterson/Teunis/ Ashbolt 2001). Stine, Song, Choi and Gerba (2005) estimated that less than one hepatitis A virus per 10 l of irrigation water could result in a risk exceeding 1: 10,000 per year considering the efficiency of the transfer of the virus to crops and its survival until harvest time. The 1: 10,000 risk of infection per year is currently the acceptable level used by the United States Environmental Protection Agency (Regli/Rose/Haas/Gerba 1991).

In Jordan, wastewater has been used for irrigation for several decades. Some treated effluent has been used directly on restricted crops of relatively low value, but the main practice has been to discharge effluent to the environment where it mixes with freshwater flows before being used downstream. In 2001 more than (70 MCM) of reclaimed water was used either directly or indirectly in Jordan (McCornick 2001). In 2009 this amount exceeded 91 MCM/year and this amount is projected to grow to around 250 MCM by 2022. The categories of use have been: a) planned direct use within or adjacent to *wastewater treatment plants* (WWTPs). Several sites are pilot projects with some research and limited commercial viability, b) indirect use after mixing with natural surface water supplies and freshwater supplies downstream, primarily in the Jordan Valley (treated effluent from As-Samra WWTPs is discharged to Wadi Zarqa, the wadi flows into the King Tala Reservoir). Water in the reservoir, blended with water from the King Abdullah Canal, is used for irrigation in the southern portion of the Jordan Valley. However, health aspects and risks related to this reuse have not yet been investigated within a coherent framework of procedures and activities, including the integration of various components of technical, social, economical, environ-

mental, institutional, and public participation requirements.

Demand for public water supplies had recently increased since access to safe drinking water supplies has been impressively reaching over 96 per cent of the population. Accordingly, wastewater generation increased that led to the deterioration of reclaimed water quality coming out of sewage treatment plants due to the increasing hydraulic and organic loads that far exceed design criteria. The most recent strategy has counteracted again this problem by adopting a goal to planning for more efficient treatment systems, and even expanding the reuse of wastewater in an efficient and economical way.

Grey water[6] treatment and reuse has become increasingly popular in water scarce and even in water rich countries. In fact, grey water application is complicated not only due to technical feasibility but also due to human issues. A major argument has been the public perception of water reuse and the risk associated with it, which ultimately dictate the standards required for water quality, and so the appropriateness of candidate treatment technologies. A holistic approach to water recycling is thus crucial, and the efficacy of individual treatment technologies or overall treatment schemes must be precisely evaluated (Jefferson/Palmer/Jeffrey/Stuetz/Judd 2004).

The rationale for treating grey water is based on the biological characterization of grey water. It has been documented that grey water may contain at least 10^5 MPN/100 ml of potentially pathogenic micro-organisms (Dixon/Buttler/Fewkes 1997). Based on the repeatedly high counts found on faecal indicator bacteria, regulatory agencies enforced combined treatment, or strict separate treatment of the grey water when it was separated.

Interest in adopting innovative, non-conventional grey water management strategies is rapidly increasing worldwide for economical, structural, and ecological considerations (Asano/Levine 1996; Gunther 2000). Domestic and industrial water is given a higher allocation priority than irrigation water. However, the agricultural sector is faced with the challenge to produce more food with less water (Al-Jayyousi 1999). Therefore, attention has been paid to the possibility of reusing grey water, especially in arid areas (Trujillo/Hanson/Zachritz/Chacey 1998; Casanova/Gerba/Karpiscak 2001). This should be supported by a suitable health system to control such a practice.

As part of the health control of grey water reuse, an overview of the health aspects of grey water reuse was published in 2004 by the WHO in Arabic that reviewed all health issues and regulations in the world for grey water treatment and reuse. This overview included guidelines for grey water reuse in East Mediterranean countries. This overview was approved and certified in a workshop at the WHO Regional *Centre for Environmental Health Activities* (CEHA) in Amman, 20–22 October 2003.

Based on the new WHO guidelines (2006), a research project is carried out at the *Environmental Research Centre* (ERC) of the Jordanian *Royal Scientific Society* (RSS) that investigates the optimal modalities for application in practice of the new WHO guidelines on the safe use of grey water in agriculture in the context of poor urban communities. The project evaluates the current status of the use of grey water in agriculture, and describes associated health issues at the 'Jerash Refugee Camp' (box 21.1, case study on water safety). So far the study revealed as the cause of diarrhoea the exposure to polluted grey water, the risk assessment posed a lack of hygiene to be the transfer route; hence awareness campaigns were lunched to educate the community on the risks and to improve the level of hygiene. This would not be sustainable if the supply of adequate quantity and quality of water were not assured.

21.5 Risk of Groundwater Pollution Due to Human Activities

Despite its importance, groundwater is often misused, usually poorly understood and rarely well managed. The main threats to groundwater sustainability arise from the steady increase in demand for water (from rising population and per capita use, increasing need for irrigation, etc.) and from the increasing use and disposal of chemicals or biological material to the land surface where it can ultimately reach and pollute groundwater.[7] In most cases, contamination of groundwater by chemicals derived from urban and in-

6 Grey water is untreated domestic wastewater originating from bathtubs, showers, kitchen activities and laundry facilities. It does not include toilet waste.

7 It is noted that pollution of a body of water occurs when an impurity (micro-organism or chemical) is introduced by or as a result of human activities, creating an actual or potential danger to human health or the environment when present at high concentrations (Morris/Lawrence/Chilton/Adams/Calow/Klinck 2003).

Box 21.1: Safe use of grey water for agriculture in the Jerash Refugee Camp focusing on technical, institutional and managerial aspects of non-treatment options. **Source:** The authors.

The Jerash refugee was set up as an 'emergency' camp in 1968 for 11,500 Palestinian refugees and displaced persons who left the Gaza Strip as a result of the 1967 Arab-Israeli war. The selection of the site is based on specific criteria that focus on poor vulnerable urban areas that exhibit grey water separation and reuse for agriculture without any treatment and the relatively high presence of indicators of adverse water-related health issues.

The camp is provided with basic infrastructure of electricity, water supply and basic sanitation services (latrines) from which black water is disposed to cesspools. The camp contains (2050) housing units, which are all provided with water tabs and 1560 of them are provided with latrines from which the wastewater is disposed to cesspools or septic tanks. Grey water is separated at the houses and discharged through small open ditches and collected in ten collection points all over the camp. Water then flows in a natural channel that crosses several farms. Along the open channel, a series of more than four earth ponds were excavated just besides the channel to collect and store water for irrigation. Pumps are placed in the ponds and they are being used to distribute the stored grey water to farms on both sides of the channel. Farmers use grey water in these farms as a supplementary water to irrigate trees, and vegetable fields between tree strips with olive and almond trees as well as vine. Eggplant, okra and beans are also being planted in the areas between olive trees. It is observed that the trees are very close to the grey water channel and in many places the distance between the trees and the grey water is about one metre, which means that during harvest time the farmers will work very closely to the polluted water and the fruit themselves would be dropped and collected very near to the source of pollution.

Health records from the *United Nations Relief and Works Agency for Palestine Refugees in the Near East* (UNRWA) health centres reveal that the Bloody Diarrhoea (waterborne disease) weekly records at Jerash refugee camp are high compared with records of another refugee camp in the same Governorate. The limited area of the Jerash camp makes the construction of a treatment plant in the camp very difficult. At the same time, the environment and public situation in the camp urges the adoption of non-treatment approaches that aim at managing health risks associated with grey water and promoting health protection measures.

In this study, the target groups were the farmers (in the farms close to the refugee camp) and the households (in the refugee camp itself). The camp became an object of an environmental health risk assessment and management approach with a focus on grey water management. Current pollution sources including grey water and wastewater were mapped. Hazards which result from direct or indirect exposure to grey water were characterized through structured interviews and observations. Data on environmental exposure, epidemiological conditions, and hygiene behaviour were used to construct the Epi Info. to assess the risks in the camp and nearby farms. The survey proved the significant relation between the hygiene behaviour of the children in the camp and the incidence of diarrhoea (the main health problem in the camp, figure 21.2). The safety of the public water network was confirmed. As a result, the health-oriented behaviour and personal hygiene for the targeted groups were promoted by developing personal skills through awareness campaigns, training, and other means. The output of the study enhanced hygiene education and health-oriented behaviour among school students and housewives.

Figure 21.2: The exposure of children to grey water in the Jerash camp**. Source:** RSS (2007).

dustrial activities, modern agricultural practices, and from waste disposal takes place almost imperceptibly. The slow movement of water from the surface through the unsaturated zone to deep aquifers means that it may be many years after a persistent chemical has entered the ground before it affects the quality of groundwater supplies (Morris/Lawrence/Chilton/Adams/Calow/Klinck 2003).

Biological contamination may, however, indicate a faster track than chemical pollution. As many human activities generate a significant microbiological contaminant load at the land surface (for example, irrigation by wastewater, intensive livestock raising and

meat processing, on-site sanitation), when detected in the groundwater, they indicate relatively rapid movement to the water-table from ground surface. This is because most pathogenic micro-organisms have only limited persistence; however, some viruses are known to survive for up to 150 days and encysted protozoa even longer. In the case of indicator bacteria (microbes commonly associated with pathogens but more easily incubated and identified), a half-life in low-temperature groundwater can be as high as 22 days, with a survival of appreciable numbers up to 32 days (Morris/Lawrence/Chilton/Adams/Calow/Klinck 2003).

Serious incidents of groundwater pollution have occurred due to accidental spills, or unsatisfactory disposal of industrial chemicals. In addition, solid and liquid waste generated by modern society is often spread over the land surface without control. In such a case moisture from the waste and rainwater form leachate that may percolate down through the underlying soil. Depending on the type of waste, the leachate may be highly acid, have a large organic load or contain a high concentration of ammonia, toxic metals or various organic compounds, all of which may contaminate underlying groundwater.

Typical examples of the effect of a rather persistent microbial pollution of groundwater are the outbreaks of cryptosporidiosis. These have been documented in countries around the world; over 45 outbreaks have been reported with the greatest documentation in the USA and in the UK (Smith/Cacciò/Tait/McLauchlin/Thompson 2006); a significant number of these outbreaks was directly associated with contaminated groundwater (wells and springs not properly protected from sewage and runoff). Water-borne cryptosporidiosis presents a serious threat to human health due to the ubiquitous distribution of cryptosporidium spp. in humans, animals, and water and the resistance of the oocysts to harsh environmental conditions, various disinfectants, and some treatment practices.

In Jordan some 10,000 people experienced such an outbreak in July 2007 (noting that previous outbreaks may have been happening but could not then be identified), when precious groundwater wells (even at depths of 150–290 m) were subjected to microbial pollution due to compromised solid waste disposal practices, including household and livestock wastes (Hayek/Al-Hmoud/Al-Kilani 2007, Hayek/Al-Hmoud/Al-Kilani/As-Sayyah 2008). The transfer of pollutants was enhanced by the coinciding heavy rainfall causing flooding every ten years or so. The outbreak started with a large increase of gastroenteritis cases in a community in northern Jordan (Munshiyat Bani Hassan, Al Munshiyat) were reported and led to an investigation of the water supply. The outbreak was investigated, taking into consideration the prevailing symptoms of the patients (which matched the symptoms of cryptosporidiosis) and some key environmental conditions. The investigation then focused on testing for cryptosporidium in the water supply; this is in addition to the classical microbial surveillance. Moreover, the geophysical data (including the existence of faults, groundwater level, and the activities around the wells) of the area were studied. The results proved the presence of cryptosporidium spp. oocysts with other faecal pollutants in groundwater wells used for consumption. The cause was related to the existence of livestock farms (dairy cows and calf raising), permeable cesspools, a dump site, grazing and uncontrolled handling of cows manure within the wells' catchment area, where also many geological faults exist. As a consequence, efficient reclaiming procedures and further water supply treatment and groundwater monitoring activities were recommended (box 21.2) for more details on the case study. The study presented a clear example of how the geophysical and human data should adequately be taken into account in striving for sustainable resources management!

Box 21.2: Case study on the outbreak of cryptosporidium in Northern Jordan. **Source:** Prepared by the authors.

An outbreak of cryptosporidiosis among the residents of Munshiyat Bani Hassan (Al-Munshiyat community in the North of Jordan) occurred in the mid summer of 2007 that affected more than 1,000 confirmed cases. Initially, the cause of the outbreak was unclear. The management team launched several investigations of the affected people, the way the infection was spreading, the microbiology of the illness and all possible causes. The study investigated the site, surveyed residents with cases of water diarrhoea and gathered data from the Al Munshiyat Health Centre. Then, samples of the tanks and wells were examined during the outbreak for cryptosporidium oocysts, and a risk analysis was undertaken for a safer approach to identify the safe wells. Based on this study, measures to avoid and minimize future risks from such incidents were proposed.

The investigations concluded that the outbreak was water-borne and linked to the main water supply of the Al-Za'atari tank. The initial analysis of the water quality in the town showed that the water supplied to the network

when the investigation started had a sufficient chlorine level. But the number of cases rose to 600 when the investigation was launched. The clinical analysis of the cases included Watery diarrhoea, abdominal cramps, fever, and vomiting, which are the symptoms of cryptosporidiosis, which do not show until five to ten days after becoming infected. Cryptosporidiosis is a diarrhoeal illness caused by a parasite called cryptosporidium, which is a major public health threat because of its insensitivity to disinfection and the increased likelihood that infected oocysts are present in conventionally treated (coagulation, sedimentation, filtration, disinfection) drinking water. Therefore, The authors assumed that the presence of cryptosporidium was the cause of this water-borne disease after food was ruled out as a direct cause. Most cryptosporidium outbreaks are the result of faecal accidents (contamination) coupled with oocyst resistance to chlorine.

Samples from house tanks of old water contained shigella and E. coli already prior to the outbreak. Water-borne outbreaks of the cryptosporidium infection were documented for drinking water from a contaminated artesian well. The authors immediately surveyed the 37 wells that fed the Al-Za'atari tank for microbial contamination in order to segregate contaminated wells from clean ones. Several wells showed positive results for faecal coliform and E. coli. In parallel, the hydrogeology of the area and the activities surrounding the wells were studied for possible sources of contamination of the wells. Based on these findings, a risk analysis matrix was made to identify the most likely clean wells to be connected to the water supply.

Water samples from 19 wells were tested for cryptosporidium. Eight wells were tested positive for cryptosporidium (figure 21.3), and giardia (figure 21.4) was detected in one well. The remaining wells tested negative for cryptosporidium and were therefore reconnected for water supply.

Environmental investigations were confirmed by microbiological tests, and a risk analysis identified the cryptosporidium oocysts that resulted in the outbreak in Al Munshiyat. Possible sources include cattle farms, cow waste, cesspools, and a dump site that are all located close to the wells and the geological faults (figure 21.5). It is possible that heavy rains and floods in April and in early May 2007 increased the groundwater recharge and thus carried some pollutants (e.g. cryptosporidium oocysts) from the surface to the groundwater. In 2005 in North-west Wales heavy rain was linked to outbreaks of cryptosporidiosis.

Further tests by the study team of the water quality of the Za'atari tank that was supplied by 13 reconnected wells proved negative for cryptosporidium. Thus, after the outbreak a periodic monitoring was recommended.

Figure 21.3: Cryptosporidium oocysts found in a well. **Source:** Photo by the authors.

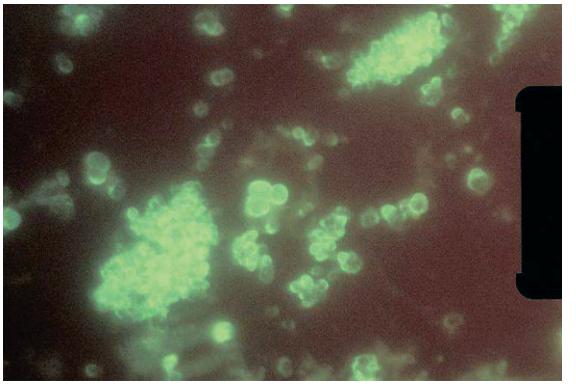
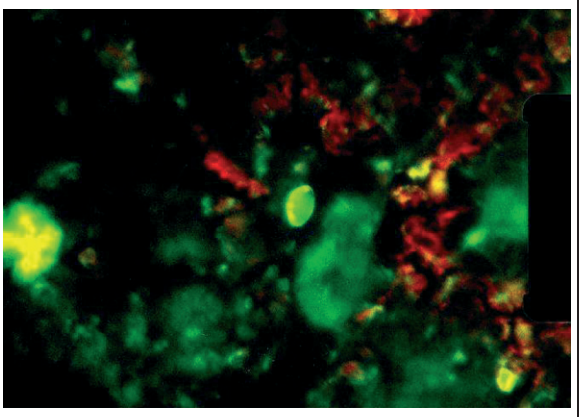


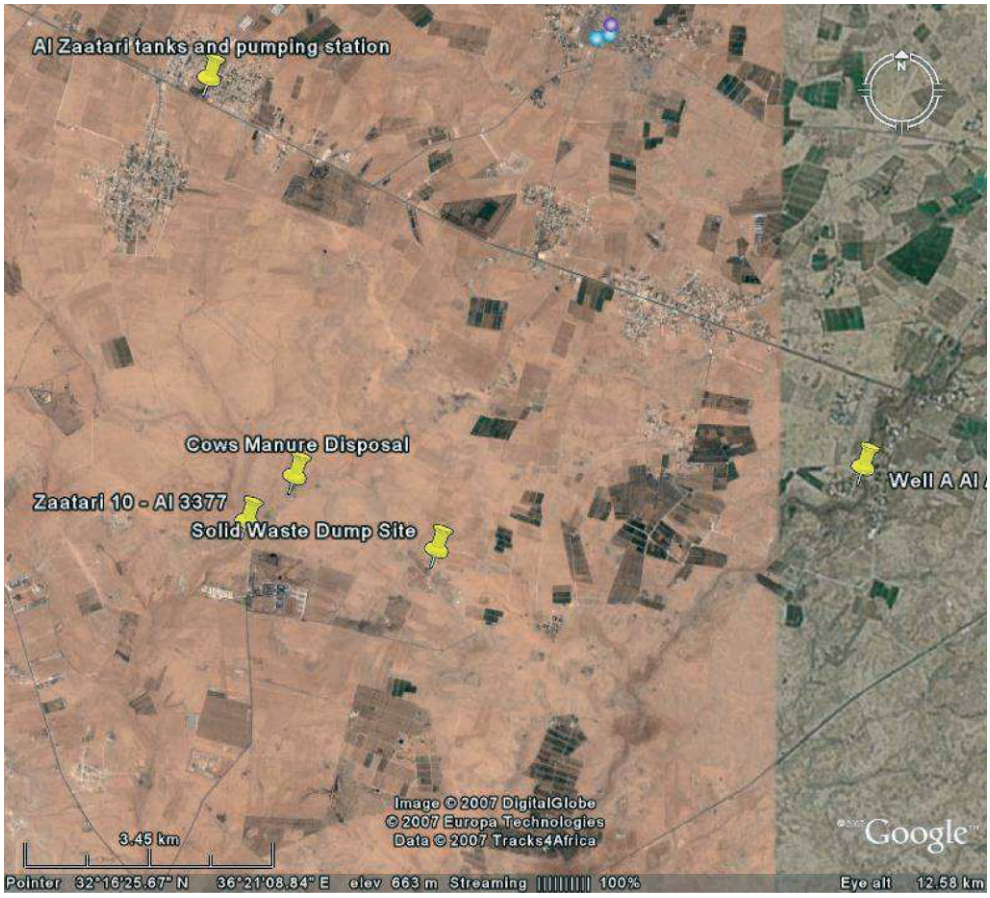
Figure 21.4: Giardia oocyst seen in a well. **Source:** Photo by the authors.



It is difficult to see how the outbreak could have been prevented, or its impact reduced, given what was known before it started and what became apparent when it spread. But if the drinking water and the wells had been adequately monitored, the problem could have been avoided much earlier. This requires an effective and frequent monitoring of the water resources including tests for microbes like shigella, cryptosporidium, and giardia. The best practice would be to test the combined water (of the Za'atari Tank) before it is supplied to consumers. This should be improved. It is essential to identify the quality of different wells and to detect any deterioration in the water quality before it spreads.

More than hundred people from different national institutions (Royal Scientific Society of Jordan, Ministry of Health, Ministry of Water and Irrigation and others) participated in this investigation for over a month. This was the largest and the first recorded water-borne outbreak of cryptosporidiosis in Jordan.

Figure 21.5: Illustration of existing activities around the wells of Za'atari. **Source:** Prepared by the authors.



This example illustrates how small communities experienced groundwater pollution. Despite water shortage there is a huge deficit in the protection of water resources. Although huge efforts are made to treat water and to monitor its quality; protecting the resource would be a better and more feasible option. In many areas water resources are subject to incidental pollution, for example by uncontrolled solid waste dump sites that may pose threats to surface and groundwater quality. Accidental disposal of chemicals may severely disrupt water resources (RSS 2009). Thus, a coherent solution of environmental issues is needed. A better approach is to think and act holistically as part of an integrated environmental resource approach.

21.6 Impacts of Climate Change

Human health and the environment are intimately interrelated. During past decades environmental quality has significantly declined in many geographical regions, increasing both the severity and complexity of numerous human health problems (Foster 1994). In the future environmental quality and human health will be greatly affected by climate change. A great deal of climate change research has focused on the potential and actual health impacts experienced by individuals, communities, regions, and nations (Martens/McMichael 2002; McMichael/Campbell-Lendrum/Corvalan/Ebi/Githeko/Scheraga/Woodward 2003). The health impacts of climate change will be influenced by interactions with other determinants of health, and by the coping and adaptation strategies adopted to reduce the health risks and threats (IPCC 2001c).

A myriad of physical impacts are associated with climate change. The physical impacts of environmental deterioration and climate change range from an increase of asthma due to air pollution, of diarrhoeal illness due to contaminated water, of vector- and rodent-borne diseases due to global warming and an

increased morbidity and death of the elderly due to heat stress. The physical and health impacts will be mediated by the social vulnerability and adaptive capacity of individuals (Erskine 2004).

The preliminary impacts of climate change have already been well documented in many parts of the world, and the remaining most threatening impacts are affecting the fragile economies and ecosystems of developing countries, including Jordan. The combined impact of climate change on the already exhausted water supply in Jordan has barely been studied. First steps were undertaken in Jordan's Second National Communication to the *United Nations Framework Convention on Climate Change* (UNFCC), which was coordinated by the *Ministry of Environment* (MoEnv) relying on the knowledge of about 40 Jordanian experts (Jordan 2009a). Although the document has not been officially endorsed yet, the main findings about the water sector's vulnerability to climate change provide a worrisome perspective.

In Jordan an increase of temperature is projected by no more than two degrees until 2050. In addition, a decline in rainfall has been projected by the models assessed by the *Intergovernmental Panel on Climate Change* (IPCC). The Jordanian study selected the Yarmouk and Zarqa basins for an analysis of the impact of climate change on water resources. The results indicate a significant change in spatial and temporal distribution of precipitation by about 20 per cent. However, the authors indicated that the inconsistency of historical data did not allow them to develop a comprehensive future scenario (Wardam 2009). It was estimated that an increase in temperature by 2 ºC would result in a higher demand for irrigation by 18 per cent, while a 10 per cent reduction in precipitation would increase the water demand for irrigation by about 5 per cent (Jordan 2009a). Considering these combined effects on the water supply, the competition for water is inevitable among the different sectors. Thus, agriculture will rely on low quality water what will eventually result in more challenges for soil and water management, i.e. in more biosafety risks and concerns.

Declining precipitation and resulting shortages will increase the probability of water-borne epidemics, such as cholera, dysentery, giardiasis, and bilharziasis. This may lead to a re-emergence of some diseases that were under control for a long time, such as malaria or the emergence of new diseases in Jordan, such as the West Nile virus fever, dengue fever or Rift Valley fever. Climatic variables have affected the seasonal pattern of respiratory and cardiovascular diseases and their mortality (Jordan 2009a).

In Jordan the actual disease burden that may be attributed to climate change is unknown. Environmental and health datasets are poorly matched and methods for analysing the relationships between them have not been applied locally. But it is very important to link available data to better understand the relationships between climate variables and actual health outcomes (Jordan 2009a). Not surprisingly, the recurrence of the peak of diarrhoea cases coincides with drought years (table 21.1). It is unknown how the projected climate change in the Middle East will impact on health.

21.7 Quest for Drought Tolerance: Risks of Genetically Modified Food

Water shortage is the most significant challenge that will confront the farmers in the Middle East in the coming decades. Drought tolerance is a feature of some crop plants, and for many years farmers and, more recently, plant breeders have taken advantage of these tolerant varieties in traditional breeding. Can biotechnology accelerate the development of urgently needed drought-tolerant crops? Biotechnology and gene technology are tools which may contribute to climate change solutions.

> Breakthroughs in molecular genetic mapping of the plant genome have led to the identification of bio-markers that are closely linked to known resistance genes, such that their isolation is clearly feasible in the future. Two forms of stress resistance especially relevant to climate change are linked to drought and temperature. A number of studies have demonstrated genetic modifications to major crop species (for example, corn and soybeans) that increased their water-deficit tolerance, although this may not extend to the wider range of crop plants. Similarly, there are possibilities for enhanced resistance to pests and diseases, salinity and waterlogging, or for opportunities such as change in flowering times or enhanced responses to elevated CO_2 (IPCC 2007a).

Although altering plants through genetic engineering has allowed for changes that traditional selective breeding could not achieve. However, the risks of introducing genetically engineered plants into the environment have not been fully characterized with regard to the ecosystem and human health. There is a growing concern that introducing foreign genes into food plants may have an unexpected and negative

impact on human health. Scientists warn that the consumption of GM foods in general might result in new allergies, resistance to antibiotics, inability for the body to absorb vitamins or minerals, and other health problems (Whitman 2000; WORC 2004).

In Jordan, the future use of *Genetically Modified Organisms* (GMOs) – their release into the environment, cultivation, importation and particularly, their utilization as food or foodstuff – should be regulated by setting up strict procedures. This is of great importance since the annual costs for imports of food and livestock have increased by 36 per cent from 2001 to 2005. With regard to food supply Jordan is a deficit country. It is expected that by the year 2010, and based on an annual growth rate of 3.3 per cent, the population of Jordan will exceed 7.1 million. Therefore, the number of GMOs ready for commercial release may expand considerably in the next few years. While the GMO applications are increasing in the near future, tools are needed to assess and implement international instruments and standards of governance which ensure health and environmental safety.

According to Jordan's Second National Communication to the UNFCCC (Jordan 2009), the agricultural sector will be most vulnerable to climate change based on studies on the impact on rainfed agriculture.[8] Both livestock and overall food production were identified as most affected due to its impact on rainfed cultivation and on the arid and semi-arid rangelands.

21.8 Discussion and Further Actions

Jordan's national water strategy (2008–2022) excluded the impact of climate change among the most pressing challenges facing its future water resources. However, the effect of climate change on water resources in Jordan is expected to be significant. Higher temperatures and lower precipitation are expected due to climate change. Significant changes in the spatial and temporal distribution of precipitation are projected due to climate change (Abdulla/Al-Omari 2008). Changes in rainfall patterns will further push rain-fed areas towards irrigated agriculture. This may cause many health effects, particularly in communities in or at the edge of deserts where water is scarce, highly polluted or salinated, and in communities where there are competing demands from households, agriculture, and other industrial sectors.

Given the natural water scarcity and the projected decline due to climate change, the dependence on reclaimed water (treated wastewater) for agriculture is growing in order to decrease the pressure on fresh water. Use of reclaimed water can increase crop yields because of supplemental irrigation and nutrients in the wastewater. However, farming communities using treated wastewater and the consumers of crops face an increase in water-borne diseases. Therefore, a proper system requiring health risk management programmes should be implemented. Such a system should cover all stages from the wastewater treatment facility to the reclaimed water transfer system, the use of this water by farmers to the consumer of their products. This system should be prepared not only for tests of major bacteria and chemicals but it should also include viral and protozoa tests. Thus the monitoring of water quality should be connected to disease surveillance and avoidance. Emergency response plans should be prepared and tested. The current system is still insufficient. The present monitoring focuses solely on major bacterial organisms and key chemical pollutants but it does not relate this knowledge to the public health, and the communication with users and farmers is still poor.

A quarter of Jordan's population, primarily living in lower income areas, use less than 50 l/c/d where repeated local outbreaks of water-borne diseases have occurred. Although in the past no proper records linked these cases to water, this does not mean that such cases did not occur. The first recorded outbreak occurred in 2007 that was reviewed above. The case study found that the waste management system is insufficient and should be upgraded to safeguard the water resources. The study showed how geophysical, environmental, and socio-economic data can help to address the problem and respond to it. As a result of this experience the preparedness of the national laboratories has been advanced. Some developed their capacity further to test for parasites, which is a rather delicate test. This gave the national laboratories, such as the ERC, confidence in meeting such challenges in the future. A case of water pollution in 1998 due to a deterioration of water quality from the presence of algae and nematodes in parts of Amman was a major incident that did not cause major health effects. Transparency and an early rapid response was a key factor for the successful management of that outbreak.

8 The investigation was done using a *Decision Support System for Agrotechnology Transfer* (DSSAT) model on two main crops, wheat and barley (Jordan 2009a).

Regarding water quality, the improvement of water supply must remain a top priority due to foreseen stresses on water resources. Jordan has witnessed some deterioration of its water quality during the last two decades due to industrial pollution, overuse of agrochemicals, drainage water, overloading of wastewater treatment plants, over-pumping of aquifers, seepage from landfills and septic tanks, and improper disposal of dangerous chemicals by certain industries. Thus, the water supply treatment system has to be upgraded to include *ultraviolet* (UV) treatment rather than chlorination, as it is commonly practised. The UV treatment will ensure an elimination of organisms resistant to chlorine such as cryptosporidium. The other concern is to ensure the non-existence of viruses. This is also an issue to be included in the water monitoring activities in addition to parasites. An adequate water quality early warning system for Jordan is needed. At present, a system covering 13 stations is operated by the RSS in cooperation with the Higher Council for Science & Technology.[9] The system covers water quality flowing from neighbouring countries (Syria and Israel) in addition to certain points downstream along the King Abdulah Canal as well as the King Talal Reservoir. These major water bodies are of concern as the water there is used for agriculture and some for drinking after treatment. The warning system should be expanded to include all water supply points from wells to surface water or desalinated brackish water.

The above preparations include adaptation measures to climate change referred to in Jordan's second National Communication to the UNFCCC that includes a wider list of measures, in addition to those above that addressed the impacts on agriculture and health. A new programme funded by the Spanish government links five ministries and four UN agencies in implementing a programme on: "Adaptation to Climate Change to Sustain Jordan's Millennium Development Goal Achievements." This programme will focus on the water sector to sustain access to improved water supply despite increased water scarcity due to climate change, and to enhance the adaptive capacity for health protection and food security to climate change under conditions of water scarcity. This programme will be the first integrated effort in Jordan to incorporate climate change adaptation in natural resource management and it is expected to set the standards and norms for future action.

The recent development in biotechnology may provide a significant potential for producing food from drought tolerant seeds and seedlings. However, in order to keep track of any negative effects of this technology, it is necessary to establish a system for monitoring probable side effects in the long-run. It is also vital to regulate the applications and use of *genetically modified products* (GMP). Developing countries like Jordan should establish their standards as to which GMP may enter the market, may be planted, and how they are to be administered. The present national regulations do not yet adequately account for GMP. At present it is unknown how many GMPs enter Jordan. This deserves full attention given the anticipated stresses from droughts and future water stresses (chap. 62 by Oswald Spring).

The challenges from water degradation and the associated human security issues should be addressed on a regional and international level. This case should be based on a fair distribution and allocation of resources reflecting considerations of equity.

9 See: <www.emarcu.gov.jo>.

22 Water Scarcity and Degradation in Palestine as Challenges, Vulnerabilities, and Risks for Environmental Security

Marwan Haddad

22.1 Introduction

Historic Palestine consists of Israel, the West Bank, and Gaza Strip. Palestine or the *Occupied Palestinian Territory* (OPT) as presented in this paper consists of the West Bank including East Jerusalem and the Gaza Strip. The OPT equals 23 per cent of the land of historic Palestine. The West Bank and the Gaza Strip are those parts of historic Palestine which were occupied by the Israeli army during the 1967 war between Israel and Egypt, Syria, and Jordan. The land area of the West Bank is estimated at 5,572 km^2 extending for about 155 km in length and about 60 km in width. The Gaza Strip, with an area of 367 km^2 extending for approximately 41 kilometres in length and approximately 7 to 9 kilometres in width (figure 22.1; Abdel Salam 1990; Haddad 1998).

Water resources in the OPT are relatively limited due to the country's hydrological, geographical and geological, and demographic conditions and factors. Average annual rainfall over historic Palestine was estimated at 409 mm. The estimated average annual groundwater recharge in Palestine is 698 to 708 mcm/yr (648 mcm/yr in the West Bank and 50–60 mcm/yr in the Gaza Strip). The only surface water source in the West Bank is the Jordan River and its tributaries. In the Johnston plan, the Palestinian share in the Jordan River of 257 mcm/yr was considered as part of the Jordanian share of 774 mcm/yr as the West Bank was then under Jordanian rule. Since 1967 and until the present, Palestinians were prohibited by the Israeli army from using the Jordan River water, and their lands and farms located along the western side of the river were confiscated and the area declared as a restricted security zone (Haddad 1993).

The *Millennium Project* (ACUNU 2007) defines environmental security as environmental viability for life support, with three sub-elements: preventing or repairing military damage to the environment, preventing or responding to environmentally caused conflicts, and protecting the environment due to its inherent moral value.

Environmental safety and/or security caused either by natural or man-made purposeful water-related risks, is an essential component of the quality of life (livelihoods and health). Man-made purposeful risks are generally subject to and influenced by government/authority regulation/control. In the case of the OPT this authority is the Israeli military (fully controlling 97 per cent of the land and its resources, and partially the rest) with a few exceptions here and there where the Palestinian authority takes responsibility.

Israeli Military Order No. 2 of 7 June 1967 stated that all water resources in the newly OPT were to be state-owned by Israel. Three subsequent Military Orders in 1967 and 1968 granted full control to the military authority designated: an officer to be appointed by the Israeli military commander for implementation of the orders, the establishment of a permit system for the drilling of new wells, fixed pumping quotas, and the declaration of all prior settlements of water disputes to be invalid. The Israeli water companies, Mekorot and Tahal, were given an important role in planning, implementing, and operating water projects in the territories under occupation. With few exceptions, Palestinian institutions were only responsible for the delivery of water and the disposal of sewage (UNEP 2003).

Current forced water shortage can be reflected in Palestine's total per capita water use of 82 m^3/person/yr, which is among the lowest in the world. In comparison, the Israeli water use is about 350 m^3/person/yr. If Palestinians would acquire their water rights in 2010, the available water would be about 275 m^3/person/yr, what is the lowest in the southern Mediterranean region (WWF 2003), and still very low compared to regional and world figures (Tropp/Jägerskog 2006).

On 26 April 1995, the *Palestinian Water Authority* (PWA) was established. The PWA is the official body

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Figure 22.1: General location Map. **Source**: Amnesty International 2009.

that regulates and is responsible for overall water resources in the West Bank and Gaza Strip. Unfortunately, the PWA and according to Oslo II agreement (Oslo II 1995) cannot implement any single developmental act related to Palestinian water resources before getting the permission of the Israeli military

authorities through the so-called *Joint Water Committee* (JWC).

The 1995 Oslo II interim agreement has physically fragmented the West Bank into three areas: A (3 per cent of the total area of the West Bank), B (24 per cent), and C (73 per cent), with different security and administrative arrangements and authorities. The physical fragmentation of the land under Palestinian control and the stringent closure policies on the movement of goods and people in the OPT by Israel have negatively impacted the lives and national development of the Palestinian population (UNEP 2003).

For example, it was estimated that 46 per cent of the Palestinian population are either vulnerable to food insecurity (12 per cent) or totally insecure (34 per cent; see WFP/FAO 2007). Another example, there is a noticeable urbanization of the Palestinian population: the percentage of rural population in the West Bank was 54 per cent in 1995 and 31 per cent in 2007 (PCBS 2008).

Isaac and Ghanyem (2001) attribute the depletion of water resources, continued desertification, deforestation and the uprooting of trees, and general pollution within the West Bank as a direct outcome of Israeli government policies aimed at ensuring physical security over the land.

Due to the specificity of the OPT, water scarcity and degradation as challenges for environmental security are not self-limiting factors but an integral part of the overall Palestinian societal development. Therefore, the discussion in this chapter cannot solely be based on natural, technical, and technological causes of environmental insecurity, but must also include political, legal, human, and socio-economic security aspects and threats.

The main objective of this chapter is twofold: (1) to identify the environmental threats associated with water scarcity and degradation in the OPT, and (2) to test the hypothesis of whether these threats cause loss, harm, and damage to the Palestinian people and their environment leading to environmental insecurity.

22.2 Background

22.2.1 Historic Backdrop

At the end of the 19th century, historic Palestine was almost 100 per cent inhibited by Palestinian Arabs and there were no Jewish immigrants in Palestine (Haddad 2007). In 1873, the Royal Scientific Society of Great Britain sent a delegation to Palestine to investigate two issues; the first was the available water resources and the second was the possibility of settling Jews in the southern part of Palestine- (known as Al-Naqab in Arabic or Negev in Hebrew). The delegation reported that water could be brought to Al-Naqab from the northern parts of Palestine and Jews could be settled there (Haddad 2007).

After WWI (1917), historic Palestine was put under British mandate. Between 1875 and 1948 successful attempts were made by both the Jewish organizations in Europe and later the British mandate forces to increase Jewish immigration to historic Palestine, and in parallel to increase the Jewish physical control of the Palestinian land and water resources (Schmida 1984; Dillman 1989; Ali 1964)· During their mandate over historic Palestine, the British authorities granted concessions to immigrated Jewish groups to exploit some of the Palestinian water resources (Schmida 1984; Dillman 1989).

From 1948 until the present, many water plans and projects evolved and were presented including the Oslo II agreement (Dillman 1989; Ali 1964; Oslo II 1995). However, none of these plans and/or agreements has managed to settle the water dispute between Palestinians and Israelis. Thus, Palestinian water resources have remained under the full control of the Israeli military authorities as the occupying power.

22.2.2 Palestinian Population and Urbanization

Palestinian population census in the OPT reveals that the population in 2007 totalled 3.771 million persons, 2.345 million in the West Bank and 1.417 millions in the Gaza Strip. It was reported that 40.1 per cent of the Palestinian population is less than 14 years of age, indicating a young society with high developmental needs.

There are 686 localities in the OPT (PCBS 2008). The localities are distributed by type as 54 urban, 603 rural, and 29 refugee camps. These localities are distributed by type of authority as 107 municipalities (89 in the West Bank), 11 local councils, 374 village councils or project committees, and 29 directors of refugee camps (additional 76 rural localities are either not inhabited or joined to a larger locality).

In 2005, the distribution of land use in the OPT was 25.5 per cent agricultural land, 1.6 per cent forests and wooded land, 10.0 per cent build-up areas, 3.2 per cent Jewish colonies, and 62.9 per cent bare land

and other uses (PCBS 2008). The built-up area was distributed by urban, rural and camps, 63.7 per cent, 5.1 per cent and 31.2 per cent respectively. The trend for 2000–2005 shows that the annual increase in the built-up area in the Gaza Strip was 19.1 per cent (ARIJ 2006).

22.2.3 The Palestinian Water System

According to PCBS (2008), the total water supply for domestic purposes in the OPT was 160 mcm/yr distributed by means of supply as follows: 86.7 per cent piped networks, 3.4 per cent tankers, 6.7 per cent rain water harvesting, and 3.2 per cent by other means. This domestic water was 68.5 per cent through municipal wells, 0.9 per cent agricultural wells, 3.2 per cent through springs, and 27.4 per cent through Israeli water companies. The average rate of *unaccounted for water* (UFW) in urban areas was estimated at 42 per cent of total water supply (it varies between 25 and 55 per cent), therefore, the average consumed per capita domestic water consumption in these areas was 36.5 l/d (or as surveyed, 55 l/d as average consumed since not all UFW is lost in the ground).

The PWA (2003) also estimated that 256 rural communities in the West Bank with a population of more than 200,000 are still without access to the public water supply. The people in these communities depend on local springs and harvesting cisterns to get water for all purposes, and the water used is usually not suitable for drinking.

Water infrastructure (the system of water wells, springs, reservoirs, networks, pumping stations, etc.) in the OPT is characterized by the existence of disjointed remote sites and locations. As such, in addition to the problems associated with the job and the related administrative and legal control problems, there is no integrated water system, neither physically or on paper. As a result, it will take considerable time and money to convert the complex set of sources into a reliable and integrated national water system.

Existing water institutions in the OPT do not have the technical, technological, managerial, or financial ability for either planning or developing of resources and services, or operating and maintaining them (Haddad 2005a). Accordingly, these water institutions have high overhead costs and an inability for cost recovery.

22.2.4 Palestinian Agriculture

Agriculture has historically been a very important sector of Palestine's economy. About 63 per cent of the water allowed to Palestinians or 52 m^3/person/yr is used in agriculture. Although more labour force was employed in agriculture (15.6 per cent of total labour force employed in 2007 compared to 13 per cent in 1996). The share of Palestinian agriculture of the GDP dropped from 9 to 8.4 per cent and consequently was no shelter for the suffering Palestinian economy (PCBS 2008).

Approximately 2,180,000 durums (35 per cent of the total area of the West Bank and Gaza Strip) are considered as natural grazing areas. The eastern slopes region of the West Bank makes up most of the OPT rangeland. It represents about 1,500,000 durums or 69 per cent of the range area. Of the total grazing area only 700,000 durums are accessible to Palestinian livestock owners, while the remaining 1,480,000 are currently not accessible as a result of land confiscation for Israeli colonies, nature reserves, or closed military areas. This led to overgrazing and progressive desertification in these areas (Isaac/Ghanayem 2001).

It was estimated that 23 per cent of the forest area has been destroyed from 1971 to 1999. The majority of this destruction has been caused by the construction of Israeli colonies and military camps. Rangeland and natural grassland are also negatively affected in the last three decades due to the political situation. The limitation of the access to Palestinian herds resulted in intensive grazing to the remaining small area that is estimated to be about 15 per cent of the former area (Dudeen 2008).

22.3 Water-related Environmental Threats in the OPT

22.3.1 Natural Threats

22.3.1.1 Climate Change

Although the causes of climate change are rooted in human activities, its impacts are global and pose multiple natural hazards or risks. Multiple scenarios are projected for the 2050's, declines in annual precipitation in North Africa and in West Asia by 20 to 25 per cent. This decrease in rainfall is projected to be accompanied by a temperature rise between 2 °C and 2.75 °C, while nearer the coast the rise may be lower (around 1.5 °C). In winter (October to March), rainfall is projected to drop by about 10 to 15 per cent but

would increase over the Sahara by about 25 per cent. In the coastal areas of the Mediterranean temperatures are projected to increase but by only 1.5 °C on average while it will rise in the hinterland by 1.75 °C to 2.5 °C (Ragab/Prudhomme 2002).

Thus, it is expected that the recharge of water resources in the OPT will gradually decline due to climate change leading to an aggravation of existing water scarcity and degradation and to higher vulnerability which may contribute to a further destabilization and conflict, especially when it is combined for the Palestinians with a lack of access to their national water resources.

22.3.1.2 Droughts

An analysis of the historical rain data of Jerusalem and Nablus for the past 162 years (since 1846) reveals that an average annual precipitation of 400 mm or below occurred for 25 times or on average once every seven years (Central Water Authority 1967; PCBS 2008). With the present increase in population in the OPT and in Israel, and the increase in demand for fresh water either for domestic or agricultural sectors, the long-term availability and sustainability of water supply and food security will drop. The synergistic effect of climate change and drought will aggravate the situation and negatively affect existing size and ecosystem of the drylands.

22.3.2 Man-Made Purposeful Causes

22.3.2.1 Access and Mobility to Water Resources

Since the start of the Israeli military occupation of the OPT in 1967, Palestinians were prohibited to freely access and develop their own water resources. Furthermore, since Israel has controlled the West Bank, its authorities have prohibited with Military Order No. 92 the publication of water testing or research. Thus, the full testing of water sources was difficult for Palestinian planners (Lonergan/Brooks 1994). Palestinian researchers were also limited where they were allowed to travel to conduct such tests (ARIJ 1996).

The other major standing body of water of concern in the region is the Dead Sea that is linked to the Sea of Galilee by the Jordan River. While this is not a source of drinking water, it is a major tourist and industrial spot, as well as an important environmental ecosystem. At 411 metres below sea level, the Dead Sea is already the lowest point on the surface of the Earth. The problem is that its water level is dropping by approximately 1 metre annually, leading to the loss of one third of the sea's original surface area (FOEME 1999). This decline is expected to continue, so that the surface level reaches 430 metres below sea level by 2020. The decline in precipitation results in a drop of water inflow by 10 per cent of the original volume. This trend is expected to worsen with annual inflows expected to decline from 375 mcm/yr to 135 mcm/yr in the near future (FOEME 1999).

Israel decided to establish a permanent barrier between the West Bank and Israel in April 2002. The construction of the wall subjected Palestinians to several water vulnerabilities, including irrigation infrastructure devastation, impeded access and mobility to water resources and irrigation land, increased land aridity, and detrimental effects on community socioeconomic and migration (Haddad 2005b; Twite 2008).

Agriculture will probably be most negatively affected by the construction of the separation wall. Palestinian villagers are especially sensitive to these impacts and consequences as they heavily rely on farming. More than 100,000 trees have been uprooted. More than 36,000 metres of irrigation networks have been destroyed. Delays associated with travel through the limited gates of the wall have undermined the daily routines, productivity, and efficiency of Palestinian farmers, delaying and altering their agricultural operations. During the first construction phase of the wall, about 42 per cent of the West Bank's agricultural sector was affected. The land that was blocked contains 80 per cent of the operating water wells in the West Bank and provides 53 per cent of its water-sector employment. Currently, a minimum of 50 productive water wells and 15 villages are being trapped in the buffer zone and west of the wall (Haddad 2005b).

22.3.2.2 Colonization of Land and Resources

In 2004, the *International Court of Justice* (ICJ 2004) ruled that "Israeli settlements in the Occupied Palestinian Territory, including East Jerusalem, are illegal and an obstacle to peace and to economic and social development [... and] have been established in breach of international law."

While the second largest refugee population in Asia consisted of more than 2 million Palestinian refugees under the protection of the *United Nations Relief and Works Agency* (UNRWA), the Israeli integration of large numbers of Soviet and other Jews conflicted with the interests of the Palestinian population in the OPT with regard to land and natural resources (UN 1993). In 1970, the Israeli settler popu-

lation living in the OPT amounted to 1,514 persons. It rose to 12,424 in 1980, and ten years later it was 76,000. It nearly doubled over the next five years to reach 146,207 people, and in 2000 it reached 203,067 persons (UNEP 2003). Palestinian sources estimate that there are between 145 and 198 colonies in the West Bank with about 390,000 Jews living in, occupying, and controlling about 42 per cent of the land area of the West Bank (The Palestine Monitor 2007).

To secure the Israeli-Jewish colonies in the West Bank, Israel built a large network of by-pass roads, as well as a water and energy infrastructure. It was reported that Jewish settlers in the West Bank use much higher per capita water than the Israeli population proper. This lead to an increase in the physical fragmentation of the West Bank and made Palestinian development more difficult, since not only the land taken for the colonies but also much of the land between the roads (each road enjoys a buffer zone of 50–100 m on either side) has become dangerous to reach and to develop for agricultural or any other purpose.

The Israeli practice in the OPT of giving the Israeli army and the defence establishment the major role in deciding on the zoning and development of the land use had major impacts on the local environment in the OPT. An example is the continuous approval and direct assistance of the Israeli military authorities for the Israeli-Jewish colonies in the West Bank to develop Palestinian water resources for their full supply, while Palestinian communities are forced by the same military to use a minimum water quota.

The Israeli-Jewish colonization of the West Bank has resulted in the Israeli army increasing in Palestinian land acquisition, water resources development and withdrawal for colonies water supply, and further limitations of movement and access to their natural resources for Palestinians.

22.3.2.3 Water Pollution from Israeli Military Activities

Because of the unique geographic and political situation of the OPT, significant Israeli military forces were concentrated here for more than four decades, occupying a significant land area. So far, the environmental hazards encountered with or from Israeli military activities and the prolonged use and control of the OPT are unidentified and/or not measured. Israeli military operations and/or production and/or testing of various weapons and ammunitions in the OPT are most often secret. Munitions, for example, contain harmful and environmentally dangerous chemicals such as explosives which when released into the environment may have serious negative effects and cause contamination of soil, water, and air. In addition, the Israeli military hazardous wastes in the OPT must be basically and essentially approached, surveyed, and made definable. This matter poses a special environmental threat in many areas of the OPT where the Israeli army and Israeli colonies have military camps, munitions storage and buried facilities, and possibly industrial plants (Twite 2009).

There has been concern that depleted uranium has been used by the Israeli military against Palestinian targets (EQA 2002; Dajani 2009).

22.3.2.4 Overexploitation of Water

Despite the Israeli military control there is presently an overexploitation of water resources in Israeli as well as in the OPT areas. The water exploitation index taken as a percentage of renewable annual water resources is: 83 per cent for Tunisia, 92 per cent for Egypt, 140 per cent for Israel, 169 per cent for Gaza, 644 per cent for Libya, 50 per cent for Syria, 25 per cent for Lebanon, 20 per cent for Algeria and 40 per cent for Morocco (Acreman 2000; Pearce 1996).

A field survey of this author found that annual discharges of most springs in the West Bank were declining and some springs, such as the Al-Faraa spring (14 km north-eastern of Nablus), were totally dry in early summer. This condition affects the livelihood of many Palestinian communities and farmers. This is mainly due to the Israeli water abstraction by using deep water wells.

While Palestinians in the West Bank have limited and controlled access to their national water resources and use only 10 per cent of the annual recharge capacity of the water system (Aleiwi/Assaf 2007), it is estimated that Gaza's aquifer pumping was estimated at one point to be withdrawing 110 mcm/yr (Davis/Abumojhli/Castaldi/Hamady/Hodgkin 1996). It was also reported that a water deficit of approximately 68–90 mcm/yr and of 70 per cent of the aquifer's water in the Gaza Strip is brackish to saline water due to the over-abstraction (Nettnin 2005). The excessive use of water resources in the OPT and their degradation will damage the natural system of the Gaza aquifers, and thus threatens the present and future livelihood and health of the Palestinians living there.

22.3.2.5 Intermittent Water Supply and Unequal Water Allocation

All Palestinian communities in the OPT receive an intermittent water supply amounting to a few hours, two or three times a week. Accordingly Palestinian people install water tanks on the roofs of their houses and/or buildings to collect the maximum water volume during the limited pumping hours and manage their water use from what they get until they receive the next water pumping. This practice neither exists in Israel nor in the Jewish colonies of the West Bank.

Current estimates of total water use show that Israel is using 344 m^3/yr per person, while Palestinians in the West Bank and the Gaza Strip use approximately 93 m^3/yr per person. Per capita quantities for domestic use are estimated at approximately 40 m^3/yr for Israelis and 35 m^3/yr for Palestinians (Postel 1997).

If the present Palestinian population living in the OPT use the WHO average domestic water consumption standard of 150 liter per person per day, they would need 206 mcm/yr of fresh water, comparing this average consumption with the existing forced demand for Palestinians of 132 mcm/yr. This implies a deficit of 74 mcm/yr. If equity and equality maintained only in domestic water consumption among humans living within the same hydrological cycle, i.e. between Israelis and Palestinians, this deficit would rise to 397 mcm/yr.

In summary, the Palestinians are using much less water than required for domestic purposes according to WHO standards, and this is affecting their socio-economic situation and livelihood. It is not possible for Palestinians to develop or plan any water project, neither in the past nor at present, due to military occupation and control of land and water resources, territorialism and ownership disputes; uncertainty about key facts; political evolution; an ongoing shift in ethos; and a certain apathy, or at least a tendency towards inaction, without a crisis which would otherwise motivate.

22.3.2.6 Economic Growth

Where water is scarce, competition for limited supplies can lead nations to interpret access to water as a matter of national security (Gleick 1998). National security concerns include not only socio-economic issues of water allocation, but central political, legal, and territorial claims as well. The negotiations over water between Palestinians and Israelis did not conclude with the signing of an interim agreement and were postponed to the final status agreement. As a result, Israeli military authorities continue their full control of Palestinian water resources in the West Bank, with minor exceptions, since June 1967 until the present time. This means that water policies in the West Bank regarding quantity and quality are in the hands of the Israeli military authorities and not of the Palestinians.

Since the onset of the Israeli occupation in 1967, the economy of the OPT has been an 'income economy' rather than a 'production economy' – making the OPT extremely vulnerable to the Israeli market of labour and goods. With the beginning of the current Intifada in late September 2000, economic conditions have deteriorated in the OPT (FAO/WFP 2004). Access to food remains the most significant food security concern with food price increases resulting in drastic reductions of livelihoods (WFP/FAO 2007).

Since 2000, a progressive fragmentation of established patterns of economic activity among districts and urban and rural communities has occurred in the West Bank, involving a breakdown of relations with Israel. The Israeli army imposed military curfews on Palestinian communities, thus paralyzing all aspects of life. For example, during the last half of 2002, the imposed military curfews in the West Bank applied to 70 per cent of the time, affecting approximately 75 per cent of domestic production, what seriously disrupted the movement of goods into and from the West Bank (UNSCO 2005; UNEP 2003).

According to the PCBS (2008) the per capita GDP in the OPT was US$1,129, what reflects a sharp decline in economic growth and high poverty levels in the OPT. In its report '*The Economic Effects of Restricted Access to Land in the West Bank*', the World Bank (2008) states that the Israeli administration caused a 40 per cent decline of the gross domestic product per capita in the West Bank from 1999 to 2008. The UN *Office for the Coordination of Humanitarian Affairs* (OCHA) shows that Palestinians do not have access to 38 per cent of the West Bank, resulting in drained resources and limited development in the illegally occupied territory.

The Israeli restrictions imposed on Palestinians including movement, import and export, entering of raw materials needed for production, the limitation of funding and fund movement, has lead to suppressed and negative economic growth in Palestine. Negative economic growth in Palestine has lead to a high level of migration especially among young people. The Israeli practice in the OPT of giving the Israeli army and the defence establishment the major role in

deciding on who should invest when and where have major impacts on the local environment in the OPT.

A decline in water supply and consumption always accompanies limited economic growth and development. Limited economic growth leads to declining taxes what freezes government plans for development. Insufficient water supply and inadequate wastewater treatment and reuse capacity along with negative economic growth in the OPT are three critical factors that have negatively affected and threatened the Palestinian environment. The high adaptive capacity of the Palestinians in their national resistance to Israeli occupation is the reason that the situation has not become catastrophic.

22.3.2.7 Palestinian Population Growth, Returnees, and Water Demands

The estimated population of Palestinians all over the world reached 9.7 millions, by mid-2004 of which 4.9 millions are in the Diaspora and the rest are in historic Palestine including Israel, and the OPT (UNRWA 2005).

Future Palestinian population growth in the OPT is uncertain, since the establishment of a Palestinian state could encourage an influx of Palestinian emigrants. Some sources estimated that as many as 1 million refugees may be returning (Lonergan/Brooks 1994). The Palestinian Water Authority is officially planning for 500,000 refugees, which would increase water demand enormously. Moreover, since the goal of many planners is for an equal domestic per capita consumption of water for both Israelis and Palestinians of around 100 m^3/yr, the demands by Palestinians for water will increase enormously, since current domestic per capita use is 35 m^3/yr (Assaf/Bargouti 1999).

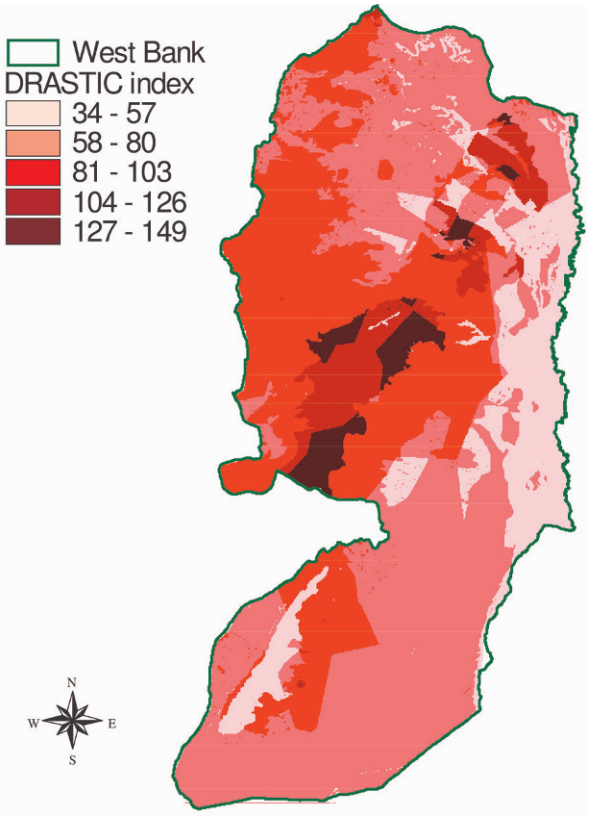
22.3.2.8 Water Quality Deterioration

At present, Israel treats its drinking water to standards which it believes are safe, yet which allow mineral concentrations higher than those considered safe in the United States or Europe (Tenne 1995). Palestinians meanwhile are struggling to maintain drinking water standards anywhere close to that of Israelis, being hampered by insufficient funds and infrastructure (Assaf/Barghothi 1999).

It was indicated that 14.9 per cent of the water supply problems in the OPT were directly associated with water contamination (PCBS 2008). About 15 per cent of the water samples taken from springs in the West Bank have nitrate concentration between 55 and 320 mg/l exceeding the WHO water quality standards (WHO 1993). Most of the springs surveyed have very high hardness levels – over 700 mg/l as $CaCO^3$ (Scarpa/Abed Rabbo/Zeitoun 2004)

A preliminary groundwater vulnerability map for the West Bank has been produced (Qamhieh 2006; Zayed/Abadi/Rajoub/Moe 2008; figure 22.2). Results indicated that most Palestinian drinking water sources can be considered as highly vulnerable to pollution. Documented and suspected sources of pollution relate to both Palestinian communities (mainly due to anthropogenic sources of pollution) and Israeli settlement activities (due to both anthropogenic and industrial sources of pollution).

Figure 22.2: The map of the groundwater vulnerability to contamination for the West Bank. **Source:** Qamhieh (2006).



Currently most pesticides on the West Bank come from Israel where there is no requirement for bilingual Hebrew or Arabic as well as English or Arabic labelling. Thus farmers often misuse pesticides with risks to their crops, groundwater, and personal health (Lonergan/Brooks 1994). In the OPT, the indiscriminate application of 1,471 tons of 123 different pesticides includes in the West Bank the use of seven of

the internationally banned 'dirty dozen' pesticides, such as DDT, that do most environmental damage (Isaac/Gasteyer 1995).

There are very few estimates of the amounts of hazardous waste generated in the OPT. In the West Bank, the amount has been estimated at 2,500 tons per year (EQA 2002). This amount refers to waste that has been explicitly identified as hazardous. The true amount is likely to be much higher, but is not apparent since there is no separation (and collection) or inventory.

Due to high rates of UFW, poor operation and maintenance of water system, and poor water infrastructures, illegal practices on the part of consumers, it is expected that public health will be negatively affected. A massive public health hazard did not happen yet, however, many individual water-related health infections were reported in the West Bank and the Gaza Strip (Haddad 1998).

The main quality problem in the Gaza Strip is the increase in salinity and nitrate concentrations. It was reported that the Gaza aquifer has nitrate levels over 100 mg/l and chloride levels averaging 1000 mg/l (Nettnin 2005). The PWA reported that total dissolved solids were greater than 1500 mg/l in the western area of Khan Yunis and in the south-eastern part of Rafah Governorates (PWA 2003). This deterioration could be attributed to water over-pumping, poor management of waste disposal, and the excessive use of fertilizers and pesticides, in addition to possible sea and salt water intrusion.

Water quality of the lower Jordan River is deteriorating as Israel diverts the saline water from springs around Lake Tiberias in addition to the dumping of polluted and industrial wastewater in the river (El-Musa 1996).

In summary, the livelihood and public health of the Palestinian population in the Gaza Strip are already experiencing a great damage due to a degradation of water supply quality, while there is also a potential for water quality deterioration in the West Bank.

22.3.2.9 Decline in the Social Value of Water

Water is needed for humans to convey all aspects of life. Water supply in the OPT is intermittent, meaning that there is no continuous pumping and most households receive water from municipal water services twice a week for a few hours only. Accordingly, each household maintains a roof water tank to collect the water when it is supplied and use it later within the limits of supply. Because supply is insufficient, Palestinian women while water pumping from the source try to finish as much household activities as possible. The water quota enforced on Palestinians caused a change in social behaviour.

22.3.2.10 Ecosystem Services

The intentional neglect of the preservation of the historical land terraces along the mountains of the West Bank is a clear example of negative ecosystem services in the OPT, leading to soil erosion and a decrease in water percolation to groundwater, in addition to its effect on the green land cover and its biodiversity. Another example is the wastewater management practices in the OPT which consist of mostly collecting wastewater from urban centres and then letting raw wastewater flow untreated into the wadis. A third example is the lack of access and mobility of the Palestinian population to their land and more specifically to government owned land, where still no political agreement is reached to allow the Palestinian Authority to plan and plant in drylands. This situation caused a decrease in green cover and soil moisture, and consequently an increased evaporation of rainwater and increased soil erosion. The reduced vegetation cover and the break of the soil crust lead to water and wind erosion of the topsoil, and with it an irreversible loss of productivity resulting in desertification. The loss of vegetation cover reduces aquifer recharge and increases the losses of floodwater (National Academy of Science 1999).

22.3.2.11 Food Supplies

The FAO and the WFP (2004) found that the OPT is not self-sufficient in food and relies on commercial imports to supply domestic demand. It was also found that with rising poverty and unemployment, the food security situation has considerably deteriorated between 2005 and 2008, with four out of ten Palestinians now being food insecure. Food insecurity is a reality for 1.4 million people (40 per cent of the population) and a near constant worry for an additional 1.1 million people (30 per cent) who are under threat of becoming food insecure should current conditions persist. People's physical access to food and farmers' physical access to the inputs and assets to produce food have been severely affected by restrictions on the movement of people and goods and the damage to personal property. Many areas in the OPT with an agricultural potential are affected by stringent closures (e.g., Qalqilya, Tulkarm, the Jordan Valley) and their isolation from urban markets (e.g. Nablus). Recently,

food aid in the OPT has become even more prominent as a major source of food supply (WFP/FAO 2007).

22.3.2.12 Wastewater Management

Sewage collection networks serve approximately 66.8 per cent of the population of the OPT, while the rest is being served either by septic tanks, cesspits or drypits (PCBS 2008). There are eight treatment plants in the OPT, five in the West Bank in the cities of Ramallah, Jenin, and Tulkarm, Al-Bireh, and Salfit, and in the Gaza Strip in Beit Lahia-Jabalia, Gaza, and Rafah. There is no real monitoring of wastewater disposal and/or reuse and therefore, it is possible that some water quality deterioration be attributed to wastewater disposal especially in the Gaza Strip.

Palestinians have recently begun to reuse wastewater as an additional water source. The total quantity of wastewater from domestic and industrial uses in the OPT is estimated to be roughly 40 mcm/year (WRAP, 1994). In the West Bank, most of this wastewater is used for irrigation without any kind of treatment. In the Gaza City area, sewage from non-functioning treatment plants is discharged onto neighbouring land.

22.4 Perceptions of Vulnerability and Risk

Water vulnerability is not a measurable property; it is a probability (i.e. 'the tendency or likelihood') of environmental damage or harm either at present or in the future. In this sense, a vulnerability assessment of scarce water resources is a predictive statement and accordingly a simple matrix of water-related threats against the impacts or responses expected from these threats was formed (see table 22.1). Based on the available data and author experience; impacts were given a scale from 1 (very low) to 5 (very high). Then the sum of scales for each threat and each impact was estimated.

As listed in table 22.1; the highest sums for the water-related environmental threats revealed that the following five environmental threats – listed in order – have the highest sum of impact weights:

- Controlled access and mobility to Palestinian water resources;
- Colonialization of Palestinian land and water resources by Israeli Jews;
- Decline in Palestinian economic growth;
- Water resources overexploitation, and
- Drought occurrence.

The highest sums for the impacts or responses connected with the water-related environmental threats revealed that the following five environmental impacts – listed in order – have the highest sum of impacts weights (see table 22.1):

- People's livelihood decline;
- Political conflict aggravation;
- Decline of available water resources;
- Declining economic development;
- Refusal of an equitable water allocation.

The least important impacts of water-related environmental threats with minimum weights of scale were exposure to radiation, people's immigration, employment decline, soil erosion, and unknown environmental hazards.

Human security or human well-being is an essential part of environmental security, as human beings are a precious element of the environment. With the decline in the livelihood of the people, the environmental insecurity in the OPT has reached a critical point.

22.5 Concluding Remarks

Palestine or the OPT need not be water self-sufficient; nor food self-sufficient. It is fully realized that there are limits to natural resources, and to our human activities. Regardless of the water deficit numbers, the water scarcity problem in the area is a long-term complex that needs continuous serious attention. For the Palestinians in the OPT, water scarcity and its impacts on environmental security cannot be disconnected from the overall abnormal status of the territories. Palestinians are subject to natural as well as man-made purposeful water scarcity, and the above water-related threats and their impacts are significant constraints on the ability of the Palestinian people to plan any aspect of their lives either for the present or for the future.

An assessment of impacts and of responses clearly indicates that the water-related threats in the OPT are causing loss, harm, and damage to Palestinian people and their environment, and consequently Palestinians and the OPT are experiencing environmental insecurity. If these threats continue and/or are aggravated, this environmental insecurity might lead to catastrophic consequences.

To overcome and/or minimize the environmental threats facing Palestinians and their scarce water re-

Table 22.1: Matrix of water-related threats and their impacts.

Water-related Environmental Threats	Impact/Response																		
	People relocation	People immigration	Public health problems	Urban congestion	Contaminated land/soil	Contaminated water	Exposure to radiation	Land use planning deficiency	Employment decline	Desertification increase	Land acquisition increase	Equitable water allocation Refusal	Water availability decrease	Political conflict increase	Agricultural production decrease	Ecosystem/biodiversity damage	Unknown environmental hazards	Peopleislivelihood decline	Soil erosion/green cover decrease	Economic development decline
Climate change	2	1	1	2	2	1	1	2	1	4	1	3	4	4	5	3	1	3	2	3
Droughts	2	1	2	2	2	1	1	2	1	4	1	3	4	4	5	3	1	4	3	4
Israeli military activities	1	1	4	1	4	4	4	2	1	1	3	1	1	4	1	1	4	3	1	1
Water resources over exploitation	2	1	4	3	4	4	1	2	1	1	1	3	4	3	4	3	1	4	1	4
Intermittent/controlled water supply	2	1	3	2	3	3	1	1	1	1	1	5	5	4	1	1	1	4	1	4
Stringent economic growth	4	4	4	4	1	1	1	3	4	1	3	3	3	4	3	4	1	5	1	4
Palestinian population growth	3	1	1	4	1	1	1	4	4	1	1	4	4	4	3	1	1	4	1	4
Controlled access & mobility to water resources	4	4	4	4	1	1	1	4	3	4	4	4	4	4	4	4	1	4	3	4
Colonization of land and resources	4	1	2	4	4	4	1	3	1	3	4	4	4	4	4	3	4	4	3	4
Water quality deterioration	1	1	4	1	4	4	1	1	1	1	1	3	3	3	3	3	1	4	1	3
Ecosystem services decline	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	2	1	1
Poor wastewater management	1	1	3	1	4	4	1	3	1	1	1	1	1	2	1	2	3	3	1	1

Note: 5 = very high, 4 = high, 3 = medium; 2 = low, 1 = very low.

sources, and in addition to the main factor which is the ending of the military occupation of the Palestinian land and resources including water, there is a need for several immediate interventions including a) local increase of water availability, b) safeguarding the quality of the environment, c) awareness and guidance of public behaviour to limit over-pumping, and d) enhancement of economic growth.

Resolving water scarcity problems and minimizing their impacts on environmental security requires from riparian sides that they start reaching and strengthening the implementation of agreements including water allocation and basin water management. Cooperation among riparian and other regional parties on jointly working on regional water availability options could follow or become the second step.

23 Social, Environmental and Security Impacts of Climate Change on the Eastern Mediterranean

Hilmi S. Salem

23.1 Introduction[1]

This chapter discusses climate change impacts for the Eastern Mediterranean, with a particular emphasis on the *Occupied Palestinian Territories* (OPT) that comprise the West Bank, including East Jerusalem, and the Gaza Strip. According to the *Intergovernmental Panel on Climate Change* (IPCC 2007a: 13), the average global temperature is projected to rise until 2100 by a range of 1.1–6.4°C, and the sea level has been projected to rise between 18 and 58 cm.[2] Data on the projected climate change at the regional scale are lacking (IPCC 1990, 1996a, 1998, 2001a, 2007a, 2007b, 2007c, 2007d).

Climate change will have many negative impacts for the Eastern Mediterranean region and the OPT that include increases in temperature and sea-level rise (SLR), of hydro-meteorological hazards (heatwaves, droughts, storms, floods, spread of diseases, etc.), changes in precipitation and evaporation rates, water scarcity, and desertification. These complement other environmental challenges, such as increased salinity of soils and of surface-water and groundwater, depletion of stratospheric ozone, and loss of biodiversity. All these physical impacts may result in declining crop yields and failure (leading to food insecurity), and to societal effects, such as 'environmentally-induced migration'.

The projected SLR poses a threat to the Eastern Mediterranean cities with a high population density and concentration of economic activity along the coast. A typical example is the Gaza Strip, which is particularly vulnerable to these effects, as it lacks the resources to prepare for potential hazards. The climate change impacts will and should lead people to take new measures, actions, and strategies that aim to engage them in combating climate change, by changing their mindset and utilizing the situation to catalyse actions for long-term improvements.

This chapter discusses potential climate change impacts for the OPT by specifying environmental, technical, economic, social, political, geopolitical, and security consequences, besides adaptation policies, on the local and regional context, for a SLR between 23 cm and 200 cm (0.23–2 m) until the year 2100. These seven issues are:

1. Possible ecological effects of the *Israeli Segregation Wall* (ISW) on the local climate;
2. Impacts of sea-level rise (SLR) on the Gaza Strip;
3. Climate change impacts on water scarcity and transboundary aquifer systems;
4. Climate-change coping strategies for the *Jordan River Basin* (JRB), and water conflict;
5. *Red Sea-Dead Sea Conveyance* (RSDSC) project and its possible impacts on regional climate;
6. Deforestation, desertification, and land degradation as causes of and effects on climate change;
7. Mitigating climate change impacts with renewable energy.

Global climate change is to a large extent due to human activity, resulting from the burning of fossil fuels and land-use changes, such as deforestation that reduces the amount of CO_2 being absorbed (Brauch/Spring/Grin/Mesjasz/Kameri-Mbote/Behera/Chourou/Krummenacher 2009). On possible political and societal effects of global climate change, three main scenarios were developed by US experts. The *German*

1 The Author wishes to extend his sincere thanks to his colleagues at the *Geographic Information Systems* (GIS) and Remote Sensing Unit of the *Applied Research Institute – Jerusalem* (ARIJ), Palestine, for their help in providing the maps for this chapter.

2 Rahmstorf (2007) assumed even much higher increases in the SLR – up to 140 cm (1.4 m). The IPCC Chairman R.K. Pachauri (2008) referred to potential SLR, for assumed stabilization levels of greenhouse gases (GHG) in the atmosphere between 445 and 710 ppm, of between 40 cm and 240 cm (0.4–2.4 m) (table 23.5 below).

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Advisory Council on Climate Change (WBGU 2008, 2008a, 2008b) distinguished four conflict constellations due to climate-change induced effects.

23.1.1 Three Policy Scenarios for US National Security

The three scenarios developed by a team of American experts (Campbell/Gulledge/McNeill/Podesta/Ogden/Fuerth/Woolsey/Lennon/Smith/Weitz/Mix 2007: 55–92; chap 42 by Scheffran) are:

1. The *Expected Scenario* projects the effects of an average global temperature increase of 1.3°C and an SLR of 23 cm by the year 2040. Global implications for this scenario would include: internal and cross-boundary tensions for US national security by environmentally-induced migration; conflicts sparked by resource scarcity; and increases in diseases and health-related problems in general, which will have economic consequences. The physical effects of climate change will have societal, political, economic, and security impacts.
2. The *Severe Scenario* foresees profound and potentially destabilizing global effects when the average temperature will increase by 2.6°C and the sea level will rise by 52 cm by the year 2040, what will trigger massive societal events, leading to a dramatic rise in migration and changes in agricultural patterns and water availability. Armed conflicts among nations due to natural resources scarcity could also take place in various parts of the world.
3. The *Catastrophic Scenario* assumes an increase in the average global temperature of 5.6°C and an SLR of 200 cm (2 m). It foresees strong and surprising interactions between the two great security threats of global climate change and international terrorism posing almost inconceivable challenges as human societies would struggle to adapt to it.

23.1.2 Four Conflict Constellations for International Security

From an international security perspective, the WBGU in its report on *Climate Change as a Security Risk* has mapped the most highly affected regions by identifying four major issues, for which climate change is expected to cause critical developments (WBGU 2008a: 79–130; they are summarized in chap. 41 by Bauer; Brauch 2002, 2007, 2009a, 2009c):

1. *Climate-Induced Degradation of Freshwater Resources*: About 1.1 billion people are currently without access to safe drinking water. The situation could worsen for hundreds of millions of people as climate change alters the variability of precipitation and the quantity of available water. Demand for water is increasing due to population growth and mounting aspirations. This triggers distributional conflicts and poses major challenges to water management in many countries. The countries which will suffer the greatest water stress are generally those which lack the political and institutional framework necessary for the adaptation of water and crisis management systems. This could overstretch existing conflict resolution mechanisms, ultimately leading to destabilization and violence, specifically in the Middle East.
2. *Climate-Induced Decline in Food Production*: More than 850 million people worldwide are currently undernourished. This situation is likely to worsen in future as a result of climate change, as food insecurity in the lower latitudes, especially in many developing countries, will increase with a temperature rise of just 2°C. With global warming of 2–4°C, a drop in agricultural productivity is anticipated worldwide. This trend will be substantially reinforced by desertification, soil salination and/or water scarcity. In North Africa and the Middle East this may trigger regional food crises and further undermine the economic performance of weak and unstable states, thereby exacerbating destabilization, the collapse of social systems, and violent conflicts.
3. *Climate-Induced Increase in Storms and Flood Disasters*: Climate change is likely to result in more intensive storms and heavy precipitation that will affect many cities and industrial regions in coastal zones. Conflicts are likely to occur more frequently in future, because: a) certain regions, especially at risk from storm and flood disasters (e.g. Central America, which have weak economic and political capacities), will make adaptation and crisis management more difficult; b) frequent storm and flood disasters along the densely populated east coasts of India and China could cause major damage and trigger or intensify migration processes.
4. *Environmentally-Induced Migration*:[3] Migration may increase conflicts in transit and target regions. In developing countries, in particular, the increases in drought, soil degradation, and water scarcity, in combination with high population growth, unstable institutions, poverty and high lev-

els of dependency on agriculture, imply a significant risk of environmental migration. Transboundary environmental migration will mainly occur as south-south migration, but Europe and North America must expect increased migratory pressure from regions which are most at risk from climate change. The question as to which states will have to bear the costs of environmentally-induced migration in the future also contains conflict potential.

Of these four conflict constellations, the first two are highly relevant to, and pertinent for, the national security of a future Palestinian state and for the human security of the Palestinian people.

23.1.3 Impacts of Climate Change on Human Security

From a human security perspective (Barnett/Adger; Brauch 2005, 2008), the *Human Security Network* (HSN), during the Greek Chairmanship in 2007–2008, addressed the climate change impact on vulnerable groups (Brauch 2009a, 2009c; Fuentes Julio/Brauch 2009). The *Friends of Human Security* (FHS) and the *United Nations Office for the Coordination of Humanitarian Affairs* (OCHA) also discussed issues of climate change and human security at a symposium on 31 July 2007.[4] Prior to the first debate on climate change at the UN Security Council, a group of scientists submitted a policy memorandum[5] that addresses challenges for the people, which are also highly relevant for the Palestinian people in the OPT, with a high degree of social vulnerability. Poor and underdeveloped nations, e.g. in the Middle East, may have fewer resources and less endurance to deal with climate change and its impacts and consequences.

23.2 Middle East

The Middle East is one of the most water-stressed regions. Climate change is expected to make water resources even scarcer in the *Middle East and North Africa* (MENA), particularly in Jordan and the OPT[6] that will experience an even greater regional water stress.[7]

During the 20th century, observations have shown that global climate change has already caused less rainfalls, higher temperatures and higher evaporation rates, SLR, extreme weather events, and biodiversity loss. As a result of climate change, many species are

3 The WBGU (2008, 2008a, 2008b) study identifies the four 'conflict constellations', which "are defined as typical causal linkages at the interface of the environment and society, whose dynamic can lead to social destabilization and, in the end, to violence." The WBGU study summarizes the climate change impacts for regional 'hotspots', including *the Middle East and North Africa* (MENA). For an expert study on Southern Europe and North Africa, see Brauch 2007b; chap. 26 by Brauch.

4 See: Workshop on: "Climate Change from the Perspective of Human Security" (UNTFHS 2007). See the presentation by Under-Secretary-General for Humanitarian Affairs and Emergency Relief Coordinator, John Holmes, on: "Human security and disaster reduction" (Holmes 2007).

5 See: Wisner/Fordham/Kelman/Johnston/Simon/Lavell/Brauch/Spring/Wilches-Chaux/Moench/Weiner 2007.

6 To better understand the water scarcity and conflict and some other important issues related to the water situation in the MENA region, this literature survey may be helpful: Davis/Maks/Richardson 1980; Shuval 1980; Khouri 1981; Stauffer 1982; Stork 1983; Cooley 1984; Matson/Naff 1984; Dillman 1989; El-Hindi 1990; Issar 1990; Lee/Bulloch 1990; Nijim 1990; Salameh 1990; Wishart 1990; Casa 1991; Hurwitz 1991; Pearce 1991; Al-Weshah 1992; Baskin 1992; Salem 1992; Sexton 1992; Bulloch/Darwish 1993; Postel 1993; Vesilind 1993; Biswas 1994; Isaac/Shuval 1994; Kliot 1994; Moore 1994; Neff 1994; Allen/Mallat 1995; Elmusa 1995; Haddadin 1995; Hof 1995; Libiszewski 1995; Lowi 1995; Schulz 1995; The Economist 1995; Wolf 1995; Isaac/Selby 1996; Rouyer 1996; Shuval 1996; Wolf 1996; Hof 1997; Pastor 1997; Kubursi/Isaac 1998; Allan 1999; Soffer/Copaken 1999; Alatout 2000; Amery/Wolf 2000; Brooks/Mehmet 2000; B'tselem 2000; Isaac 2000; Rook 2000; Allan 2001; Castelein/Otte 2001; Hass 2001; Allan 2002; Daibes 2003; Issar 2003; Mair/Kamat/Liu 2003; Rouyer 2003; Seitz 2003; Selby 2003; Brauch 2004; Haddad 2004; Handcock 2004; Hayek 2004; Issar 2004; Issar/Zohar 2004; Klawitter/Qazzaz 2004; Schwarz 2004; Soffer 2004; World Bank 2004; Frederiksen 2005; Khatib/Assaf/Claeys/ Daoud 2005; Messerschmid 2005; Selby 2005; Abu Zeid 2006; Bashir 2006; Bohannon 2006; Brauch 2006; Feitelson 2006; Fisher/Huber-Lee 2006; Gray/Hilal 2006; IRIN 2006; Tal 2006; Tropp/Jaegerskog 2006; Aliewi/Assaf 2007; Allan 2007; Baker/Freeman/Steinber 2007; Brauch 2007a, 2007e; Frederiksen 2007; Isaac/Salem 2007; Pearce 2007a, 2007b; Phillips/Attili/McCaffrey/Murray 2007; RSS 2007a; Salem 2007; Salem/Isaac 2007; Shuval/Dweik 2007; UNESCO 2007; Bergstein 2008; Bigman 2008; Biswas/Rached/Tortajada 2008; Dinar 2008; Fischhendler 2008; Hoetzl/Moeller/Rosenthal 2008; Lendman 2008; Makdisi 2008; World Bank 2008c; Zeitoun 2008; Zeitoun/Allan 2008; Zereini/Hoetzl 2008; Abdel Hamid 2009; Pedersen 2009; Picow 2009).

expected to disappear. A recent IPCC (2008) report warns that temperatures in the Middle East have increased 2–3°C in the last century, which is faster than the global average of about 1°C (Pedersen 2008). As a result, the Middle East region is expected to have fewer but more intense rain events, increased droughts, and decreasing resources of fresh water. More than 80 per cent of climate models have shown that rainfall in the MENA region will decrease by up to 40 mm per year (ENN 2008). With rainfall decreasing, the growing seasons for farmers will be shorter.

The Middle East is already experiencing a severe water crisis that is partly due to a mismanagement of freshwater resources. Within the next few decades, climate change will have severe regional impacts, not only for the natural environment, but also for the political and socio-economic context, adding to the political instability and tensions in the region. The dispute over water has been and will remain part of the Israeli-Palestinian, and of the Israeli-Arab conflict.

If water becomes too scarce under the climate change scenarios and conflict constellations discussed above, given the political circumstances affecting the region, then the Palestinians in the OPT will become the first victims who will further suffer from climate change. Water prices will rise dramatically. The Palestinians in the OPT presently purchase water for 5 NIS (*New Israeli Shekel*) or about 1.5 US$/m^3 (Salem/Isaac 2007) from *Mekorot*, a semi-private Israeli water company whose major shareholders are the Jewish Agency and the Jewish National Fund. Further, the decrease of agricultural lands will result in higher food prices, particularly for fruits, vegetables, and cereals, and, thus, their food security will be badly affected.

The projected SLR could affect the nearby aquifers due to the sea water intrusion. The *Gaza Coastal Aquifer System* (GCAS), which provides water to approximately 1.5 million Palestinians, is a typical example for such a disaster. Higher temperatures, annual decreases in precipitation, and higher rates of evaporation have already reduced the available fresh water (surface-water and groundwater) in the OPT. Israel, for example, which consumes more than 85 per cent of the water that should be allocated to the Palestinians in the OPT, must urgently take decisive measures to reduce the large-scale planting of water-consuming crops, and reduce the huge amounts of water that irrigate large areas, in order to conserve the use of water.

23.3 Historical Palestine – Occupied Palestinian Territories

Historical (or Mandate) *Palestine* (HP, including the OPT and Israel), with its small territory of about 27,000 km^2, is characterized by drylands and a natural habitat, where significant topographic and climatic variations prevail, what is a unique phenomenon in the MENA region (figure 23.1). Being located in West Asia, at the edge of the 'Fertile Crescent', and east of the Mediterranean Basin, HP has been a centre where human civilizations originated and spread throughout human history (Issar/Zohar 2009). Its long history of indigenous and invading cultures, and human movements for trade and politics have made HP a migration route for the exchange and dispersion of crops, seeds, flowers, and animal species. Many species have, thus, entered the region throughout history, making HP highly biodiverse by hosting over 4,000 plants, 120 mammals, 500 birds, 100 reptile and amphibian species, about 1,000 fishes, and an unknown number (5,000 to 10,000) of insects (Zohary/Feinbrun-Dothan 1984). Several species experience threats of degradation and extinction, and many are classified as 'endangered species'.

Based on its geographic attributes and geomorphologic and topographical characteristics, HP is recognized as rich and diverse, composed of five climatic zones: the coastal zone, the semi-coastal zone, the central highlands zone, the eastern slopes zone, and the Jordan Valley zone (Salem 2008a) that have a common flora and fauna. HP was primarily an agricultural country, and the West Bank in particular, has been a major food producer. Agriculture makes up a large part of the Palestinian economy and land use, representing 30 per cent of the Palestinian *Gross National Product* (GNP), with more than 50 per cent of the population benefiting directly from food production. Only 31 per cent of the land in the OPT is cultivated, 32 per cent is classified as grazing land, and the rest is classified as urban and barren land. Of the cultivated area, 28 per cent is considered rain-fed, and 3 per cent is irrigated mainly for vegetables.

The West Bank is located on the central highlands of HP, just above the Jordan Valley, while the Gaza

7 The MENA region is one of the most water scarce regions of the world, where 5 per cent of the world's population has access to only 1 per cent of the planet's freshwater resources (World Bank 2004, 2007a, 2008c). By 2025, most countries in MENA will face an absolute water scarcity (Abu Zeid 2006).

Figure 23.1: Historical Palestine within the Current Regional Context. **Source**: ARIJ (2009).

Strip runs along the South-eastern Mediterranean. The OPT, located between 31° 13' and 32° 33' latitude, and between 34° 13' and 35° 34' longitude, comprises a total area of 6,023 km^2, whereby the West Bank covers 5,661 km^2 and the Gaza Strip covers only 362 km^2.

The US *Population Reference Bureau* (PRB 2004) estimated the population of the OPT at 3.8 million (with an *annual population increase* (API) of 3.5 per cent); of Israel at 6.8 million (API: 1.6 per cent); of Jordan at 5.6 million (API: 2.4 per cent); of Lebanon

Table 23.1: Projected Population Growth for the Narrow Middle East countries for the Period 2005-2050. **Source:** UN (2001, 2005, 2009).

	Population in 2005 (UN 2009)	Projected Population in 2050 (UN 2009)	Projected Population Difference 2005-2050
Egypt	77 154 000	129 533 000	52 379 000
Syria	19 121 000	36 911 000	17 790 000
Jordan	5 566 000	10 241 000	3 957 000
Israel	6 692 000	10 649 000	3 957 000
OPT (Palestine)	3 762 000	10 265 000	6 503 000
Lebanon	4 082 000	5 033 000	951 000

at 4.5 million (API: 1.7 per cent); of Syria at 18 million (API: 2.4 per cent); and of Egypt at about 74 million (API: 2.0 per cent).

Table 23.1 shows the highest *projected population difference* (PPD, in percentage) for the OPT (Palestine) followed by Jordan, where PPD reaches to 269 per cent and 139 per cent, respectively. The lowest PPD is for Lebanon followed by Israel, where it reaches to 43 per cent and 67 per cent, respectively. Egypt and Syria will have lower PPD (68 per cent and 125 per cent, respectively) than the OPT (Palestine) and Jordan, and higher PPD than Lebanon and Israel. A PPD in the range of 43–269 per cent over 45 years will put extra pressure on the region's water resources and on the environment, taking climate change impacts into account.

According to the *Palestinian Central Bureau of Statistics* (PCBS 2008, 2008a), the OPT's population was about 4 million in the year 2007, about 2.5 million in the West Bank and 1.5 million in the Gaza Strip. The present estimated natural population growth rate for the Palestinians in the OPT is 3.5 per cent (3.1 per cent in the West Bank; 3.7 per cent in the Gaza Strip), being one of the highest growth rates in the Middle East (Salem 2009a). The average population density in the West Bank is 432 persons/km^2 in the total area, and 6,842 persons/km^2 in urban areas (PCBS 2006), while in the Gaza Strip, the average population density is 3,981 capita/km^2 in the total area, and 7,485 capita/km^2 in urban areas (PCBS 2006), making it one of the most densely populated areas in the world.

The climate in HP is typically Mediterranean, with a long, hot and dry summer; a short, cool and rainy winter, and a dry autumn. The temperature and the evaporation rate increase in the south and east. The average annual rainfall ranges from less than 50 mm to 800 mm, almost 70 per cent occurs between November and February, and the rest between March and May. The climate change impacts on rainfall, evaporation, desertification and storm intensity have been observed in the OPT which has suffered from severe shortages of natural resources, particularly water.

23.4 Climate Change Impacts on the OPT

This section reviews major physical and socio-economic impacts of climate change on the OPT for water resources (23.4.1), agriculture (23.4.2), due to Sea-Level Rise (23.4.3), for biodiversity (23.4.4), and human health (23.4.5).

23.4.1 Water Resources

Interest in water resources in the Mediterranean has risen due to population growth and increase in density in urban areas (Brauch 2007). The water demand in the OPT is dominated by three major user groups: agricultural irrigation, domestic use, and industry. Even without climate change the water scarcity in the Middle East is a huge problem, politically, demographically and economically. A rapid growth in agricultural and industrial output is needed to sustain the growing population, which requires a good water management.

23.4.2 Agriculture

In the OPT fruit production is a primary source of income for agricultural areas, which is extremely vulnerable to temperature extremes which the OPT experienced since the 1980's (table 23.2).

The following impacts of climate change are projected for agriculture in the OPT:

- Increases of temperature and extreme-events frequency will reduce crop yields (some crops are

Table 23.2: Extreme Weather Events in the OPT (1997-2004). **Source:** Salem (2007).

Date	Event
18-19 March 1997	A heavy storm hit the central and southern parts of the West Bank, which was the second heaviest storm in March during the past 60 years.
July-August 1998	The hottest summer in 35 years where the temperature rose up to 46.8°C in Jericho.
September-November 1998	The driest and warmest autumn during the past 58 years.
24 January 1999	A hail storm hit Jerusalem with hail stones as big as marbles (1.3 cm in diameter).
28 November 1999	Unusually cold and dry weather. The temperature in Jerusalem dropped to 6°C below zero.
July 2000	The hottest month of July in the last 50 years, with a mean temperature of 4°C higher than average. The highest recorded temperature (41°C) in Jerusalem since 1888.
February 2003	The wettest month since December 1991, and the wettest February ever recorded.
29-30 May 2003	Lowest pressure (995 mb) ever recorded in May, accompanied by an incredible sand storm that covered the entire OPT and the region with thick red sand and dust.
9-10 May 2004	Very intense heat affected the OPT, especially during the night of 9 May, when 32°C was recorded in Jerusalem. In the following nights, the temperature in Jerusalem was 20°C lower than the temperature at noon.

more tolerant than others), and will negatively affect marginal land and its farmers.
- Mean-temperatures modification will induce changes of the agricultural distribution of crops.
- Water scarcity will force farmers to abandon marginal land and will increase desertication.
- Socio-economic impacts, associated with the loss of agricultural and other related jobs, will result in increasing unemployment and in the loss of income, as well as in political disorder.

23.4.3 Sea-Level Rise

The Gaza Strip covers 40 km of the South-eastern coast of the Mediterranean Sea and is only 11 km wide. The *sea-level rise* (SLR) due to global warming will enhance erosion of the Gaza Strip beaches, and will also cause sea water intrusion into the *Gaza Coastal Aquifer System* (GCAS). Some low-lying coastal structures will be affected or damaged, causing a huge loss in valuable lands and buildings and forcing inhabitants to migrate.

23.4.4 Biodiversity

During the 20th century global warming has already resulted in extensive biodiversity losses. The Mediterranean Basin is one of 25 'global biodiversity hotspots' (Myers/Mittermeier/Mittermeier/Fonseca/Kent 2000). The biodiversity in HP has been high, being at a crossroad of African, Asian, and Mediterranean bio-geographic regions. The speed and magnitude of climate change may elicit different responses at different levels of ecological organizations, namely the people, the species, and the communities, and at all levels of the ecosystems.

23.4.5 Human Health

Climate change is expected to have critical impacts on human health in the Mediterranean and in the OPT, due to the lack of advanced medical care. It will have both direct and indirect impacts on the Palestinian society (Salem 2008b). People who suffer from pollen and dust allergies will suffer more from changes in climate, as the allergy season will start earlier, last longer, and become more intense. In the past, the allergy season started in May but now it starts in March. An increase in respiratory diseases is expected among children, the elderly, and those with chronic diseases. In addition, the very young, the very old, and the very weak are likely to be affected by heatwaves and, thus, mortality rates may increase in these groups.[8]

Many prevalent human diseases are linked to climate fluctuations, including cardiovascular mortality and respiratory illnesses (due to heatwaves), infectious diseases, and malnutrition from crop failures. The *World Health Organization* (WHO) estimated that the warming and precipitation trends, due to anthropogenic climate change during the period of 1972–2002, had claimed annually over 150,000 premature lives (WHO 2002). The global warming trend has already increased mortality rates (Patz/Campbell-Lendrum/Holloway/Foley 2005).

Indirect impacts of climate change may appear from diseases being transmitted by insects. Many diseases may spread in the OPT, particularly in the Gaza Strip, where impacts are expected to be severe. A cause of greatest concern is the possible spread of malaria (Kovats/Menne/McMichail/Corvaln/Bertollini 2000). Approximately half of the world's population is at risk of malaria, with over 270 million cases per year and more than one million deaths (WHO 1998, 2009).

23.5 Climate Change Impacts due to Man-Made Activities

For a healthy and productive environment, the impact of climate change and its causes must be taken into account (Pararas-Carayannis 2003). These factors have contributed to anthropogenic climate change: a) burning of fossil fuels; b) rise in urbanization, industrialization and consumption; c) production of huge amounts of waste; d) increased air, water, and soil pollution; e) lack of appropriate land and water management; f) deforestation; and g) many wars.

23.5.1 Effects of the Israeli Segregation Wall on Climate Change

The construction of the *Israeli Segregation Wall* (ISW) was started in 2002. Until December 2008 its total length had reached 768 km on the northern, western, and southern borders of the West Bank and it encircled East Jerusalem. The ISW (table 23.3; figure 23.2) consists of a 4–5 m high double-layered electric metal fence, reinforced with barbed wire, trenches, surveillance cameras, sensors, footprint-detection tracks, security patrols, and military roads. Other parts of the ISW, dividing Palestinian population centres, consist of 8–12 m high concrete segments that form an immense solid concrete barrier with military watchtowers lined up to 250 metres apart. The ISW has devastated an area of 40–100 m along its route. Besides its huge cost, the ISW has major environmental, social, economical, and political impacts on the Palestinians in the West Bank (ARIJ 2007, 2008).

Table 23.3: Changes in the Route of the Israeli Segregation Wall (ISW) between June 2004 and December 2008. **Source:** ARIJ (2008).

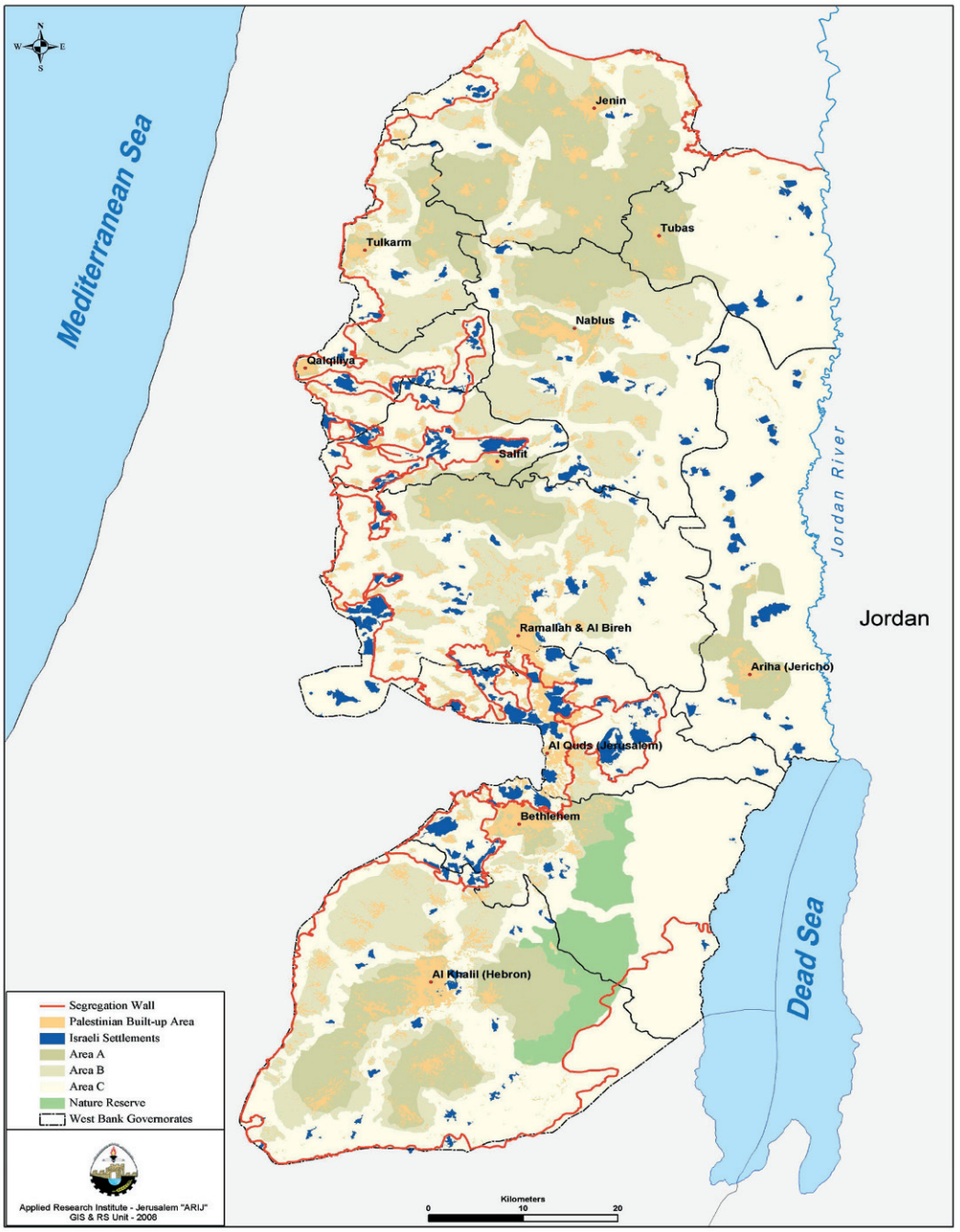
Date of Change	Wall Length (km)	Area Isolated (km²)	Of the West Bank's Area (per cent)
June 2004	645	633	11.2
February 2005	683	565	10
April 2006	703	555	9.8
April 2007	770	713	12.6
December 2008	768	734	13

In June 2002, the Israeli Government launched its policy of unilateral segregation of Israel and the OPT by establishing a segregation zone along the western terrains of the West Bank which covers large areas that are rich in natural resources (groundwater, springs, agricultural lands), grabbing fertile agricultural land, isolating Palestinian communities in enclaves, undermining the territorial contiguity between Palestinian villages and cities, controlling the natural resources, and encapsulating most of the Israeli settlements built illegally on Palestinian lands since 1967.

A decision of the *International Court of Justice* (ICJ) of 9 July 2004 saw the ISW as an attempt to connect illegal Jewish settlements in the West Bank to Israel by annexing Palestinian land. The ISW will have significant impacts on future negotiations on borders. By building the ISW (and of 200 Jewish settlements) on confiscated Palestinian territory, Israel violated the Hague Convention of 1907 and the Fourth Geneva Convention of 1949 (IHL 1907, 1949). The ISW violates the right to self determination and basic human rights, especially the right of free movement and access to holy places, work, health, education, and to an adequate standard of living. 'Self-defence' cannot be used to justify violating international legal principles and the rights of a people living under military occupation (McMahon 2005). The ICJ concluded

8 On May 18, 2007, Greece assumed the tenth Chairmanship of the *Human Security Network* (HSN) founded in 1999, which includes countries from Europe, North and South Americas, Africa and the Middle East. The HSN supports the United Nations' principles and aims at raising the awareness of the international community in the direction of effective support and protection of vulnerable population groups against modern threats to human security, which undermine development prospects in many parts of the world. Within the framework of its Chairmanship, Greece's priority is to point out the relationship between climate change and human security at international level. The aim is to raise the international community's awareness of the impact of climate change and global warming on human security, with regard to vulnerable groups, particularly children, women and persons fleeing their homes, due to climate change impacts (GMFA 2007).

Figure 23.2: The Israeli Segregation Wall (ISW) and Segregation Zones in the West Bank. **Source:** ARIJ (2008).



that the ISW was contrary to international law and, therefore, Israel must cease the wall's construction.

Since 2002 the route of the ISW has been changed several times (table 23.3) to benefit Israeli settlements in the West Bank, thus expanding the segregated zones. In September 2004, the Israeli army issued military orders that created a buffer zone of 150–200 m on the Palestinian side where new construction by Palestinian citizens is prohibited. As a result, an additional area of 252 km^2 (or 4.4 per cent) of the West Bank has become inaccessible to Palestinians.

Until December 2008 the ISW was 768 km long, of which only 80 km (10.4 per cent) follows the 1949 'Armistice Line' or 'Green Line' (figure 23.1, 23.2). The

ISW has isolated 734 km^2 (13 per cent) of the West Bank's area (table 23.3). By its completion, the ISW will enclose 107 Israeli settlements (with 425,000 Jewish settlers), and it will totally enclose East Jerusalem. The settlers that will be enclosed represent more than 80 per cent of all settlers in the West Bank (ARIJ 2008). Israel has made a few cosmetic changes of the ISW's route that do not ameliorate its devastating effects on the Palestinians and their lands and properties. The goal of these small changes has been to include more settlements between the ISW and the 1949 Armistice Line.

The Israeli army has consolidated its control over the West Bank in the Eastern segregation zone (1,555 km^2, or 27.5 per cent of the West Bank), through 28 military checkpoints. Until December 2008, Israel has illegally established 670 checkpoints in the West Bank (ARIJ 2008). After the 1967 War, Israel classified some 925 km^2 as a 'closed military area', and it illegally classified an additional 632 km^2 of the Eastern segregation zone as 'state land', which includes the settlements and the military bases, and parts of the closed military areas. The Israeli segregation plan appropriates more than 40 per cent of the West Bank (ARIJ 2007, 2008).

Until winter 2008, about half (377 km) of the ISW's total length (768 km) was completed; 12.4 per cent (or 95 km) of it was under construction (ARIJ 2008), and plans to complete an additional 38.5 per cent (or 296 km) were confirmed. The boundaries of 29 Palestinian villages (or 216.7 km^2) are trapped in enclaves behind the ISW, and another 138 Palestinian villages (or 555 km^2) are significantly affected and lost behind the path of the ISW. Furthermore, 45 Palestinian communities with more than 43,000 people will be isolated in the Eastern segregation zone.

The Western segregation zone includes 107 Israeli settlements in the West Bank that cover an area of 106.7 km^2 (or 15 per cent of the zone). In addition, 56 settlement outposts are located in this zone. Settlements in the Eastern segregation zone cover an area of 38 km^2 (or 2.4 per cent of the zone). In the Eastern segregation zone 12,550 Israeli settlers live in 39 settlements, besides 30 settlement outposts. Until December 2008, the total number of settlement outposts has reached 220, in addition to the 200 settlements spreading all over the occupied West Bank (ARIJ 2008).

The ISW has considerable impacts on the region's water supplies around it. "The climate of Palestine is semi-arid, and water sources are precious. In villages around Qalqilya and Tulkarm, more than 30 wells will be lost in the first phase of the wall [ISW]. These wells, located in the western groundwater basin, were drilled prior to the 1967 Israeli occupation of the West Bank. As a result, Palestinians will lose nearly 18 percent of their share of the basin's water" (Reese 2003). The Israeli journalist Meron Benvenisti claimed, "terrible environmental damage is being inflicted on large areas in the heart of the country. Seventeen million cubic meters of soil, with tens of thousands of olive trees, thousands of dunoms of orchards and groves, tens of thousands of dunoms of natural growth, hot houses, archaeological sites and [water] wells – as well as the fabric of life of hundreds of thousands of people [Palestinians] – are being crushed by giant bulldozers. Yet the environmental organizations have nothing to say about the damage caused by the fence [ISW]. On the contrary, they exploit the tragedies of others to promote their own interests. The destruction of the Palestinian environment presents the opportunity to demand 'environmental compensation' within Israel. Moreover, the environmentalists are fighting for safe passage for small wildlife, while ignoring the fact that freedom of movement is being denied to hundreds of thousands of people – including small children – in an arbitrary manner. What selective sensitivity!" (Benvenisti 2004).

Due to the ISW, the Palestinians in the West Bank have already lost huge amounts of their water in the *Western* (WAS), *North-Eastern* (N-EAS) and *Eastern Aquifer Systems* (EAS). Further, parts of their agricultural land and many water wells and springs were lost (Salem/Isaac 2007):

- Up to 192 km^2 of agricultural lands are isolated in the Western, in addition to 844 km^2 in the Eastern segregation zone, which both constitute 18.3 per cent of the West Bank's total area (5,661 km^2).
- Up to 247 km^2 of forest land and areas with shrubs are isolated in the Western and 708 km^2 in the Eastern segregation zone, which constitute 16.9 per cent of the West Bank's total area.
- The Eastern segregation zone has isolated 204 groundwater wells and 43 springs, and the Western segregation zone has isolated 29 groundwater wells and 29 springs.

The negative ecological footprint of the ISW is enormous, as huge areas of fertile Palestinian lands in the West Bank are lost, being isolated behind the ISW and thus beyond the reach of Palestinian communities. With the construction of the ISW a large number of trees have been uprooted, what has severe impacts on the hydrology of the watersheds in the affected areas.

As a result of the ISW, considerable changes in water quantity and quality have occurred in the stream channel morphology, in the groundwater levels, and in the region's water supplies. The surface water flow has been altered, and severe increases in the rates of erosion and sedimentation have already occurred. Given this complex geopolitical situation, politics has, directly and indirectly, contributed to local changes of the climate (Salem 2008c). The OPT is not only suffering from Israeli policies and practices but also from the SLR due to the impacts of global climate change.

23.5.2 Sea-Level Rise Impacts on the Gaza Strip

The Gaza Strip (figure 23.3), with a total area of 362 km^2 and a population of about 1.5 million, is one of the most densely populated areas worldwide. The Israeli buffer zones along Gaza's northern and eastern borders are based on a clause of the Oslo Agreement (1994), under which Israel maintains a 0.5 km wide zone along the 58 km long northern and eastern borders of the Gaza Strip. This buffer zone occupies 29 km^2 (8 per cent) of Gaza's territory and is controlled by the Israeli army with a Palestinian security monitoring. In September 2000, the Israeli army unilaterally expanded this zone from 800 up to 1,300 metres.

This buffer zone is off limits for Palestinians who are not allowed to build, cultivate, or to be in or close to that area. When the Israeli army completed its disengagement from the Gaza Strip in late 2005 the buffer zone then covered 61 km^2 (or 17 per cent of the territory of the Gaza Strip). On 28 June 2007, the Israeli army expanded the buffer zone along the Gaza Strip's northern and eastern borders to become 1.5 km wide. Accordingly, this newly defined buffer zone occupies an area of 87 km^2 (or 24 per cent of the Gaza Strip; Salem 2007). No recent information is yet available about the new size of the buffer zone after Israel's most recent war in the Gaza Strip from 27 December 2008 to 18 January 2009.

The Gaza Strip is a foreshore plain gradually sloping westwards to the Mediterranean Sea. It has four ridges with different elevations, ranging from 20 to 90 m above sea level. With its extremely large population and low altitude, the Gaza Strip is highly vulnerable to climate change impacts.

The population of the Gaza Strip experiences severe water quality and quantity problems. These include: a) intrusion of sea water, and of saline water from deeper saline strata into the *Gaza Coastal Aquifer System* (GCAS); b) high levels of water pollution (high concentrations of chloride, nitrate and other chemicals); c) biological and chemical contamination, due to untreated sewage and the heavy use of pesticides and fertilizers in agriculture which penetrate into the GCAS; d) return flows from intensive irrigation; and e) over-extraction of water from the GCAS. This is in addition to the rapid population growth, the high level of poverty, the spread of diseases, and the scarcity of water resources. All these problems are beyond the capacity of the Gaza Strip's inhabitants. These problems have caused not only environmental hazards but also profound risks to peace, stability, and sustainable development (Kelly/Homer-Dixon 1998; Brauch 2003; Salem/Isaac 2007). These problems have already resulted in 'environmental migration', in addition to the 'political and economical migrations' the Gaza Strip has experienced for a long time.

Qahman and Zhou (2001) predicted that by the year 2015, the sea water intrusion will be 2,300 m (2.3 km) in the upper part of the GCAS and 2,800 m (2.8 km) in the GCAS's lower part. The poor quality of water supply in the Gaza Strip is such a major concern for its people that it is seriously affecting their quality of life and, thus, exposes them to severe health risks (Alfarra/Lubad 2004; Bohannon 2006; IRIN 2006; Salem/Isaac 2007; Abu Heen/Tubail/Abu El-Naeem 2008).

These problems have already contributed to a serious deterioration of the local environment. The projected climate change impacts for the Gaza Strip during the next 30 to 100 years will be significant. Considerable attention should be paid to problems of SLR, sea water intrusion, and water contamination and their impacts on environmental migration, poverty, hunger and health problems, as well as on instability in this small and very densely populated area.

Scenarios of the *United Nations Environment Programme* (UNEP) indicated that a 50 cm rise in sea level could displace millions of Egyptians living close to the Mediterranean shoreline by the year 2050.[9] As the Gaza Strip is a natural extension of the Egyptian coastal shores on the Mediterranean, it will be affected by the SLR in a similar way. To give a rough estimate of the SLR for the Gaza Strip, the empirical equation given by El Raey (2007) is used (table 23.4).

Table 23.4 shows that for the last century, the sea level rose about 20 cm, and it will rise another 23 cm

9 See FoEME (2007); El Raey, Nasr, Frihy, Desouki and Dewidar (1995); El Raey, Fouda and Nasr (1997); El Raey, Dewidar and El Hattab (1999); Agrawala, Moehner, El Raey, Conway, van Aalst, Hagenstad and Smith (2004); El Raey (2007); chap. 45 by El Raey.

Figure 23.3: The Gaza Strip Surrounded by Three Israeli Buffer Zones. **Source:** ARIJ (2008).

until the end of this century. Over the 185 years from 1915 to 2100, the sea level in the Gaza Strip rose or may rise by at least 43 cm, or about 0.23 cm/yr. These values correspond with the findings of UNEP for the global SLR by 2 cm in the 18th, by 6 cm in the 19th, and 19 cm in the 20th century (UNEP 2009; IRIN 2009a).

According to recent publications the SLR may accelerate. When the ice melted at the end of the last ice age 10,000 years ago, the sea level rose by between 70 and 130 cm per century (UNEP 2009). Recent studies argued that if the atmospheric CO_2 concentrations were not kept below 350 part per million (ppm), the results could be disastrous (Hansen/Sato/Kharecha/Beerling/Masson-Delmotte/Pagani/Raymo/Royer/Zachos 2008). The current level of CO_2 concentration in the atmosphere is 385 ppm. If it exceeds 450 ppm, it could lead to a catastrophic SLR. The EU has set a target to stabilize the atmospheric GHG concentration at 550 ppm by the year 2035 (TGG 2008). Hansen argued that the EU target of 550 ppm should be reduced to 350 ppm if "humanity wishes to pre-

Table 23.4: Calculated Sea-Level Rise (SLR) for the Gaza Strip's Region during the Period of 1915-2100 (based on the El Raey's (2007) empirical equation for the Port Said Area in Egypt: *Y = 0.2314X - 442.7, where Y is SLR in cm and X is year.*).

1915 (cm)	1925 (cm)	1950 (cm)	1975 (cm)	2000 (cm)	2010 (cm)	2025 (cm)	2050 (cm)	2075 (cm)	2100 (cm)
0.4	2.8	8.5	14.3	20.1	22.4	25.9	31.7	37.5	43.2

Table 23.5: Characteristics of the Stabilization Scenarios. **Source**: Pachauri (2008).

Stabilization level (ppm CO_2-eq)	Global mean temp. increase (°C)	Year CO_2 needs to peak	Global sea level rise above pre-industrial from thermal expansion (m)
445 – 490	2.0 – 2.4	2000 – 2015	0.4 – 1.4
490 – 535	2.4 – 2.8	2000 – 2020	0.5 – 1.7
535 – 590	2.8 – 3.2	2010 – 2030	0.6 – 1.9
590 – 710	3.2 – 4.0	2020 – 2060	0.6 – 2.4

serve a planet similar to that on which civilization developed" (Pilkington 2008). Table 23.5 shows the SLR for the next 50 years due to increases in global mean temperature.

Studies on the SLR in the Gaza Strip are urgently needed, especially after Israel's 21 day invasion in 2008/2009, which also caused huge damages to the environment (Bergstein 2009; Falk 2009; IRIN 2009b, 2009c; Kloosterman 2009; Mitchell 2009; Salem 2009b, 2009c).

23.5.3 Water Scarcity and Transboundary Aquifer Systems

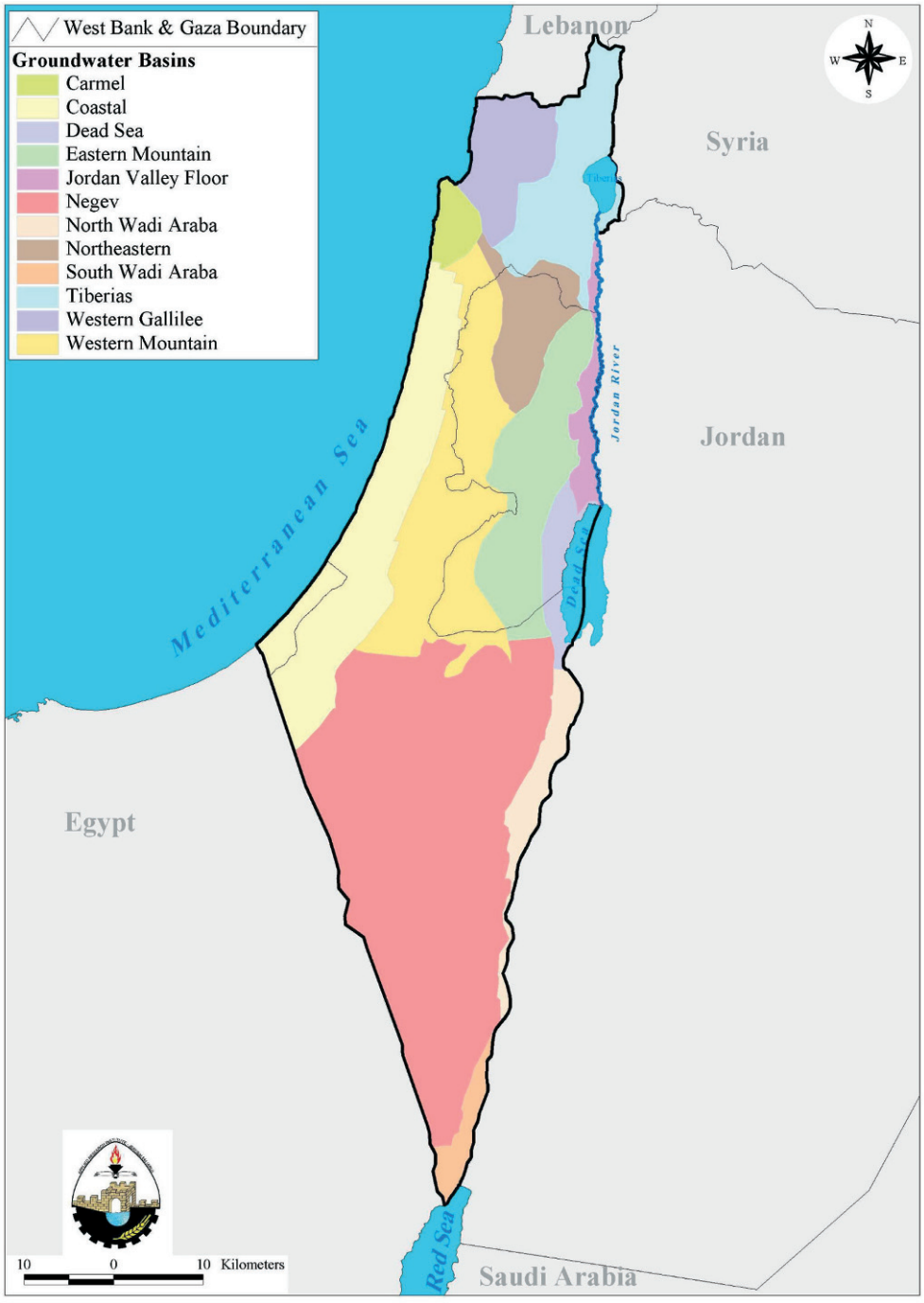
During the 5th World Water Forum in Istanbul in March 2009, Koïchiro Matsuura, Director of UNESCO, said, "that unless we change our behaviour towards fresh water we will face a major water crisis. Water is the principal medium through which climate change will affect economic, social, and environmental conditions" (IRIN 2009d).

Historical Palestine (HP) includes 11 groundwater aquifer systems (figure 23.4) of which three are in the West Bank: the *Western* (WAS), *North-Eastern* (NEAS), and the *Eastern Aquifer Systems* (EAS) which all comprise the *Mountain Aquifer Basin* (MAB), as well as the *Gaza Coastal Aquifer System* (GCAS) under the Gaza Strip (figure 23.4, 23.5). These four aquifer systems are extensively used by Israel and the 200 Jewish settlements in the OPT (Salem/Isaac 2007). The Palestinians have severely suffered from huge water shortages (for domestic, agricultural and industrial needs). The Palestinians are only allowed to use 15 per cent of their own water. As Israel controls the water in these aquifer systems, the impacts of climate change will double in the OPT, given the severe water shortages and Israeli denials of Palestinian water rights.

Independent research by Palestinians is urgently needed to acquire detailed knowledge on the aquifer systems in the OPT, their recharge and discharge areas, the status of wells penetrating them, and their delineation, as well as on the flow of pollutants within these aquifer systems.

The *Western Aquifer System* (WAS) is the largest system, with a safe yield of 365 million cubic metres/year (MCM/yr), of which 40 MCM is brackish water. Eighty per cent of its recharge area is in the West Bank, whereas 80 per cent of its storage area is in Israel. The water flows towards the coastal plain in the west (figure 23.5), making it a shared basin for Israelis and Palestinians. Water in this WAS is mainly of good quality and is largely used for municipal supply. Israelis have exploited this system through 300 deep wells in the west of the Green Line, as well as through the deep wells drilled by *Mekorot* in the West Bank (Salem/Isaac 2007). Palestinians consume only about 7.5 per cent of this water. They extract their water from 138 wells, including 120

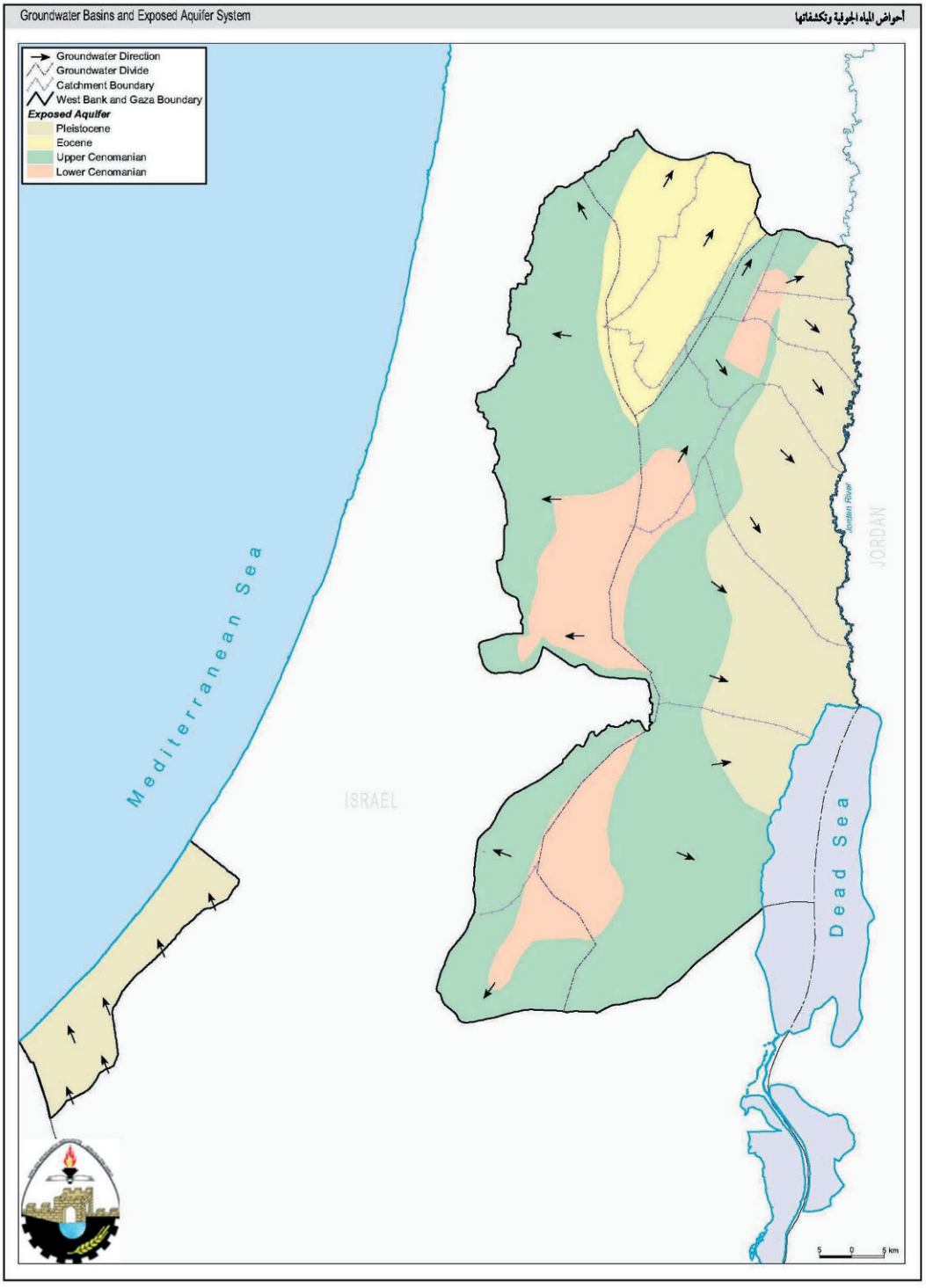
Figure 23.4: The Aquifer Systems in Historical Palestine (including Israel and the OPT). **Source:** Salem and Isaac (2007).



wells for irrigation use and 18 wells for domestic use in Qalqilya, Tulkarm, and western Nablus (figure 23.2). There are 35 springs with an average flow of approximately 0.1 l/s (360 l/hr). Many of these wells are beyond the reach of Palestinian communities as they are isolated behind the ISW.

The *North-Eastern Aquifer System* (N-EAS) has an annual safe yield of 145 MCM, of which 70 MCM is brackish water. Palestinians in the Jenin district and eastern Nablus (figure 23.2) consume only about 18 per cent for both irrigation and domestic purposes. There are 86 Palestinian wells, including 78 for irrigation and 8 for domestic use. The general groundwater

Figure 23.5: The Aquifer Systems in the Occupied West Bank and Gaza Strip. **Source:** Salem and Isaac (2007).



flow in this aquifer system is towards the natural springs in the north and north-east (figure 23.5).

The *Eastern Aquifer System* (EAS) has an annual safe yield of 175 MCM, of which 70 MCM is brackish water. This EAS lies entirely in the West Bank and was exclusively used by Palestinian villagers and farmers until 1967 (Salem/Isaac 2007). Then Israel expanded its control and tapped it to supply Jewish settlements

in the West Bank. Seventy-nine springs, with an average discharge of more than 0.1 l/s (360 l/hr), provide 90 per cent of the total annual spring discharge in the West Bank. There are 122 Palestinian wells drilled in this system, including 109 for irrigation and 13 for domestic use. The groundwater flows towards the Jordan Valley and the Dead Sea (figure 23.5).

The *Gaza Coastal Aquifer System* (GCAS) is the sole water source for Palestinians in the Gaza Strip (figure 23.5), providing it with 96 per cent of its needs. This aquifer system is a continuation of the shallow sandy/sandstone Coastal Aquifer used by Israel (figure 23.4). Over 4,000 wells penetrate the GCAS with depths ranging from 25 to 30 metres. The annual safe yield of this system is 55 MCM. It has been overused with more than 120 MCM annually. As a result, the groundwater table fell below sea level, and saline water has intruded the aquifer system in many areas.

23.5.4 Water Scarcity, Climate Change Coping Strategies for the Jordan River Basin (JRB), and Water Conflict

The study of the impacts of climate change for water scarcity, biodiversity, agriculture, ecosystems, irrigation, desertification, etc. requires multidisciplinary scientific knowledge based on *in situ* and remote sensing measurements, monitoring and experiments, socio-economic data, and modelling from conventional and non-conventional methods of water management and of their ecological and socio-economic implications.

While Historical Palestine and Jordan have one of the lowest per capita water supplies worldwide, the water demand has rapidly increased due to population growth and economic development. These conditions have further deteriorated due to the political conflict. Climate projections for the Eastern Mediterranean refer to increased aridity, which has started during the past few decades with lower precipitation and higher evaporation rates. Temperature increases and prolonged droughts have severely reduced the surface-water and groundwater supplies.

The *Upper Catchment of the Jordan River* (UCJR) is a valley (80 km long and 15–30 km wide), covering approximately 1,600 km^2. The flow into the UCJR is continuous throughout the year, with an average yield of about 500 MCM annually, all of which is taken by Israel, contributing about 25 per cent of Israel's total water budget (Salem/Isaac 2007). Since 1967, the OPT has not benefited from the JRB's waters. Most groundwater resources in the region are transboundary, requiring strategies for sustainable water management based on regional collaboration.

Research on climate change impacts for the JRB and other regional transboundary water resources requires comprehensive analyses on: a) the range of environmental stresses and their effects; b) the resilience of regional ecosystems; c) the adaptive capacity of regional socio-economic systems to changes in the hydrological cycle and water resources; d) the interactions of agriculture and irrigation with water resources and regional atmospheric processes; and e) the extreme events (droughts, heatwaves, floods, etc.). The studies of the *Global Change of the Water Cycle* (GLOWA) on the JRB (Part I, II), focusing on the Upper and Lower Catchments of the Jordan River, indicated that an increase in average temperature of 0.75°C and a decrease in rainfall will take place in the JRB during the period from 2007 to 2045 (GLOWA 2007).

The water resources available to Palestinians in the OPT are, per capita, among the lowest in the world (Salem/Isaac 2007). The Israeli per capita consumption for domestic and agricultural uses is 254 *cubic metres per year* (m^3/yr), while the Palestinian per capita consumption for both domestic and agricultural uses is only 81 m^3/yr, or less than one third of the Israeli per capita consumption. The Israelis take about 60 per cent of their water needs from the JRB, more than 25 per cent from the *Mountain Aquifer Basin* (MAB), and the rest from desalination and water treatment plants, water harvesting, and fossil water in the Negev Aquifer System (figure 23.4). A study referred to high rates of radioactive elements (radium isotopes) in the fossil groundwater aquifers in the Middle East. The study on the Disi Aquifer System in southern Jordan concluded that the findings raise concerns about the safety of this and similar non-renewable groundwater aquifer systems, exacerbating the already severe water crisis in the Middle East (Vengosh/Herschfeld/Vinson/Dwyer/Raanan/Rimawi/Al-Zoubi/Akkawi/Marie/Haquin/Zaarur/Ganor 2009).

Most of the Israeli water consumption (75 per cent) goes to irrigated agriculture (Isaac/Selby 1996; Salem/Isaac 2007), though this sector contributes less than five per cent to the Israeli GDP, and only two per cent of the Israeli labour (including support service) is employed in this sector (IMA 2004). Almost half of Israel's cultivated land is irrigated, and about 70 per cent of the land cultivated by Israeli settlers in the West Bank is irrigated. By contrast, only 6 per cent of the Palestinian land is irrigated and the rest is rain-fed,

although agriculture is more important to the Palestinians and more central to their economy than to the Israelis, as it contributed about 11 per cent to the Palestinian GDP in the year 2004 (Attaya 2005) and more than 26 per cent to employment in the OPT (HighBeam 2007).

Since June 1967, Israel imposed several military orders to control the Palestinian water resources, including the Order No. 92 of 15 August 1967 (JMCC 1995), stating that the water is to be considered a strategic resource and all new wells must be approved by the Israeli military where both Israelis and Palestinians are purportedly given equal consideration. While Israel and its settlers consume more than 85 per cent of the Palestinian water resources, Israel has granted only a few wells to the Palestinians (Isaac/Salem 2007). Many other military orders followed, extending a complete Israeli military control over Palestinian water resources, including the three West Bank aquifer systems of the MAB, the JRB and its tributaries, Lake Tiberias, and the Syrian Golan Heights. The Palestinian water and fishing rights in Lake Tiberias are unquestionable, based on the fact that the Palestinians are riparians with the privilege of equitable utilization.

While the Palestinians are not allowed to drill new wells or rehabilitate old ones, Israel drilled deep wells in the four aquifer systems (WAS, N-EAS, EAS, and GCAS; figure 23.4) under the OPT. This means that the old shallow Palestinian wells dry up, leaving the Palestinian population without water, especially in hot summers and during drought. The Palestinians have no choice but to buy their water from *Mekorot* that extracts it from the four aquifer systems under the West Bank.

Israel takes about 60 per cent of the surface water (685 MCM/yr) of the Jordan River, while Jordan receives 23 per cent (263 MCM/yr), Syria 11 per cent (126 MCM/yr), and Lebanon only 0.3 per cent (3.4 (MCM/yr), and the rest (5.7 per cent or 65 MCM/yr) flows into the Dead Sea.

Currently the Palestinians in the OPT receive nothing from the JRB. Until their water rights in the JRB were taken away by the Israelis, the Palestinians had used this water for centuries and they extracted 30 MCM/yr for domestic and agricultural purposes. Israel claims prior usage of the MAB (Shuval 2007), but denies the Palestinians' prior use of the Jordan River's waters. Palestinians have used the MAB's waters for centuries. They used the natural springs that are recharged from the WAS, and they had a few deep wells penetrating that system, long before Israel was established in 1948. With the construction of the ISW, Israel has surrounded important Palestinian water resources, including many springs and wells owned by Palestinians.

It is estimated that 70 per cent of the recharge area of the Western Aquifer System has been or will be isolated between the ISW and the Green Line (figure 23.2). In the northern part of the West Bank, the ISW acts as a concrete dam, trapping water and preventing it from flowing west and thus causing flooding in nearby areas. Furthermore, while the 200 Israeli settlements in the West Bank always receive water, the Palestinians in the West Bank may get water once or twice a month. About 25 per cent of the West Bank's Palestinian population are still not connected to the water network. Bringing water to these people is still a decision of Israel, according to the 1993 Oslo Agreement that divided the West Bank into 'Area A', 'Area B', and 'Area C', each of which has certain jurisdictions (Salem 2009a).

Article 6 of the *UN Convention on the Law of the Non-Navigational Uses of International Watercourses* (1997) on 'Factors Relevant to Equitable and Reasonable Utilization' states the following factors should be considered in water conflicts (UN 2005b; Salem/Isaac 2007):

> 1) the geography of the basin, including the drainage areas; 2) the hydrology of the basin, including the contribution of water by each basin (if more than one); 3) the climate affecting the basin; 4) the past utilization of the basin's water; 5) the economic and social needs of each of the basin's riparians; 6) the population dependent on the basin's water, with regard to each of the basin's riparians; 7) the comparative costs of alternative means that satisfy the economic and social needs of the basin's riparians; 8) the availability of other water resources; 9) the avoidance of unnecessary waste in the utilization of the basin's water; 10) the practicability of compensation to one or more of the basin's riparians, as a means of adjusting conflicts among users; and 11) the degree to which the needs of a riparian of the basin may be satisfied, without causing substantial injury to any of the basin's riparians.

Israel bases its claims on the fourth point (Shuval 2007), while ignoring the other 10 points that do not give Israel a favourable treatment regarding the water resources in Historical Palestine. Israel has ignored (Shuval 2007) the vast history of the prior Palestinian use and current needs, as well as the Palestinian shares of the water resources in the region. In this case, Israel has violated the Hague Resolutions of 1907 (IHL 1907) and the Fourth Geneva Convention of 1949 (IHL 1949), and many other international

treaties, by controlling and exploiting the water resources far beyond what is allocated to Israel. Israel has ignored the water agreements signed with the Palestinian leadership in 1993 and 1995, according to the Oslo Peace Agreements, whereby Israel should acknowledge the Palestinians' immediate needs of 28.6 MCM/yr and future needs of 70–80 MCM/yr (Palestine Facts 2009).

Israel argues that huge extraction of water from the Jordan River is supported by international law (Shuval 2007), basing its claims on a draft proposal called the *Johnston Plan* (JP) which they negotiated with their Arab neighbours in 1956 (Elmusa 1997). Israel considered the JP as a de facto law and invoked it on occasions. The JP called for the *West Ghor Canal* (WGC) to supply the West Bank with 250 MCM/yr to meet the needs of the Palestinians. While the WGC was never built and the JP was never enacted due to the political conflict, the Palestinian water rights in the JRB still remain. Before Israel was established in 1948, the Jewish Agency ignored the *Ionides Plan* (IP) of 1939 which outlined a realistic assessment of water resources in the region (Elmusa 1997; Isaac/Salem 2007).

But Israel has never been interested in solving the water conflict with the Palestinians with respect to their water rights based on international law. Instead, Israel has been concerned about giving the Palestinians the minimum of what they need. Accordingly, Israel has always addressed the concerns of the Palestinian people in the OPT in terms of *water needs but not water rights* (Rouyer 2003).

While denying the Palestinians their water rights, Israel suggested water quantities for Palestinians from non-conventional sources, such as desalinization, water treatment, and water imports from Turkey. To find a common ground for a lasting peace, the allocation of waters among Palestinians and Israelis in *Historical Palestine* (HP) should be equally shared, and Israel needs to do its part to demonstrate that it has genuine peace aspirations with its neighbours.

A proposal has been made, based on international law, to solve the water conflict between Israel and Palestine fairly and peacefully, where the population size is considered (Salem/Isaac 2007; Isaac/Salem 2007). Under this proposal, the annual renewable amount of water in HP, which is about 2086 MCM/yr, should be equally shared, whereby the Palestinians in the OPT would get 698 MCM/yr instead of the 238 MCM/yr presently allocated to them. The Israelis would get 1,388 MCM/yr instead of the 1,959 MCM/yr they currently use. Accordingly, the per capita share would be 241 m^3/yr for both Palestinians and Israelis, instead of the 81 m^3/yr and 254 m^3/yr, which are presently consumed per person, respectively, in the OPT and Israel (including the illegal Jewish settlements in the OPT). A joint management structure would have to be agreed upon by both sides for the monitoring and compliance with these quotas, to assure protection of the water resources and a periodic reallocation, based on climatic and demographic changes.

This proposal reflects equity, which is essential for sustaining peace, stability, security and development. It offers the best way for resolving the water rights issue. It introduces an integrated water management scheme that will expedite resolving water conflicts not only between the Israelis and the Palestinians, but also among the Israelis, Jordanians, Syrians and Lebanese. The proposal encourages regional and international water cooperation. Such an initiative for a fair solution of the water conflict between Israelis and Palestinians and in the Middle East needs cooperation with other international bodies, such as the *Quartet* (UN, EU, USA, and Russia).

During the Euro-Mediterranean Ministerial Conference on Water in 2008 at the Dead Sea, in Jordan, the ministers decided to identify the different stages and the most suitable framework needed to strengthen the coordination of existing networks of information and expertise on water in an independent and neutral way (EuroMed 2008a). The ministers avoided any reference to the water conflicts in the Middle East.

23.5.5 Red Sea-Dead Sea Conveyance Project and Climate Change

The Dead Sea is the lowest body of water on the Earth's surface (421 m below sea level). Its water has the highest salinity and density of sea water. Its shores are the natural borders of Historical Palestine (OPT and Israel) on the west, and of Jordan on the east (figures 23.1, 23.5).

The goal of the proposed *Conveyance between the Red Sea and the Dead Sea* (figure 23.6) is to restore the considerable decline of the Dead Sea water level that dropped since the 1970's by more than 25 m. This negative water balance is due to the diversion of water from the catchment area of the Dead Sea by Israel, Jordan, and Syria (Bromberg 2008). This results in a loss of huge amounts of water that should be discharged in the Dead Sea. It is also due to the water mismanagement policies and strategies of upstream countries, and due to Israeli and Jor-

danian pumping of the Dead Sea water into evaporation ponds to produce salt. Thus, the Dead Sea Basin, a unique natural heritage (habitat for wildlife), a global cultural, archaeological and religious site, a natural clinic for many illnesses, and a tourist resort, is threatened with disappearing (Salem 2009d).

During the *World Summit on Sustainable Development* (WSSD) in Johannesburg in 2002, Israel and Jordan announced their interest to save the Dead Sea by constructing the *Red Sea-Dead Sea Conveyance* (RSDSC) that would pipe water from the Red Sea to the Dead Sea. The proposed RSDSC would be located in the Wadi Araba (Arava) between the Gulf of Aqaba and the Dead Sea (figure 23.6). The RSDSC would be between 180 and 200 km long, and it would transfer two billion cubic metres of salt water per year (BCM/yr), of which about 850 million cubic metres (MCM/yr) would be desalinated, and the huge amounts of salt from the desalination process would be left behind and dumped into the Dead Sea (Salem 2009d).

The difference in the water level between the Red Sea and the Dead Sea of about 590 m would be used for power generation. This includes the natural difference of water levels between both seas (about 420 m) and the height (about 170 m) to which the Red Sea water must be pumped. The power would be used for running the desalination plant(s) as part of the project. Although the RSDSC project (figure 23.6) may have some positive impacts, it would form a real hazard due to its environmental impacts and its possible contributions to climate change.

The RSDSC project would be one of the biggest projects in the region to restore the Dead Sea, to generate power, to provide fresh water to neighbouring nations, to establish development projects, to build new cities and rehabilitation centres, to create jobs, and to activate the peace process in the region. However, critics on both sides of the Dead Sea argue that this project fails to address the root cause of the depletion of the Dead Sea, which may have serious negative side effects.

The RSDSC would cross the Araba (Arava) Valley, a highly active seismic area, where many earthquakes and a steady micro-seismic activity along the fault in the Jordan Rift Valley have been documented (El-Atrash/Salem/Isaac 2008; Salem 2009d). Geologists, seismologists and earthquake engineers predicted that (given the 1–10 mm annual slip rate) the Dead Sea fault could trigger fatal earthquakes of 7.0 in magnitude every 200 years (Klinger/Avouac/Dorbath/Abu Karaki/Tisnerat 2000; El-Atrash/Salem/Isaac 2008; Salem 2009d), where the hydropower facilities and the desalination plant(s) would be highly vulnerable. Some argue that the large amount of explosives needed for the construction of the RSDSC and the large quantities of sea water that will be transported through the RSDSC could lead to strong seismic activities, as the Earth crust in the project's area is thinner than elsewhere. Furthermore, hundreds of sinkholes have already emerged along the shores of the Dead Sea and, hence, large areas are subsiding (Closson 2005; Salem 2009d).

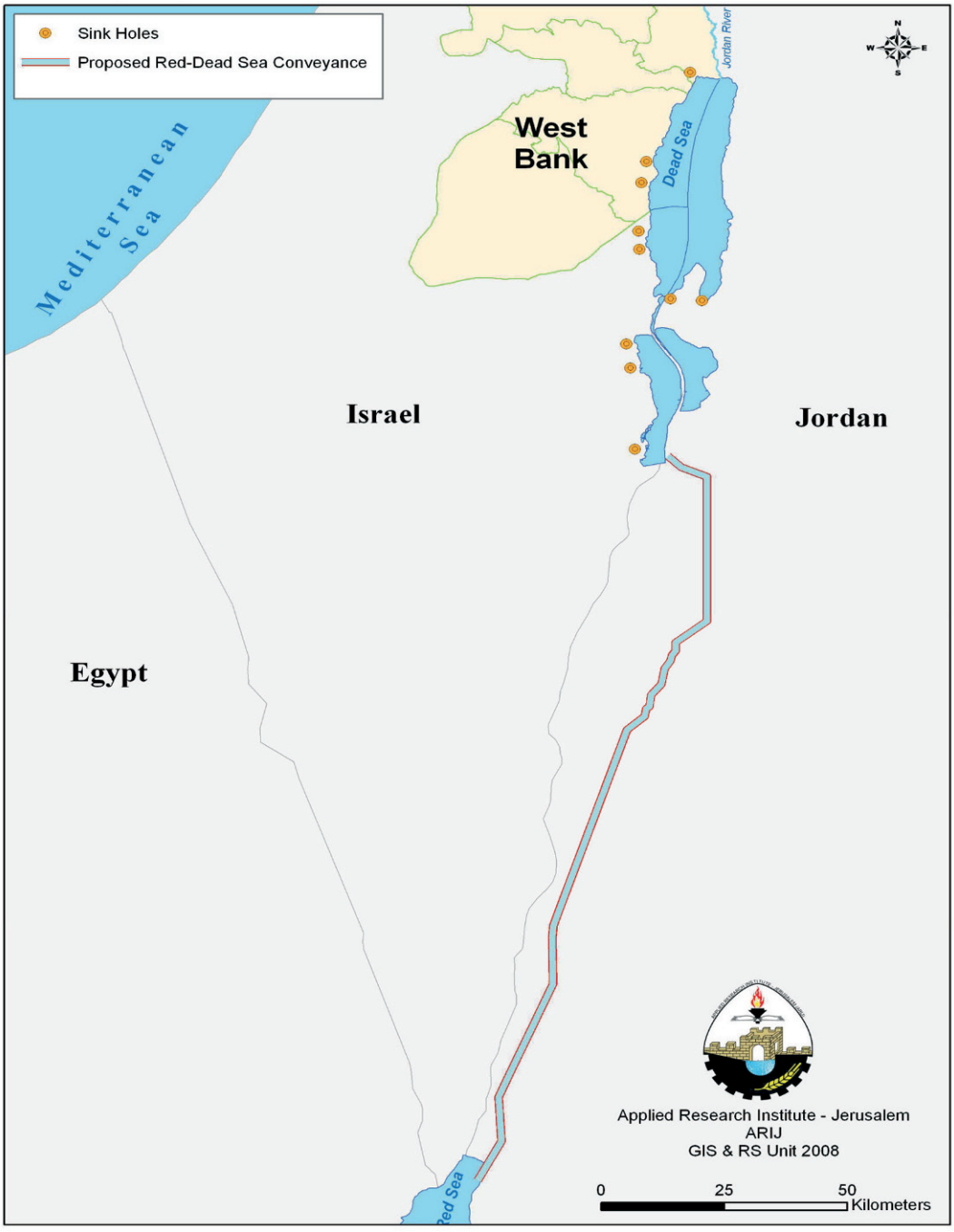
Besides these potential seismic hazards, the huge intakes of saline water from the Red Sea may have unwanted and unpredicted implications for the marine ecosystem of the Red Sea that has some of the most beautiful coral reefs in the world. The RSDSC project will place the fragile coral reefs of the Jordanian city of Aqaba and the Israeli city of Eilat at risk (Bromberg 2008). The Dead Sea itself is already a severely disturbed ecosystem due to anthropogenic interventions in its water balance, and, thus, this mega project would have negative impacts on the fragile ecosystem of the Dead Sea.

Mixing the waters of the Red Sea and the Dead Sea would have considerable negative environmental impacts that would affect the chemical and biological characteristics of both seas, and would affect tourism and the salt industries. Experiments by a team of scientists from the Geological Survey of Israel have shown that mixing the water from both seas could lead to blooms of algae, to precipitation of gypsum, and to turning the water red (Gavrieli/Bein/Oren 2005; Shafy 2007; Salem 2009d). Environmentalists argued that the waters of the Red and Dead Seas may not mix well and may damage the fragile ecosystem of the Dead Sea, and could kill the delicate micro-organisms of the Dead Sea and harm its appeal to tourists.

The inflow of sea water and the brine from desalination into the Dead Sea will have major impacts on the Dead Sea's limnology, geochemistry and biology. During the filling stage, relatively diluted surface water may emerge and the rate of evaporation may increase. Dilution of the surface water may result in microbial blooming of unknown duration. Once the target level would be reached, the inflow would be outbalanced by evaporation, and salinity of the surface water would increase, due to the accumulation of salt.

Gidon Bromberg of *Friends of the Earth – Middle East* (FoEME) warned that mixing water from the Red Sea with the unique chemical soup of the Dead Sea could create a natural disaster:

Figure 23.6: The Proposed Red Sea-Dead Sea Conveyance (RSDSC). **Source:** El-Atrash, Salem and Isaac (2008).



The Dead Sea's [natural] mix of bromide, potash, magnesium and salt is like no other body of water on the planet. By bringing in [the Dead Sea], the marine [Red Sea] water, this composition will be changed. There is concern about algae growth and we could see the sea change from deep blue to red and brown and the different waters could separate (TimesOnLine, 13 September 2006).

The proposed RSDSC would cross the *Eastern Aquifer System* (EAS), what may increase the probability of a groundwater contamination due to leakage or sudden overflows of the non-treated sea water with high saltwater concentrations to be transported through the RSDSC.

Some environmentalists claim that the RSDSC is driven by the Israeli and Jordanian construction com-

panies' interest in such a mega project. "The RSDSC is not the only solution to the water problem, neither is it going to undo the mismanagement of the Jordan's water resources", Dureid Mahasneh, the Secretary General of the Jordan Valley Authority, explained. He added, "Re-exporting water in the form of watermelons and tomatoes is part of the Jordan's mismanagement that also has to stop" (El-Shamayleh 2007). Gidon Bromberg (2008) suggested alternatives for the RSDSC Project:

> Our vision is based on water sharing, water conservation technologies, sustainable agriculture and sustainable tourism. The Peres [Israeli President Shimon Peres]-Tshuva [Israeli billionaire Yitzhak Tshuva]-World Bank (WB) vision may lead to ecological disaster.

According to the *World Wildlife Foundation* (WWF), extracting salt from sea water to make it drinkable is the wrong way to handle global water shortages that could also exacerbate climate change (WWF 2007), as desalination uses large amounts of energy, emits greenhouse gases, and destroys marine life in some coastal areas. Pumping two *billion cubic metres* (BCM) of saline water out of the Red Sea could alter water temperatures in the Red Sea Gulf. The rate of building these desalination plants seems to be growing exponentially. If that continues, greenhouse gas emissions would accelerate and increase climate change dramatically (WWF 2007).

It is argued that the construction of huge desalination plants on both sides of the proposed RSDSC would produce huge amounts of CO_2 and other GHG emissions that would contribute to a temperature increase in the region above the present high temperatures that usually reach up to 50°C during the summer months. The higher evaporation rates could result in greater humidity. All these changes, possibly resulting from desalination plants and the huge RSDSC project, may contribute to a change in the regional climate that would further deteriorate the present conditions in the region with water scarcity, water, air and soil pollution, and damage to the ecosystems.

23.5.6 Deforestation, Desertification, and Land Degradation: Causes and Effects on Climate Change

Land-use change is related to climate change both as a cause for and as a possible effect of climate change (Dale 1997). Trees are a carbon sink. Thus, cutting millions of trees (as Israel does in the OPT) reduces the potential for absorbing CO_2. Desertification and land degradation may contribute to changes in the local climate and may become irreversible due to climate change.

23.5.6.1 Deforestation

Deforestation causes up to 30 per cent of global GHG emissions (Johnson 2008). Due to the deforestation and the land-use changes in the Amazon, Brazil has become a major GHG emitter (Manneh 2008). Accordingly, some groups have suggested that stopping deforestation should be included in the post 2012-Kyoto Climate Change Agreement (GCA 2007; Hmaidan 2008).

According to the *Arab Group for the Protection of Nature* (APN), Israel has cut about 1.4 million trees in the OPT between 2001 and 2005 (APN 2005), of which 1.1 million disappeared between 2001 and 2003, including 263,000 olive trees, 356,000 citrus trees, 113,000 forest trees, 69,000 stone fruit trees, 51,000 grape vines, 18,000 banana trees, 23,000 palm trees, and 251,471 other trees (Abdelrahman 2005). For example, to build the Jewish settlement of Jabal Abu Ghnaim (or Har Homa), Israel has cut more than 60,000 pine trees between 1997 and 2007 (figure 23.7).

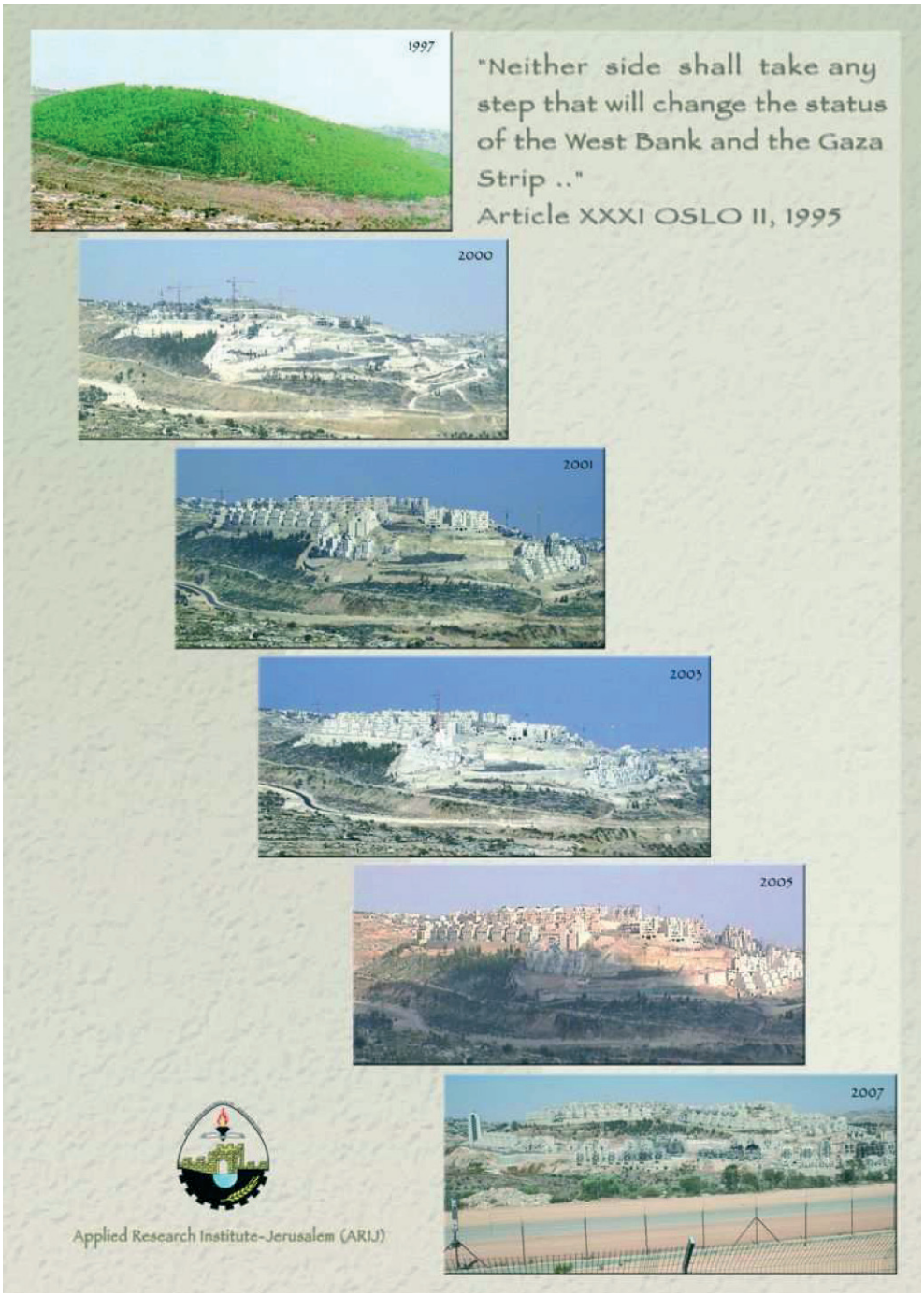
23.5.6.2 Desertification

Land degradation and desertification have also contributed to changes in the climate of the OPT, whose biodiversity has seriously declined since 1967 (Salem 2008a), on which no accurate figures are available. According to a study by CAMRE, ACSAD and UNEP (2004), the desertification in Palestine is mainly due to the practices and activities of the Israeli occupation authorities. Other factors include the overexploitation of the water resources, confiscation of the agricultural land, and the increase of the level of salinity. These factors have led to the decrease of agricultural production, drying up of water resources, disappearance of wildlife, deterioration of rangelands, and encroachment of sand dunes (UNEP 2004). The Palestinian lands suffer from the consequences of desertification that resulted in a decrease in the fertility of arable lands.

23.5.6.3 Land (Soil) Degradation

Soils are degraded due to many factors, including erosion, acidication and salinization. In the OPT, the major causes are soil erosion from water and wind, and *in situ* soil deterioration, due to chemical and physical soil degradation. Incorrect agricultural management

Figure 23.7: The Israeli Settlement of Jabal Abu Ghneim (Har Homa) in the West Bank, as developed in a 10-year period (1997-2007): **Source:** ARIJ (2007, 2008).



due to water scarcity, uncontrolled domestic and industrial dumping sites, and the heavy use of fertilizers and pesticides are important reasons behind the *in situ* soil deterioration in the West Bank (Salem 2008a). The Israeli occupation has increased the pressure on the land that Palestinians retain access to, encouraging overgrazing and intensive farming practices, besides creating a difficult environment for planning and implementing sustainable land-management schemes.

Anthropogenic soil degradation in the OPT includes political and socio-economic factors and exist-

ing land-use practices, whereas the natural causes include changes in precipitation intensity and temperatures. These natural factors are a response to air and water transport of soil particles. However, the anthropogenic factors are more tangible due to Israeli activities in the OPT that have contributed to the destruction of the Palestinian environment (Twite 2003; Salem 2009c). "There is no Palestinian environmental problem without bearing on Israelis, and no Israeli problem without consequences for Palestinians" (Twite 1998).

The misuse of arable lands by Palestinians has led to the destruction of the natural land's cover that stabilizes the soil cover. The prevailing rain-fed agriculture in the dry and semi-dry regions in the OPT has contributed to the destabilization of the soil cover, which causes deterioration of the soil particles. This has led to a decline in the fertility rates of arable lands, where the affected particles lost much of their ability to absorb the rainfall, leaving them susceptible to percolate to the underneath soil layers. The cultivation of lands in dry periods has made the surface soil more susceptible to air erosion. The loss of balance between the major elements of the surrounding environment (plants, animals, soils, water, etc.), due to the unsustainable use of natural resources by humans, has caused decreases in the quality of soils.

23.5.7 Reducing Climate Change Impacts with Renewable Energy

Most of the electrical energy consumed by Palestinians in the OPT is imported from Israel through the *Jerusalem District Electricity Company* (JDEC). There is one electric power plant in the Gaza Strip, which has been repeatedly damaged through Israeli air strikes and land incursions. This power plant generates about 40 per cent of the Gaza Strip's electricity, and the rest is imported from Israel and Egypt. While the percentage of households in the OPT which are connected to the *Public Electricity Network* (PEN) reached 99.4 per cent in January 2005 (PCBS 2006), there are still many localities with 10,000's of Palestinians without electricity as some localities are far from the PEN and connecting them would be costly; and as it is difficult for some localities to get electricity because they are close to Israeli settlements or military bases.

Compared with other Middle Eastern countries, the cost of electricity in the OPT is high and higher than in Israel (Salem 2007). The cost for industrial and commercial purposes is higher than for domestic use. The electricity cost for domestic use is about 14 US cent/kwh, while it is about 18 US cent/kwh for industrial and commercial uses according to the JDEC's tariff of 2007.

The average electricity consumption per household was 227 kwh in July 2006, 264 kwh in July 2005, but 380 kwh in July 1999 (PCBS 2007). It reached 332 kwh in the middle of the West Bank and did not exceed 196 kwh in the north. The average was about 240 kwh in urban localities, 190 kwh in rural areas, and 230 kwh in refugee camps. The overall average per capita electricity consumption in the OPT in July 2006 was 35.8 kwh (PCBS 2007).

The OPT is behind many other countries in using *Renewable Energy Sources* (RES), such as solar, wind, and biogas. Research projects are needed to pursue these objectives (Salem 2008d):

- to assess the opportunities for cost-effective *Renewable Energy Technologies* (RET) to be primarily used in rural areas and remote villages in the OPT which have no electricity;
- to assess their effectiveness through better knowledge of social and end-user behaviour;
- to assess the society's acceptability for clean and efficient RET;
- to measure the impact of electrification on socio-economic development in rural areas; and
- to enable parts of the society to widen their knowledge and expertise on RET, which will help Palestinians to build capacities and improve their way of life.

By embracing the RES the Palestinian society may move towards a cleaner environment. This could be done in collaboration with local, regional and international academic, industrial and other institutions. This is particularly important due to the high prices of fossil fuels many Palestinians cannot afford due to the unstable political and economic situation in the OPT.

Research projects on RES in the OPT will contribute to partnerships with different stakeholders, particularly the EU within the *Union for the Mediterranean* (UM). On 3–4 November 2008, ministers from *European and MENA* countries agreed in Marseille on launching a *Mediterranean Solar Plan* (MSP) and a *Euro-Mediterranean Climate Change Framework* (EMCCF), in support of regional efforts to combat climate change (EuroMed 2008b). Such an initiative could become a cornerstone for a clean environment and for programmes that will encourage using RES in the OPT. This will enhance the multiple relationships (economical, political, social, environmental, etc.)

between the OPT and the EU and other international organizations (Salem 2008d).

As the MENA region has increasingly been affected by the impacts of climate change, Palestinian policy-makers should be highly concerned about its impacts on the environment in Palestine. As this region has been negatively affected by rapid variations in temperatures, rates of low precipitation and high evaporation, hot summers, cold winters, and by desertification and deforestation, using RES should become an excellent option to gradually eliminate the dependence of the Palestinian people on fossil fuels (Salem 2008d).

Developing RET, particularly solar and wind technologies, would enable Palestinians to produce their own electricity. This is particularly important, as this system would require low maintenance and could be used for long periods of time, and would create jobs. It would enable Palestinians to gradually reduce their dependence on imports of fuels and electricity from Israel. As some Palestinian localities still have no access to the *Regional Electricity Grid* (REG), this has forced some Palestinians to leave their homes and move to other places that have electricity. Thus, international donors should support the Palestinians in using RET to help them overcome the hardships they have been facing for a long time.

23.6 Conclusions

Israel, the OPT, and Jordan have been and will be affected by climate change impacts. According to UNEP (2003): "The Middle East is a meeting point of many escalating environmental threats. This is particularly the case in the Occupied Palestinian Territories. Long-term environmental degradation has occurred over recent decades. In an already densely populated area, there are additional problems of scarcity of water resources and land, rapid population growth, a long-lasting refugee situation, climate change, desertification, and land degradation."

As climate-induced resource scarcity could escalate existing conflicts, violence and political turmoil, the Euro-Mediterranean Partnership suggested integrating the climate change dimension into water resource management (EuroMed 2008c). Unless adequate and urgent actions are taken to reduce vulnerability to climate change, the region will be exposed to large economic and social risks, which will put further pressures on groundwater that has been used beyond the aquifers' recharge potential (EuroMed 2008a, 2008b, 2008c).

Besides the political instability, the impacts of climate change will intensify in the Eastern Mediterranean, with more pressure on the OPT, what is due to the following reasons:

- Water scarcity contributes to deteriorating health and socio-economic conditions besides high rates of poverty and unemployment.
- As precipitation has been projected to decline further, more conflicts may occur in the Middle East besides the existing tensions and past wars.
- Geopolitics has so far prevented joint initiatives in addressing regional climate change impacts. The Israeli Segregation Wall (ISW) and settlements in the OPT have increased the pressure on the limited natural resources that may have impact on local changes in climate. These activities have resulted in deforestation, land degradation, desertification, a decline or loss of biodiversity and of water resources.
- The possible construction of mega projects, such as the Red Sea-Dead Sea Conveyance will cause huge ecological and environmental damage that may have impact on climate change.
- Given its high population density and growth, the Gaza Strip is extremely vulnerable to climate change impacts, due to sea-level rise, sea-water intrusion and water shortages, besides many other socio-political and socio-economic problems. Under present political conditions adaptation to combat climate change in the Gaza Strip is not feasible, and, therefore, mitigation measures are urgently needed.

In the Eastern Mediterranean region, political circumstances have been the main cause that efforts to address the causes and impacts of climate change are widely lacking (Brauch 2009b). As long as a peaceful resolution of the Middle East conflict is missing, the Eastern Mediterranean region will severely suffer from climate change impacts. Technical initiatives were suggested to develop and use renewable energy technologies in the region, especially solar energy.

On 22 May 2008, Prince Hassan Bin Talal of Jordan, in a speech to the *United Nations General Assembly*, addressed the linkages among global instability, climate change, and human security (Bin Talal 2008):

> Rising temperatures and extreme climate patterns are also having an enormous impact on human security. Many people, especially the poor in some of the world's

most crowded and marginally productive areas are affected by: a lack of water for drinking and irrigation; a decline in agricultural production; increased resource scarcity; loss of supportive wildlife; widespread diseases from mosquitoes and other pests; declining health; economic losses caused by hurricanes, tornadoes and cyclones; volatility in economic output and trade; and increasing poverty.

The harmful impact of these climate extremes on human livelihoods and living conditions, combined with heightened competition for scarce resources, has triggered disputes over territory, food and water supplies, social and cultural traditions, and tribal and religious differences. Fundamental and unresolved issues of territoriality, identity and movement of peoples lead to sectarian and ethnic violence, armed conflict, mass migration and the spread of infectious diseases. ... The health, well-being and rights of those who are forced to leave their homes and communities through external disruptions must be given particular attention. We usually think of migrants and refugees fleeing political conflict, but increasingly there are also victims of the menacing effects of global warming. We are currently witnessing many instances of this kind of temperature-driven civil strife and social displacement in parts of Central Asia, the Middle East, Africa and Latin America.

24 Progressive Development of the Water Resources of Israel and Palestine to Mitigate the Negative Impact of Global Warming

Arie S. Issar

24.1 Introduction[1]

For the last three decades, the author has been investigating the impact of climate changes on the hydrological cycle, past, present and future, worldwide, in the Middle East and in particular on the water resources of the Israeli and Palestinian territories.[2] These investigations have been based on analyses of the impact of climate change on the hydrological cycle and human settlements, from the time human beings arrived in the Middle East from Africa, to the present. The general conclusion was that warm periods in the past caused droughts and famine. As the present warming process is gaining momentum beyond past records, the impact may surpass that of the past, namely, its negative effects may mean a severe reduction in the water resources of these countries.

As the standard of living rises in Israel and hopefully, will also rise in the Palestinian and neighbouring populations, the demand for water per capita will also increase. These trends raise the question of whether the conventional policy of 'sustainable development' will allow for the increasing demand for water in this region.[3] In other words, the question is whether this ideal goal can be maintained in a region undergoing a simultaneous process of diminishing natural water resources and increasing demand. As the answer is negative, the question then becomes: Should widespread and profound changes in the natural environment be effected in order to avoid a crisis in the water supply system? Such changes, among others, are the drying up of the summer flow of springs, by pumping and lowering the groundwater table, in order to prepare an empty volume of storage for recharge by winter rains; the reuse of reclaimed sewage for irrigation as well as recharge to ground water, thereby reducing the quality of the water in the sub-surface; the introduction of desalination projects, of either sea water or brackish ground water, for purposes additional to irrigation; the mining of fossil water, etc.

These actions, which are indispensable for sustaining standards of living, if not the basic existence of human societies in this region which is in the process of drying up, interfere with the natural hydrologic systems. Nevertheless, this interference should be carried out in the framework of a regional long-term master plan. The need for such a plan led the author to suggest a new conceptual model, 'progressive development', as a replacement for the sustainable development model in regions that are drying up.

24.1.1 The Progressive Development Model Should Replace Sustainable Development in Regions Where Water Resources Are Drying Up

The principle aims of 'progressive development' are to bring about a gradual change in natural and human environments that will enable survival in the face of deteriorating climatic conditions, and to guarantee progress towards safer and higher standards of living. The most important aspect of the conceptual model of 'progressive development' is its multi-dimensional holistic approach, which aims to manage the long-term impact of each of the above-mentioned steps on

1 The author would like to thank Prof. Yehuda Bachmat, the former head of the Hydrological Service of Israel, for his corrections, remarks and suggestions. The English editing by Ms. Marcia Ruth is gratefully acknowledged. After introducing the changes suggested by the reviewers, the English was re-edited by Camille Vainstein and is hereby acknowledged.

2 See: Angelakis, Issar (1996); Issar, Brown (1998); Issar, Zohar (2004, 2007); and Issar (1976, 1990, 2003, 2007, 2007a).

3 The Brundtland Commission (1987) report on *Our Common Future* defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

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water resources and on natural and human environments. In the first stage, such management will involve planning the steps needed to ensure water supply to a growing population while helping it progress towards a higher standard of living, despite the drying-up of natural water resources. This progress is dependent on the promotion of standards of education for both male and female populations, from the very young to adolescents, from kindergarten to the university level, in the technical as well as natural sciences.

Progressive development will not be restricted, however, to technical and general education. It will simultaneously target the full development of all natural water resources in the region described in the introduction, the most negative action from a sustainable development point of view being the exploitation of one-time reserves, by either allowing the controlled advance of the sea or connate water interface, or utilizing fossil water reserves.

The stages for fulfilling these aims are the following:

1. On the basis of a preliminary survey, prepare a regional development plan, starting with the exploitation of the most available and low-cost water resources, and progressing, stage by stage, to more costly resources and advanced methods of exploitation.
2. Construct an infra-structure consisting of an extension service and schooling for the population involved in the project, covering technical as well as cultural aspects.
3. Promote demonstration projects by the local inhabitants, backed by an advisory team.
4. Promote the settling of the nomad population by offering them a piece of land and a water resource on which they can continue raising their livestock while ensuring their water and food supply without having to move from one place to another.
5. Move to more advanced and sophisticated stages once the basic supply of water and food has been guaranteed.
6. Promote local industry for the supply of equipment, spare parts, etc.

These steps will guarantee that while the one-time reserves are being consumed, the economy of the region is progressing to a level that will enable the construction of more sophisticated projects in order to produce new income resources to replace the consumed ones. One such project might be the desalination of brackish water existing below the fresh-water fossil aquifers.

Generally speaking, projects should be designed and carried out as integral components of a comprehensive plan of regional development preceded by research into the hydrology, soil and ecology of the region, and followed up by monitoring and re-assessment procedures. Special emphasis should be placed on monitoring programmes as a part of management planning to avoid irreversible salination damage to the soil and water resources (Issar 2008, 2009).

24.2 Impact of Global Warming on Water Resources of the Middle East

In connection with the international effort to evaluate the impact of the global climate change on the hydrological cycle of the world, the author was invited in 1981 by the Division of Water Sciences of UNESCO to join a working group set up in the framework of the *International Hydrologic Programme Project* (IHP IIc). Its main objective was to assess 'the impact of climate variations on water management systems and related socio-economic systems'. Based on his previous investigations, the author suggested making use of all available data on past climate changes, proxy as well as historical documents, available in the Middle East, and investigating these changes' impact on the availability of water resources in this region. The results could then be used to correlate such impacts with changes in other regions on a global scale and later, to forecast the future, based on the assumption that the past is the key to the future.

The suggestion of a worldwide survey, starting with an investigation of the Middle East, was adopted and sponsored by UNESCO. It involved a survey of available data, which included visits to research centres all over the world.[4] This survey confirmed the working hypothesis that pre-historic as well as historical climate changes observed in the Middle East can be correlated with major changes in various regions of the globe. The correlations were presented in a report

4 This survey included the Institute of Geography of the Chinese Academy of Science in Beijing, the Department of Geography of the Universities of Tokyo and Tsukuba in Japan, the University of Arizona at Tucson, the Free University of Amsterdam, as well as the Departments of Geology at the University of Madrid and at the University of Perugia, Italy.

to UNESCO (Issar 1995, 2003). The author's conclusions were presented at two international conferences in Heraklion, Crete (Greece) sponsored by NATO (Angelakis/Issar 1996) and in Sede Boker (Israel) sponsored by UNESCO (Issar/Brown 1998).

A more focused advanced study was carried out on the influence of climate changes on water resources throughout history and thus on the environment of the Middle East. The emphasis on this region took into consideration that it is the root of Western Civilization and rich in archaeological remains and ancient documentation. This research was initially based on new proxy data, such as Dead Sea levels, the isotopic composition of stalagmite rings of the Soreq Cave near Jerusalem, among others, pollen ratios in the Sea of Galilee lake-bottom deposits, and humidity data in the drainage basin of Lake Van, Turkey. The major conclusion was that rather severe climate changes had indeed influenced the proto-history and history of the region. During cold periods, the climates were humid and the desert flourished and was settled. The warm periods, on the other hand, spelled out dryness, desertification, and the migration of populations from regions that were drying up into the fertile belts along the big rivers (Issar/Zohar 2004, 2007, 2007a).

Combining the results of these investigations, the forecast can be made that global change will result in a decline in the average precipitation in the Middle East, and most probably will lead to years of drought.[5] These will have a negative effect on the economy, which – in many countries of the region – still very much depends on rain-fed agriculture. It is beyond the scope of this chapter to discuss the reasons for the phases of global warming and cooling in the past. Nevertheless, it is important to emphasize that the human factor has been negligible for most, if not all desertification phenomena in the Middle East, which were a result of warm climates.

At present the world, including the Middle East, is undergoing a process of warming. The IPCC (2007) concluded that global warming is accelerating due to human activity, which results in increasing the production of *greenhouse gases* (GHG) due to the burning of fossil fuels. These gases include *carbon dioxide* (CO_2), the major GHG that has risen from 279 parts per million (ppm) in the atmosphere in the pre-industrial period (1750) to 384 ppm in 2007. Simultaneously, a longer term (from 1900 to 2005) declining precipitation trend has been observed in the semi-arid regions of the Sahel and in the Mediterranean-type climate of the Mediterranean region and southern Africa. Linked to higher temperatures, more intense and longer periods of drought have been observed, particularly in the tropics and subtropics. Computerized models predict that even if the emission of GHG and other contributors to the warming process were held constant at the level of the year 2000, warming would continue, due to the slow reaction of the oceans, in the next two decades at a rate of 0.1 °C per decade. A decrease in precipitation of up to 20 per cent is likely to occur in most subtropical regions. In general, mid-range scenarios predict severe droughts and floods, more intense hurricanes and cyclones, decreasing fresh-water and food supplies, increasing spread of diseases, and rising sea levels that could displace hundreds of millions of people worldwide. According to records of the *World Meteorological Organization* (WMO),[6] the year 2006 was estimated to be the sixth warmest year since observations started in 1880. Thus, the predictions which were based on the proxy data of the past have been confirmed by present-day observations (IPCC 2007, 2007a, 2007b, 2007c[7]).

Recent computerized mathematical modelling of future precipitation in the Eastern Mediterranean due climate warming, by Alpert, Krichak, Shafir, Haim and Osetinsky (2008) and Kitoh, Yatagai and Alpert (2008), based on the observation that the average temperature over the Mediterranean area has increased by 1.5 to 4 °C during the past 100 years, predict that temperatures towards the end of the 21st century may increase by about 4 to 6 °C over northern Israel. Processing of climatic data shows that precipitation over most of the Mediterranean region has followed a dominant negative trend during the past 50 years and that there is a tendency toward extreme events. The models predict that the standard deviation of the average annual precipitation will continue to be high, showing a trend toward both drier and wetter years in the future. The impact of these forecasts on the water resources of the Middle East will be a series of dry years followed by a series of wet

5 This does not apply to Egypt, which gets its water from the Nile that is fed by rains coming from the Indian Ocean.

6 See: "2006 Was the Sixth Warmest Year Ever", in: *ENS (Environment News Service)* staff report, 3 January 2007.

7 See Israel's *First National Communication on Climate Change* (2000). In this present author's opinion this report fails to mention the impact of climate changes on the water resources of Israel during history.

years. Such a trend necessitates the storing of water, which requires adequate storage capacity. This issue is discussed further on.

In ancient periods, the prediction of changes from good to bad years led to the storage of food. As the consumption of water was mainly for drinking, the storage of water for dry years was not vital, except for the watering of herds. However, today the problem is not only food but water for many other purposes beyond the supply for drinking and domestic use. In a semi-arid region like the Middle East, the problem extends to water needed for irrigation. The negative impact of such a deficiency due to decreasing precipitation in this region will become more severe as the population, particularly the Palestinian population, continues to grow at a high rate. This is due to modern medicine, which has reduced infant mortality on the one hand, and increased life expectancy on the other.

This chapter focuses on measures to mitigate the impact of diminishing water resources resulting from global climate change. This will be considered in the framework of the conceptual model of 'progressive development', while the population increase will be dealt with as an important but secondary factor to the diminishing resources.

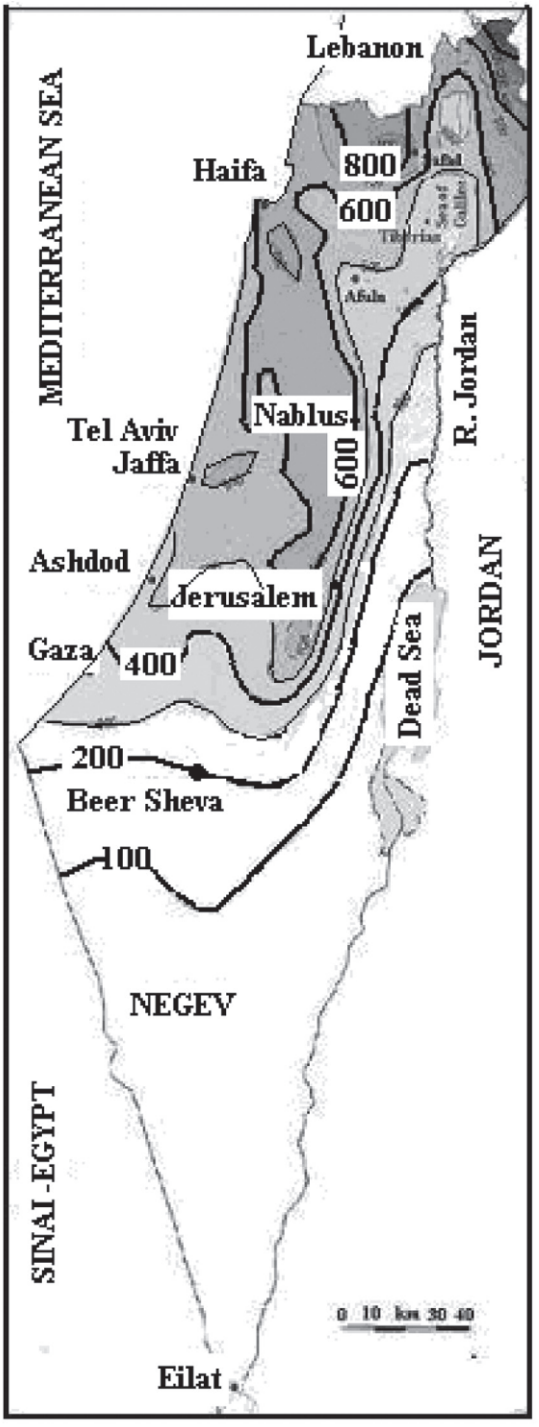
24.3 The Present State of Water Resources

24.3.1 Water Resources of Israel

The development of the water resources in Israel has been dictated by various factors, the most important of which is its geographical location along the margin of the Arabian-Saharan desert belt: as a consequence, its southern part is arid, while its northern part is rather humid (figure 24.1) but is susceptible to abrupt variations in the amount of precipitation from years of excessive precipitation to years of severe drought. Moreover, the climate is seasonal. Thus, precipitation is limited to the colder winter season from November to February, while the summer months are hot and dry. The second factor has been the need to meet the demand of a rapidly growing population due to immigration and natural growth since the establishment of the State of Israel in 1948.

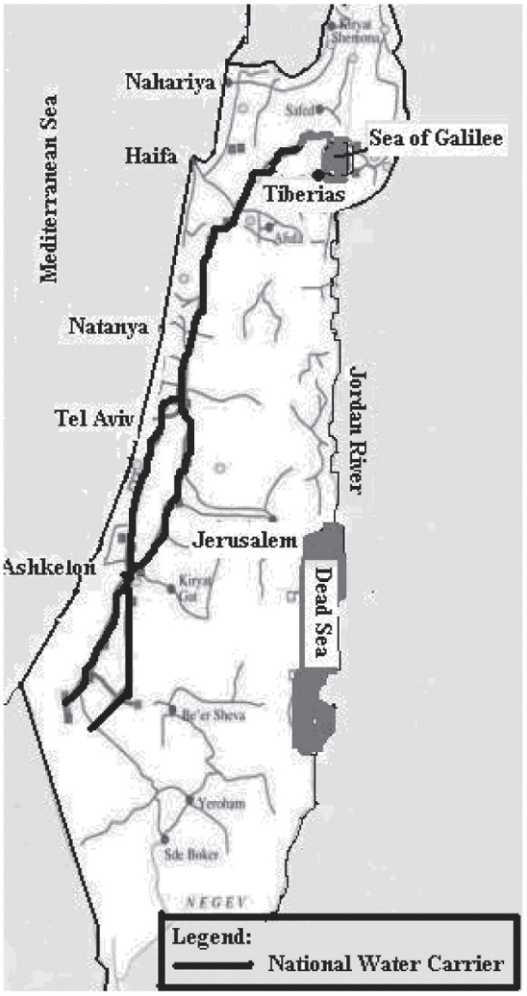
While precipitation is abundant in the northern part of Israel, land resources are rather limited there. On the other hand, there is a relative abundance of land in the south where precipitation is low. Thus one

Figure 24.1: Precipitation map of Israel and Palestine. **Source:** Based on the map in the Israel Atlas (1995: 27).



of the first endeavours undertaken by the government of Israel, immediately after the state was established, was to reduce the natural water deficiency in its southern part. This was done, in the 1950's, by planning

Figure 24.2: National Water Carrier, Israel. **Source:** Based on Mekorot's Major Water Plants Map, Mekorot, Israel National Water Co.



and constructing the National Water Carrier, which brought water from the Sea of Galilee to the Negev – the southern arid part of Israel (figure 24.2).

At the same time a National Water Law was adopted (1959) which declared that "all water resources in the country are [in the] public domain, are owned by the state for the benefit of the people and the development of the country." Prior to its approval, the law recognized the water rights of private people and organizations, and it therefore allowed them to use the quantities they were already using.

The total quantity of the annual natural replenishment of the water resources of Israel and the Palestinian territories amounts to an average 1,555 *million cubic metres* (MCM), of which 650 MCM come from the Sea of Galilee catchment areas, about 135 MCM from the Cretaceous carbonate aquifers of the Western Galilee and Carmel mountains, and about 450 MCM from the aquifers building the central part of the country. To the Coastal Plain aquifer, built of Quaternary age sandstones, about 250 MCM is recharged annually. The mean annual replenishment of water of the Negev is about 70 MCM.

In addition to the supply from the National Water Carrier, Israel gets its supply from the western watershed of the Central Mountain aquifer and from the Coastal Plain aquifer. The western Central Mountain aquifer is also called The Yarkon-Taninim basin due to the Yarkon River, fed by the springs of Rosh Haayin in the central part of the basin, and the Taninim stream, fed by the Taninim Springs in the northern part of the basin. The recharge zone of the Rosh Haayin-Yarkon system extends over an area of about 1,400 km^3. In historical times, the springs emerged over an area of 25 hectares and their annual discharge was about 220 MCM. Due to the big storage capacity of the aquifer, the hydrograph of the springs was rather flat, ranging from about 15 MCM/month during the winter months to 9 MCM/month during the summer. In the early 1950s, there was a need to enlarge the supply of water to the new and old urban centres of central Israel as well as to the new settlements of the Jewish refugees from North Africa, Iraq and Syria in the arid lands of the northern Negev. This led to the decision to make full use of the water of these springs for urban supply as well as for irrigation of the lands, which before the War of Independence were partly occupied by Arab settlements living mainly on rain-fed agriculture and partly desolate sand dunes.

This task was accomplished by drilling a series of wells in the central western foothills area of the Judean mountains. A pipeline was laid parallel to these to convey the water to the Negev. The project was launched in 1952 and started to function in 1955. It enabled the establishment of about 75 settlements, altogether 6,000 farms irrigating about 15,000 hectares. Part of the economy of the settlers in this region was based on rain-fed field crops, yet these failed every few years due to the occurrence of drought. Later on this project was integrated into the above-mentioned National Water Plan of Israel. The pumping brought about a cessation of the Yarkon springs and the drying up of the Yarkon River, especially due to a few dry years during the late 1950's and early 1960's. It was only in 1964, which was a good year for rain, that the springs recuperated and the river flowed. Nevertheless, because of the intense urbanization of the entire region, which forms the northern suburbs of Tel Aviv,

the quality of the Yarkon River water deteriorated, due to the drying up of the springs and uncontrolled flow of sewage. In 1988, the Yarkon River Authority was established. The entire area from the springs to the sea became a national park, the rehabilitation of which depended on fresh water coming from various sources: either the springs' flow in wet years or the National Water Carrier, or reclaimed sewage and warm sea water discharged from an electrical power station. The yield of the Taninim springs, originally about 100 MCM per year (Y) of brackish water, declined to about 10 MCM/Y.

The Coastal Plain aquifer is recharged by rain falling on its outcrops and to some extent by floods coming from the mountains. It is also fed by a return flow from irrigation and leakage from sewage systems. The annual natural recharge (including the flow from the east), as calculated by the Hydrological Service of Israel, amounts to an average of about 250 MCM (with a standard deviation of 68 MCM). About 30 MCM is recharged annually due to infiltration from irrigation and about 140 MCM/Y is recharged artificially, 87 per cent of which is reclaimed sewage, and about 30 MCM/Y flows into the aquifer from the east. An average of 420 MCM is pumped out annually and an average 30 MCM flows to the sea (Hydrological Survey of Israel 2007). The average salinity of the water in this aquifer in Israel has risen from 100 mg Cl /l during the 1930's to 205 mg Cl /l at present, and is rising at a rate of 2 mg/l annually. This is mainly due to return flow from irrigation, recharge by reclaimed sewage and inflow of brackish ground water from the east. Nitrates have increased from an average of 10 mg/l in the 1930's to about 62 mg/l at present, and are rising at an annual rate of 0.7 mg/l.

The total annual consumption of water in Israel reached 1,959 MCM in 2006, of which 737 MCM was for domestic use, about 114 MCM was used by the industry and a total 1,128 MCM was used by the agricultural sector. Due to innovative methods of irrigation and advanced agronomy, about 50 per cent of this quantity was second-grade water, either reclaimed sewage or brackish water (Shani 2008).

As the average annual replenishment is about 1.5 *billion cubic metres* (BCM), while the annual total consumption is about 2 BCM, the annual deficit is 500 MCM. Moreover, there is an accumulated deficit of more than 2 BCM. In addition to the quantitative deficit, there is an ongoing process of deterioration of water quality. In order to deal with the deficit and deterioration, a national endeavour was undertaken to develop second-grade water sources, namely reclaiming waste water as well as intercepting runoff, mainly for artificial recharge. In 2005, desalination of brackish and sea water began. The quantities of desalinized brackish and sea water in Israel in 2008 reached 145 MCM/Y. The plants under construction will bring the total supply in 2009 to 160 MCM/Y, while according to the Water Authority of the State of Israel (Shani 2008) it is anticipated that the plants under planning will supply in the year 2013 the total amount of about 500 MCM/Y.

In parallel, water-conservation measures were undertaken to promote the efficient use of water in the agricultural sector by introducing advanced methods of irrigation such as drip irrigation, micro-sprinklers, and computerized automatic *fertigation* (irrigation + fertilization). These measures brought the average quantity of water needed for irrigation to about 5,000 m^3/hectare, compared with about 9,000 m^3/hectare in 1975. Thus while the output by the agricultural sector has increased 12-fold, the total water used for irrigation has remained almost constant.

The urban sector has applied control and conservation efforts such as monitoring municipal water systems, and installing water metres for every household. At the same time, special measures to reduce water for the irrigation of urban parks have been taken, including the planting of drought-resistant plants and watering at night to reduce evaporation and transpiration.

According to the figures of the Israeli Ministry of the Environment, some 450 MCM of wastewater are produced in Israel per year, some 96 per cent of which is collected in central sewage systems. About 63 per cent, i.e. 283 MCM/Y, is adequately treated and reclaimed, while about 36 per cent, i.e. 160 MCM/Y, is either untreated or inadequately treated and still used for irrigation of plantations. Only a small quantity is still directed to cesspools or flow to the sea.

However, despite these measures, there is a general diminishing trend in available water resources due to re-occurring dry years, which in the author's opinion are due to global warming. An increase in the salinity of the ground water has been observed in many wells due to a return flow from irrigation and the influx of pollutants from human activity.

24.3.2 Palestinian Territories

The main source of fresh water in the Palestinian territories is from ground water. The four main basins are the mountain cretaceous and Eocene aquifers in the central mountain region, and the Gaza Coastal

Plain aquifer. The western part of the Mountain aquifer underlies the two states, with 68 per cent of its recharge in the Palestinian territories. In the West Bank, Palestinians now control, and consume, approximately 125 MCM/Y, while the Palestinians in Gaza consume around 103 MCM/Y. The per capita consumption of water in Palestinian territories for irrigation amounts to between 106 m^3 in the West Bank to 172 m^3 in the Gaza Strip (UN document A/46/263, annex, table 1). The average urban daily per capita consumption in the West Bank is about 50 l/day (about 18 m^3/Y), while in Gaza it is 78 l/day on average (about 28 m^3/Y). Water quality is poor, with high nitrate and chloride concentrations. In both regions, system losses are high – about 40 per cent of the supply. Palestinian per capita water consumption has risen from 86 m^3/Y in 1967 to 100 m^3/Y currently. Palestinian use of water in the West Bank is limited to 17 per cent of the total water in the aquifers. Israel uses the remaining 83 per cent either for its settler population in the West Bank or for pumping from the shared aquifers for consumption in Israel or for sale back to the Palestinian utilities. Palestinian allocations from wells are restricted, with rare approvals for new wells or for increasing outputs from existing wells dug before 1967. As a result, Palestinian annual water extraction has actually dropped by about 10 per cent, from 120 MCM to 98 MCM, since the mid-1990's. This is despite the fact that 10 to 14 per cent of the Palestinian *gross domestic product* (GDP) comes from agriculture, as opposed to 2 to 3 per cent of Israel's GDP. Only 10 per cent of Palestinian agriculture uses irrigation; the rest is rain-fed. The Gaza Strip relies on wells that are increasingly become saline (World Bank 2008d: 51).

In the West Bank and Gaza Strip, in 1996 agricultural water use was about 7150 m^3/Y per hectare, much of it for drip irrigation and greenhouse agriculture (Stanhill 1992). In the Gaza Strip, the only water source is the Coastal Plain aquifer built of Quaternary sands and sandstones. The average annual recharge is estimated to be 50 to 80 MCM, including return from irrigation and leakage from sewage facilities, while the annual utilization is more than double, i.e. between 120 and 160 MCM. Thus, the present overall annual deficit is on the order of 90 MCM. This quantity will undoubtedly increase with a rise in per capita consumption. In addition, approximately 44 per cent of the wells show nitrate concentrations higher than 90 mg/l (Melloul/Collin 1994). This situation is expected to worsen due to the high annual population growth rate which according to the 2007 census of The Palestinian Central Bureau of Statistics has reached 2.6 per cent in the last decade (not yet published, cited by the World Bank 2008b: 18).

24.4 Anticipated Water Demand by the Year 2020

According to The World Bank AAA Program report (World Bank 2006) on Israel, based on the estimates of Israel's Water Commission (2002), by the year 2020 the total annual agricultural water demand in Israel (8.6 million inhabitants utilizing 1,330 MCM/Y for domestic needs) will reach 1,300 MCM, of which 600 MCM will be fresh water. Future agricultural demand by the Palestinians may reach 415 MCM/Y (Alatout 2000). Thus, in the year 2020, the total Palestinian and Israeli water demand for agriculture may reach 1,770 MCM. Taking into account that part of this will come from reclaimed sewage water, which when fully exploited in both countries may reach 830 MCM/Y, and that an annual amount of about 530 MCM can be supplied from natural resources, there will still be an unmet annual demand of about 400 MCM for agriculture. These projections are based on the assumption of no major deterioration in climate. When future climate change impacts on precipitation are included, the natural water supply could decline by 25 per cent of its present average. This would increase the agricultural water demand deficit by the year 2020 to 500 MCM/Y for both Israel and Palestine.

During the last decade, agriculture was the largest sector of the Palestinian economy, generating over 22 per cent of the GDP of the West Bank and Gaza Strip and providing employment to over 15 per cent of the population (Butterfield/Isaac/Kubursi/Spencer 2000). Taking into account that by the year 2020 agriculture may still be an important source of income for the Palestinians, the drying up of the climate due to the ongoing increase in global temperatures will have a severe negative impact on Palestine's economy. At the same time, Israel's above-mentioned desalination plants may cover the urban consumption, even in dry years, while in extreme dry years the supply to agriculture may be reduced, without causing severe damage to Israel's economy. However, it is assumed that in such years, Israel will be ready to increase the Palestinians' share of the ground-water resources. This increase will be at the cost of the flow of springs, not to speak of the one-time reserves. Thus, this increase must be in the framework of a general development

programme, not only of water resources, but also of the efficiency of agriculture and irrigation methods. In order to ensure that these steps will not lead to a dead end if the dryness continues, it is suggested that the policy of 'progressive development' be applied, as discussed above (24.1.1), in order to mitigate the impact of increasing aridity.

24.5 Applying the Policy of 'Progressive Development' to Mitigate the Impact of Water Scarcity

In fact, the principles of 'progressive development' were applied through a policy of 'trial, error and innovation' during the development of Israel's agriculture and water supply system, both rural and national. This policy involved the stage-by-stage integrated development of the various water resources, starting from deep drilling and intensive utilization of the ground-water resources, which brought about utilization of the one-time ground-water reservoirs, the use of aquifers containing brackish water, and irrigation by treated effluents. At the same time, the application of advanced economizing irrigation methods, as well as other advanced agricultural methods, which conserved water and provided a higher income per cubic meter of water were introduced. The lessons learnt served as a practical field experiment on which the theoretical program of 'progressive development' is based.

In the case of the Middle East, one needs to bear in mind that all major surface and sub-surface water resources are trans-boundary and that the riparian and upper basin users are inter-dependent. Thus the impact of increasing water demand, deteriorating water quality, etc. needs to be investigated on a regional basis. It is beyond the scope of this chapter to suggest a master plan for the water supply of the Middle East, let alone for Israel and Palestine, despite the fact that the future need for such a master plan is beyond question.

A master plan for Israel's water needs for 2002–2010 does, in fact, exist (State of Israel 2002). This master plan is being updated by Israel's Water Authority (2007, 2008) for the period beyond 2010, taking declining climate conditions into account. In the 2002 plan, climate change was not included as the impact of this factor was not yet obvious.[8] In the topical master plan (2002), the solutions for satisfying future demand concentrate on water conservation, replacement of fresh water with effluents and desalination of brackish water (which will reach 50 MCM/Y of fresh water in 2010). By the year 2010, desalination and water imports (of about 50 MCM/Y from Anatolia) were projected to reach 500 MCM/Y. In addition, by 2010 the amount of treated effluents was planned to reach 230 MCM/Y, from which about 33 per cent, i.e. about 115 MCM/Y, would be upgraded from the secondary to the tertiary level. The 'first level' of treatment includes only the deposition of solid components in depositional basins, while in the 'secondary level', the effluents undergo biological treatment in anaerobic oxidation ponds, or bio-mechanical separation of the organic materials. In the tertiary treatment, the effluents are filtered and chlorinated.

With regard to the Palestinian territory, the Israeli master plan forecasts a supply of 115 MCM/Y from the Israeli system based on signed agreements, in addition to the water available to the Palestinians from their own resources. No official master plan by the Palestinian Authorities is available. The one available projection was prepared by the Committee on Sustainable Water Supplies in the Middle East (1999): it does not take future climate change into account but it emphasizes sustainable development.

The following section focuses on non-conventional solutions, in the framework of a working plan for 'progressive development'. Such a plan reflects the water conflict between Israelis and Palestinians, which will become even more severe due to population growth and the decrease in precipitation due to global warming.[9]

24.5.1 The Mountain Aquifer

The western Mountain aquifer is the main issue of controversy between Israel and the Palestinians, as about 80 per cent of the recharge of this aquifer is over the Palestinian territories. Yet because of the geological structure, the water is not stored under the recharge zones but flows to the west where it is stored in the sub-surface of the foothills region. While the Palestinians claim that the water belongs to them because it is recharged in their territory, the Israelis claim that they were the first to tap into and develop this source.

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8 Personal note by Y. Dreizin, chief planner of Israel's Water Commission.

9 This dilemma has also been stressed by Brauch (2004, 2006a, 2007). The argument has been partly taken up by Freimuth, Bromberg, Mehyar, Al Kahteeb (2007).

Moreover, due to the semi-arid character of the region, in dry years the aquifer in the mountain region may be exhausted as there is not enough storage capacity there. This controversy could potentially become worse if indeed, as envisaged by the author, global warming causes a decline in average precipitation. This will decrease the flow of the perched local springs and also diminish quantities of water collected by the Palestinians into cisterns. These springs and cisterns are their source of drinking water and are also used for the irrigation of vegetable plots, for both domestic and marketing purposes.

The negative impact of the diminishing precipitation will particularly affect the eastern and southern parts of the mountain region belonging to the Palestinians. The eastern region will be affected because it is situated in the rain shadow while the southern region borders the desert. Thus in these regions, where the present precipitation averages 350 mm/Y, an approximate 20 per cent reduction will reduce the average to less than 300 mm/Y, which is below the minimum needed for the rain-fed fruit plantations upon which many Palestinian farmers depend. Thus, the main problem to be faced is storage, which is available on the Israeli side.

Discussing this issue at an Israeli-Palestinian meeting, the author suggested regarding this problem as an argument between two neighbours that he experienced in his childhood in Jerusalem, where the source for drinking water was collection from a domed plastered roof into a cistern in the yard. Thus, while the upstairs neighbour claimed that the water belonged to him, as he owned the roof and looked after its annual plastering and white-washing, the neighbour who owned the yard in which the cistern was located also claimed ownership of the water. The only solution was the cooperative use of water resources, where each neighbour would get water according to his/her needs.

Yet here enters the problem of defining need. While the Israelis will claim that their need is according to their per capita domestic demand of about 100 m^3/Y, while for irrigation they only need 5,000 m^3/Y per hectare, the latter partly supplied by reclaimed effluents, the Palestinians will claim that they need only 50 m^3/Y per capita, but 7,150 m^3/Y per hectare for irrigation. These arguments represent only the tip of the iceberg of conflicting demands, where the main issue is the chasm between an advanced society adapted to a high standard of living and manufacture, and a traditional society adhering to an ancient way of life and production.

To reach an agreement, the Israelis must reduce their domestic demand via water-conservation measures, and satisfy part of that demand with second-grade water resources. The Palestinians must improve their irrigation methods, treat their effluents and reuse their waste water for irrigation. The latter measure is essential and will have an additional positive effect in curtailing contamination of the Mountain aquifer.

Additional non-conventional sources are discussed next, which have not been utilized to date and which will have to be developed mutually by Israeli and Palestinian authorities.

24.5.1.1 Management of the Flow of Springs and Streams

In semi-arid regions like the Middle East, where precipitation falls only during the cold winter season, two types of springs exist, seasonal and perennial. The difference is in the volume of storage feeding the spring. The seasonal springs, which depend on a local perched aquifer that is relatively limited in area and thickness, flow mainly during the wet season and part of the dry season. In a good year, they may flow the whole year, but their flow during the dry summer season keeps diminishing, until the winter when they recuperate. The perennial springs, fed by an aquifer whose storage exceeds the quantity of outflow during the dry season, will flow during this entire season, diminishing only at the end, and then recovering its maximum flow during the wet season. The bigger the volume of storage, the more flat the flow hydrograph will be. The flow of such springs, either seasonal or perennial, is controlled by drilling into the feeding aquifer and utilizing the storage during the dry summer, by lowering the water table. Such a management policy may cause the total drying up of the natural spring and its efficient utilization by pumping. In this case, the stream, which was fed by the spring, will dry up if not artificially fed by the pumping wells. Thus, use of the aquifer storage is much more efficient, but the drying up of the springs, if not taken into consideration and controlled, may have a negative impact on the natural environment. This flow may be artificially renewed by treated effluents.

The most salient issue is the management of the Rosh-Haayin springs, the source of the Yarkon River and Taninim springs and stream, both outlets of the western Mountain aquifer. The same policy can be applied to efficiently utilize the springs emerging from the eastern part of the Mountain aquifer, namely the ground-water flow towards the rift valley, by wells

drilled in the mountainous region. The sub-surface flow towards the north-east and east is on the order of 240 MCM/Y, from which about 140 MCM/Y flows towards the north-east, i.e. the valleys of Esdarelon and Beit Shean, while about 100 MCM/Y flows eastward. The north-eastern flow is almost totally utilized by wells drilled along the fault lines bordering the mountains (Rosenthal/Mandel 1985). As some of the springs are brackish due to the up-flow of saline water from depth, the over-utilization of these wells has brought about a slow increase in salinity in some of them (Rosenthal 1988). From the flow towards the east, about 80 MCM/Y flows towards the springs flowing directly towards the Dead Sea, from which about 15 MCM/Y is pumped in the mountain region. It is estimated that about 50 MCM/Y can still be utilized in the mountain and foothill regions from the flow of the springs along the western border of the rift valley.

24.5.1.2 Desalinization of Brackish Fossil Ground Water in the Mountain Region

An investigation of data from the oil-exploration wells drilled in the central mountain region (Greitzer/Issar 2001) showed that underlying most of the mountainous region, there exists an additional aquifer in the layers of the Kurnub Group. The water in these layers is brackish. The layers in the south-eastern part of the anticlinorium consist of sands and sandstones, but towards the centre and north, the facies change into shale and limestone. The shale layers may divide the aquifer into sub-aquifers. It is assumed that the regime of flow is decided by the geological structure and thus is more or less in the direction of that of the limestone-dolomite aquifer of the Judea Group overlying it. The Kurnub Group aquifer outcrops over an area of about 40 km^2 at the peaks of the anticlines. However, as the thickness is rather limited (around 200 m) and part of the section is composed of shale, the recharge is limited as well. No direct measurements have been performed but considering that these areas also coincide with the areas of maximum precipitation, reaching about 600 mm/Y, the annual recharge is estimated to be about 5 to 8 MCM. Some recharge may take place by leakage from the overlying Judean Limestone aquifer, which has a higher water table. This recharge, the quantity of which is unknown, is estimated to take place along the fault zones. The aquifer in the mountain area extends over 2,400 km^2 with an average thickness estimated at no more than 100 m. From the interpretation of the oil-exploration well logs, the salinity of the water is on the order of 1,000 to 5,000 mg Cl/l. The lower salinities are found around the outcrops and increase towards the synclinal areas and towards depth. The stored quantity is about 7.2 BCM, as estimated according to the abovementioned data, taking into account an effective storativity[10] of 3 per cent. It was calculated that by pumping about 30 MCM, the water table will drop by 0.5 m/Y. Taking into account a thickness of about 100 m, the supply can last about 200 years, or about 60 MCM/Y for 100 years. An investigation in the Beer Sheva region, which will be discussed later, showed that when the supply of fresh water is needed for an urban centre located far from the sea, the local desalination of brackish ground water is more economical than importing desalinized sea water. As any addition to the supply of water to Israeli-Palestinian populations will have to come from the desalination of sea water, the supply to the urban centres of the mountain region of partially desalinized water from the Kurnub Group aquifer should be investigated in more detail.

24.5.2 Turning the Coastal Plain Aquifer into a Storage Reservoir of Second-grade Water

As the demand for fresh water increases and precipitation decreases, it is clear that the water supply from natural resources for irrigation will have to be drastically reduced by the year 2020 (and even totally eliminated during dry years), and that a major portion of the urban demand of the Israeli and Palestinian populations will have to be met by the desalination of brackish and sea water. At the same time, the increased demand for agriculture will be made mainly by the Palestinian population, and for this purpose the use of reclaimed sewage will increase. Considering these general assumptions, the three main problems to be dealt with are:

1. The storage of surplus of water during years when precipitation is above average;
2. The storage of fresh water from desalinization plants (either brackish ground water or sea water) which, in order to ensure their economic profit,

10 Storativity is the percentage of volume of the aquifer which can be filled with water, while 'effective storativity' is the percentage of this which can be pumped out (minus the water which remains due to hygroscopic forces).

will also have to operate in periods of low demand such as the winter season;
3. The storage of reclaimed sewage in general and particularly during the winter months, when supply exceeds the seasonal demand for irrigation.

Examining the various aquifers from the point of view of storage, it seems clear that the greatest potential for further augmentation of storage is in the Coastal Plain. This is due to the fact that the sandstone layers from which this aquifer is built have a high storativity coefficient (average 10 per cent), due to their high porosity. At the same time, the velocity of flow in the sandstones is relatively low due to a low permeability coefficient (K = 1 m/day). On the other hand, the high permeability of the limestone aquifer (K = 100 m/day) causes recharged water to flow to the outlets in a rather short time. Another fact to be considered is that in the eastern part of the Coastal Plain, a large volume of the aquiferous layers is unsaturated and can be recharged artificially, providing additional storage. The shifting of the recharge and storage areas to the east is a prerequisite to meeting future storage requirements, which should reach about five times that of the present. Today, this is being carried out in a densely populated region while the demand for, and cost of land are on the rise. Moreover the location of the present sub-surface storage field of treated sewage in the central Coastal Plain (the Shafdan) is at a rather small distance from the sea. This area is underlain by confining layers, which limit the inflow of the recharged water to the deeper aquifer and thus cause water to flow to the sea. If use of this storage field continues and the quantity stored is increased, these losses will become even more pronounced.

These are the basic assumptions concerning desalination and agricultural use. They, as well as the hydro-geological characteristics of the Coastal Plain, must be taken into account in planning for the storage of reclaimed sewage and flood water. Once Israel and the Palestinian Authority collaborate, they will jointly be able to close the gap between supply and demand. In the first place, the Coastal Plain aquifer will have to become joint storage for Israel and the Palestinian Authority. Once the recharge of reclaimed sewage and storage areas have shifted from the western part of the region to its eastern part, it will also be possible to recharge and store the flood water coming from the Palestinian territory. At the same time, Israel will have to plan anew its recharge areas for its reclaimed sewage and flood water. Due to paleo-environmental conditions which existed during the Quaternary period, all the riverbeds crossing the Coastal Plain are underlain by thick layers of clay. Moreover, adequate natural sites for storage dams are very rare in the central and western parts of the Coastal Plain. These conditions dictate that the best places for storage and later gradual recharge by floods are in the eastern parts of this region, close to the foothills.

In the vicinity of the coast, clay layers exist in the sub-surface which divide the aquifer into sub-aquifers. These sub-aquifers can be used to store the desalinized sea water during periods of low demand, since in order to be economical, the operation of the desalinization plants has to be continuous.

As part of the new cooperative planning, storage in the section of the Coastal Plain under-lying the Gaza Strip should follow a similar policy. This will enable recovery of the over-pumped aquifer below the Gaza Strip. This can only be done once the gap between supply and demand in this region has been supplied from Israel and from local desalinization projects. On the whole, the total quantity of water recharged annually to the Coastal Plain aquifer would be on the order of 600 MCM. The quality of this water supply would be as follows:

1. One-third recharged from precipitation, infiltration from urban runoff and returning irrigation water, containing about 300 mg Cl /l.
2. Another third, coming from the winter flow of the Jordan River, diverted above the Sea of Galilee to the Israeli National Carrier, containing about 100 mg Cl/l.
3. One-third, coming from reclaimed wastewater, containing an average 400 mg Cl/l.
4. An additional quantity, not yet estimated, will come from the desalinization plants during periods of low demand.

All this would eventually combine to give an average water quality of about 250–270 mg Cl/l.

24.5.3 Utilization of a One-time Reserve from Fossil Aquifers

Studies by the author and his colleagues (Issar/Bein/Michaeli 1972; Nativ/Bachmat/Issar 1987; Issar/Nativ 1988; Tsur/Park/Issar 1989; Issar 1994) have shown that a few hundred million cubic metres per year may be pumped from the Nubian Sandstone aquifers underlying the Negev and the Sinai. This pumping is guaranteed for at least the coming century. The actual quantity and duration would be a function of management policies and various economic factors. In principal, however, such a project is technically feasible, and

the water is of adequate quality. Although this water source is not replenishable, it may be regarded as any other non-replenishable resource (e.g. oil, coal, iron ore). In other words, the evaluation of whether or not to use it should be based on socio-economic considerations aimed at encouraging settlement of the empty desert regions in order to relieve the population density in the overcrowded Coastal Plain area, as well as the settling of the Bedouin population. The latter issue is one of the principles of the paradigm of 'progressive development'. The drying up of the desert boundary region of Israel, a process which has already begun and where most of the Bedouins reside, will bring about this process anyway. It is thus advisable to do it in the framework of a general plan.

24.5.4 Desalinization of Sea Water and Greening of the Desert

As discussed earlier, natural recharge of the water resources of Israel and Palestine is not sufficient to fulfil the present, let alone future demands of the growing population. Israel has begun the desalinization of sea water and in 2013 the plan is to reach the amount of 500 MCM/Y. This target amount was set without taking into consideration the future negative impact of climate change. Thus, as the desalinization of brackish and sea water is the only solution for the future, it is suggested to increase the target volume of desalinization according to the forecasted 20 to 30 per cent reduction in precipitation, which will thus have to reach the volume of 650 MCM/Y in 2013.

The desalinization of sea water, as well as brackish water, necessitates the input of energy. Until economically and environmentally friendly resources such as wind mills, solar photovoltaic cells (Brauch 2006a, 2007; Faiman 2009; Trieb/Krewitz/May 2009) and the like are developed, most of this energy will have to come from conventional sources, i.e. fossil fuels. In order to compensate for this, plantations for sequestering atmospheric CO_2 can be planted in the desert. Preliminary projects involving the planting of olive and date palm trees in the Negev Desert, utilizing fossil brackish water, have proven successful both agriculturally and economically (chapt. 48 by Safriel). However, this combination, although an important issue, is beyond the scope of this chapter.

24.6 Conclusions

The impact of accelerating global warming on the natural and human environments of the arid and semi-arid zones in general, the Middle East in particular, has been projected to be negative. The drying up of the climate and thus of the water resources raises some doubt as to whether the principles of sustainable development will be able to avert the forthcoming crises, especially in developing societies, in these countries. A desire to avoid the impact of such crises brought the author to suggest the new policy of 'progressive development', which entails the comprehensive development of soil and water resources, including one-time water reserves and marginal land resources. Such projects will include deep drilling and pumping, modern irrigation and agricultural methods. In parallel to the investments in the development of natural resources, efforts will be made to advance the human resources, via both technical and cultural education.

25 Jerusalem: Where To? In Search for Hidden Opportunities

Mohammed S. Dajani Daoudi and Ashraf M. Dajani

Two women came before King Solomon, each claiming that a newly-born baby was hers. The judgment of Solomon was to have the baby sliced in two and each be given a half. "Let it be neither thine nor mine, but divide it!" As the sword was drawn to carry out the order, one of the women agreed with the verdict whereas the other rushed forward to save the baby, exclaiming, "Oh my Lord, give her the baby, but please do not slay it". Observing these reactions, King Solomon judged the later women to be the true mother and ordered that she should have the child.

25.1 Introduction

This chapter addresses one of several major obstacles to the Israeli-Palestinian peace process the dispute over Jerusalem - a complex controversial issue, which seems insoluble and the search for any hidden opportunities it may contain has proved elusive. The model proposed reflects the potential for shifting the political discourse in the holy land from the persistent conflict to address the common threats, challenges, vulnerabilities and risks both Palestinians and Israelis face and experience to various degrees. It explores the hidden opportunities for Jerusalem as a sustainable city on which all sides are proud and which all parties can co-exist and co-develop based on equality of opportunities and mutual respect and not on control and power. The search for viable solutions to the future status of Jerusalem is the focus of this chapter. It attempts to deal with future concerns about Jerusalem, and to discuss how they may be alleviated. By exploring ways of achieving a balance between national interests, religious beliefs, political demands, and international legality, it enters the thorny field encompassing the political, religious, legal, and economic agendas of both Palestinians and Israelis dealing with the future of Jerusalem as well as their psychic adoration of the city. The key goal of this chapter is not to offer answers as much as to provide a milieu or setting that may be conducive to thinking in terms of problem solution. This objective is usually lost when emotions overcome rationality. Palestinians and Israelis often get so immersed in their national pursuit to win all that the windows of opportunities and promises escape attention.

25.2 Significance of the Jerusalem Issue

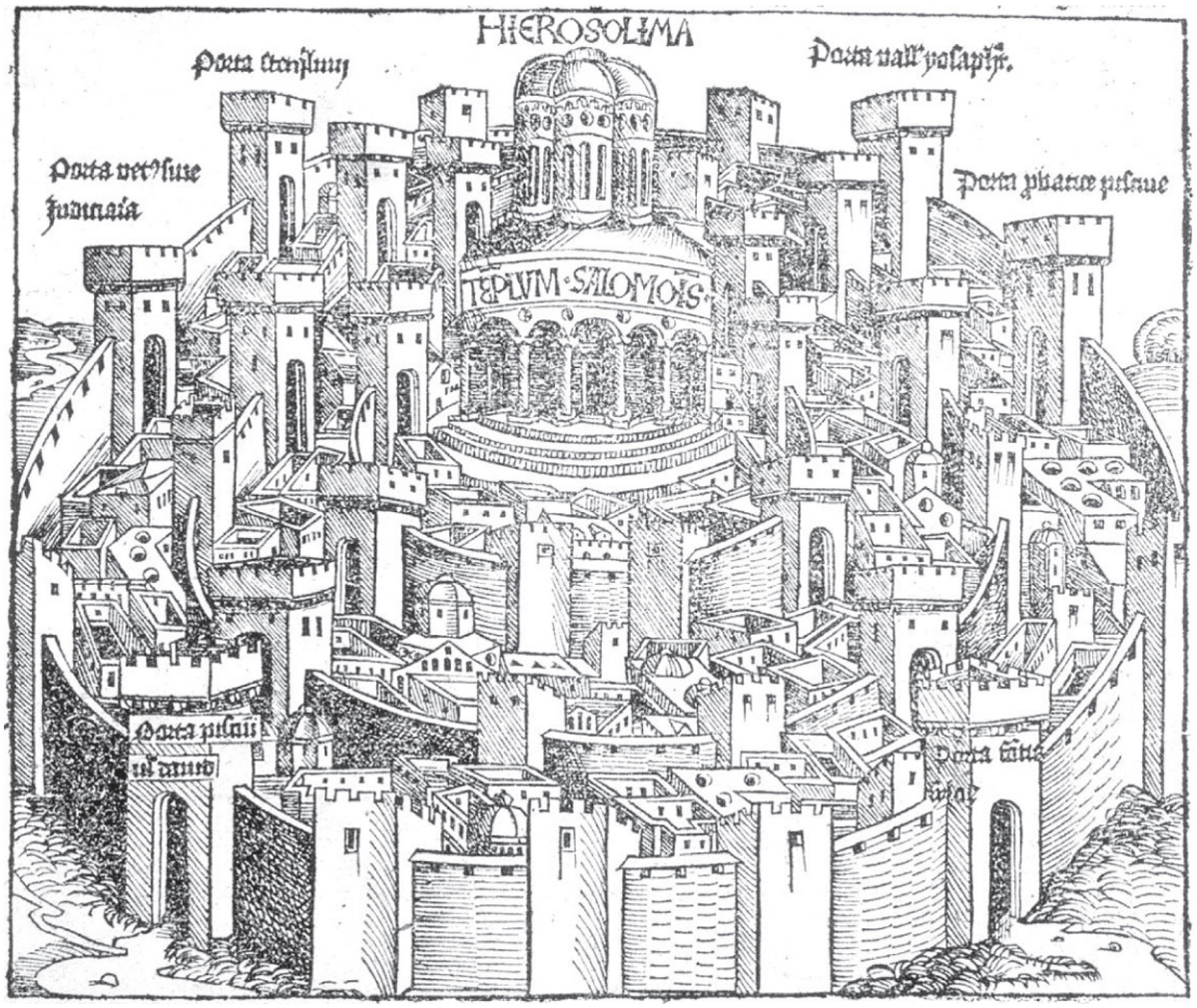
The significance of the Jerusalem issue stems from its universal religious importance for the three great monotheistic faiths: Christian, Muslim, and Jewish who for centuries have been competing for its soil. It also stems from the assorted colourful mosaic of peoples living in it and the rich culture, traditions and customs surrounding it. The ancient Greeks called Jerusalem 'The Navel of the world'. The sources of Muslim[1], Christian[2], Jewish[3] and joint Israeli and Palestinian[4] attachment to Jerusalem are deep and complex; both have infused different ingredients of spiritualism, politics, religion, nationalism, history, and patriotism to demand unquestioned loyalty to the

1 There are many sources on Jerusalem by Muslim, Arab or Palestinian authors, among them are: Arafeh, Rahman (1992); Albin (1990); Asali (1989); Bin Talal (1979); Boudreault and Salaam (1992); Cattan (2000); Mattar (1994); Musallam (1996); Karmi (1996); Sabbah (1990).

2 There are many sources on Jerusalem by Christian or other authors, among them are: Armstrong (1996); Ellis (1999); Hodgkins (1996); O'Mahony, Gunner and Hintuan (1995); Peters (1985); Sinclair (1995); Whitbeck (2000).

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_25, © Springer-Verlag Berlin Heidelberg 2011

Figure 25.1: Map of Jerusalem. **Source:** Hartmann Schedel (1440-1514); Hierosolima (Jerusalem) Liber cronicarum, Nuremberg/Nürnberg 1493 Woodcut, 19.0 x 22.3 cm - Kyram Collection; at: <http://commons.wikimedia.org/wiki/File:Hartmann-schedel-hierosolima-1493_2-BW-1147x965.jpg>. This map is in the public domain.



cause of maintaining and holding on to absolute sole political and religious sovereignty over the holy city.

Muslims, Christians and Jews share many identical values and beliefs such as the oneness of God, the need for total submission to the will of God, as well as the similar differentiation between good and evil. In Islam, the antecedent of the other two religions, many of the individuals, events, stories, and places sacred to Jews and Christians are similarly sacred to Muslims. The Holy Quran states:

> Say: We believe in Allah and that which is revealed to us; in what was revealed to Abraham, Ishmael, Isaac, Jacob, and the tribes; to Moses and Jesus and the other prophets by their Lord. We make no distinction amongst any of them, and to God we submit ourselves. [Baqara Sura; verse 136]

Many Jews believe that God promised the holy land to the descendants of Abraham, Isaac, and Jacob. According to the Jewish *Tanakh*, God made a covenant with Abraham, saying to him: "I assign the land you sojourn in, to you and your offspring to come, all the land of Canaan, as an everlasting holding. I will be their God" (Bereishit/Genesis 17:7–8).

3 There are many sources on Jerusalem by Jewish or Israeli authors, among them are: Ahimeir (1983); Amirav (1992); Baskin (1994); Beckerman (1996); Benvenisti (1976, 1983, 1989, 1996); Blum (1974); Chazan (1991); Cohen (1977); Elon (1995); Feintuch (1987); Friedland and Hecht (1996); Gold (1995); Lapidoth and Hirsch (1994); Romann and Weingrod (1991).

4 And there several joint publications by Israeli and Palestinian authors on Jerusalem: Amirav and Siniora (1991–1992); Nusseibeh and Heller (1991); Nusseibeh and Maoz (1991).

Figure 25.2: Jerusalem as pictured in the 6th-century Madaba mosaic map. **Source**: Photo by Hans Günter Brauch (Germany). Printed with permission.

Jewish attachment to Jerusalem dates to the 10th century BC when David captured the city and declared the city the capital and religious centre of Israel. King Solomon, who followed him, enlarged the city and erected the temple, which transformed the city into a permanent centre of the Jewish religion. When the Babylonian King Nebuchadnezzar II (562–630 BC) captured the city in 586 BC, he exiled the Jews and destroyed their temple. Nevertheless, Jerusalem remained to the Jewish diasporas the spiritual centre. The Jews returned and rebuilt the city after the Persian exile, but it was destroyed by Trajan about 70 AD. The centrality of Jerusalem in Jewish life is reflected in the vow uttered by Jews on religious occasions, 'Next year in Jerusalem'. The Jews consider the City 'uniquely holy', and assert that Jerusalem has always been the heart and soul of Judaism and the Jewish nation: "And the Torah shall be disseminated from Zion, and the word of the Lord from Jerusalem" (Isaiah 2: 3).

The times Jesus of Nazareth spent in Jerusalem and his crucifixion, burial, and resurrection makes the city most sacred to Christianity. Christian attachment to Jerusalem is reflected in the various names for the city contained in the Bible, such as the 'city of righteousness', the 'faithful city', the 'city of God', the 'holy city', and the 'city of truth'. The book of Psalms says: "Pray for the peace of Jerusalem" (Psalms 122: 6); "Praise God O Jerusalem, laud your God O Zion" (Psalms 147: 12).

For Muslims, Jerusalem is the third most holy city in Islam, next to Mecca and Al-Madinah. The Muslim heritage in Jerusalem is reflected in the Holy Quran as well as in the sayings of Prophet Muhammed. Jerusalem has had an important spiritual meaning for Muslims, not only for being the first Qibla but also for the mystical experience of the prophet's ascendance to heaven as recited in the Quran:

> In the name of Allah, most gracious, most merciful: Glorified be he who carried his servant [Prophet Muhammed] by night from the inviolable place of wor-

> ship [The Sacred Mosque in Mecca] to the farthest distant place of worship [Haram el-Sherif in Jerusalem] the precincts whereof we have blessed, that we might show him some of our tokens. [Surat al Israa', Chapter 17, Verse 1]

Prophet Muhammed is quoted to have said: "Pilgrimage is restricted to only three mosques: Al-Haram al-Sharif, in Mecca, my Mosque, in Al-Madinah, and Al-Aqsa Mosque, in Jerusalem." He asserted that the Muslim who starts procedure for pilgrimage or *umra* from Al-Aqsa Mosque shall have all his/her sins forgiven. "Jerusalem is the land of the ingathering, go to it and worship in it, for one prayer therein is equivalent to 1,000 acts of worship elsewhere."

To yield political sovereignty over Jerusalem would be to the Israelis a betrayal of their history, heritage, tradition, and sacrifices. On the other hand, to yield political sovereignty over their holy city, which they call 'pearl of the cities', would be to all Muslims, a betrayal of their religion, history, identity, heritage, and tradition.

25.3 Concept of Sustainable Conflict Resolution

The most perplexing question to answer on the future status of Jerusalem is: Is a sustainable resolution for the Arab-Israeli or Muslim-Jewish conflict over Jerusalem elusive or can it be achieved? If a 'sustainable resolution' to the Jerusalem issue is achievable, the persisting dilemma remains: How best can it be achieved, and will there be good will to implement it by all parties concerned? Here, the term 'sustainable resolution' refers to a solution to the conflict that satisfies the basic needs and aspirations of the present generation without compromising the ability of future generations to meet their basic needs, demands, and aspirations.

This definition contains three key concepts and ideas: conflict resolution, psychological needs satisfaction, and future collective aspirations. The concept 'conflict resolution' proposes a durable peace without any residues for future conflict. It includes the satisfaction of minimal political and national demands. The term 'needs' introduces the idea of distribution of resources: meeting the basic needs of all and extending to all the opportunity to satisfy their longing for a better secure prosperous life. The third concept of 'future collective aspirations' means that we have a moral duty to look after the city of Jerusalem in terms of physical and environmental status, and to pass it on in durable political, administrative, and organizational order to future generations. It suggests that whatever solution to the conflict reached today must continue to be acceptable, relevant and workable in the future – embodying ideals and conditions that future generations will be happy to live with. Its sustainability would stem from its success to meet and satisfy religious, social, economic, and political demands and efficiency measures. Should one party impose unacceptable terms on the other today, then this would, no doubt, constitute a potential seed recipe for a future conflict. Sustainable resolution implies resolving the conflict both for moral and practical reasons.

At least there are eight basic assumptions required to achieve a sustainable peaceful solution. Both peoples:

1. Respect and recognize the right of each other to live, work, and move freely within the borders of the city of Jerusalem.
2. Recognize the right of others, Christians, Muslims, and Jews, to have free access to their holy shrines to practice their faith.
3. Value the need to protect the unique spiritual, religious and cultural diversity of the city of Jerusalem.
4. Appreciate that joint planning, coordination and cooperation between the *de facto* present Palestinian and Israeli sectors of the city of Jerusalem is vital to overcome the economic, technological and educational gap between them.
5. Acknowledge the need to alleviate the religious, cultural, and social enmity between both communities on a gradual and continuous process.
6. Seek to ensure order, security and peaceful coexistence for all the inhabitants of the city of Jerusalem.
7. Call for fostering good will among all residents of the city of Jerusalem.
8. Encourage the development of peaceful relations among residents.

25.4 City Borders

A sustainable resolution of the Jerusalem issue requires the concise allocation of territory over which the Palestinians and Israelis exercise political and administrative authority. *The Webster's New World Dictionary* defines the word 'border' as "a dividing line between two countries, states, etc., or the land along it." The Arabic Dictionary, *Lisan al-Arab*, defines borders as "a means of separation between two objects,

Figure 25.3: Map of Jerusalem. **Source:** The Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www.sacred-destinations.com/israel/images/maps/jerusalem-nc-passia-org.gif>.

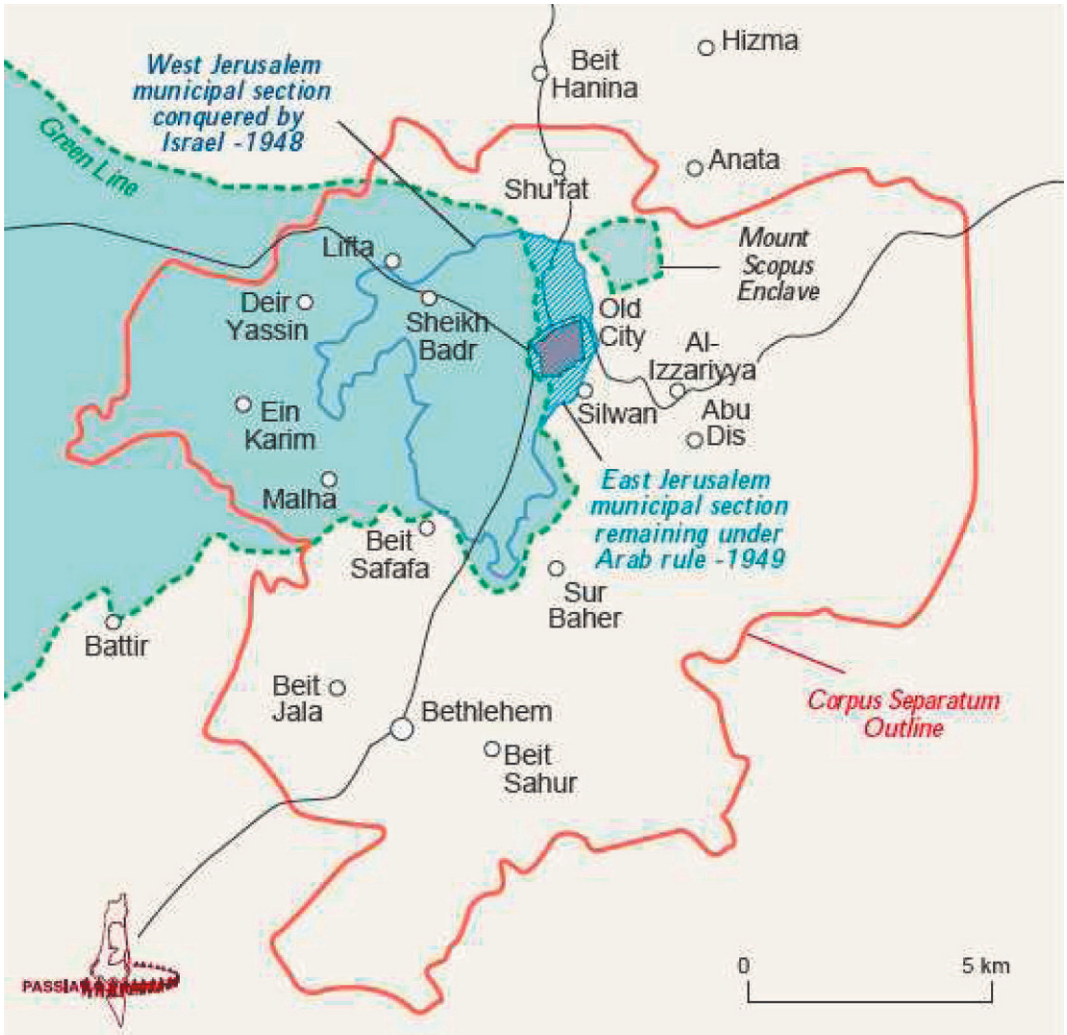
in order that one does not mix with the other, or does not transgress on the other." In our context, it is the second meaning that is of interest. The importance of good demarcation of borders stems from the famous expression: 'Good borders make good neighbours. Bad borders are often the source of tension and conflict'.

The major difficulty facing the question of addressing the city boundary of Jerusalem is that the boundary pillars, which marked the boundary lines, had subsequently been demolished and erased. However, the issue of borders may be discussed on the following six levels by distinguishing between geographical (25.4.1), *de jure* (25.4.2), *de facto* (25.4.3), *status quo* (25.4.4), administrative (25.4.5) and municipal borders (25.4.6).

25.4.1 Geographical Borders

Jerusalem is situated at the top of mountains, on the crest of the ridge that forms the watershed partition line between the foothills to the west and the desert

Figure 25.4: Jerusalem and the Corpus Separatum proposed in 1947. **Source:** Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www.passia.org/palestine_facts/MAPS/images/jer_maps/UNPartition.pdf>.



to the east. The geographical location determined to a large extent the area of the city, its boundaries, and the direction in which it expanded throughout the ages. The city began on a hill and later extended to the north, and in the course of time expanded in the direction of Mount Zion and the western and northern hills. Jerusalem's topography influenced the alignment of the city's boundaries on all sides (figure 25.4).

25.4.2 *De Jure* Borders

The Council of the League of Nations approved on July 24, 1922 the mandate for Palestine entrusted to Great Britain. The mandatory instrument gave Britain the authority with regard to all holy places and religious foundations, with the express injunction that they should be administered according to religious law, existing rights, and public order.

In 1947 the *United Nations Special Committee on Palestine* (UNSCOP) recommended Jerusalem to be internationalized. The United Nations General Assembly adopted on 29 November 1947 Resolution 181 entitled "Plan of partition with economic union" that envisaged Jerusalem as an international city. It was the first international document delimiting the boundary of the city of Jerusalem.

The resolution stated:

[Part II. Boundaries

A. The City of Jerusalem

> The boundaries of the City of Jerusalem are as defined in the recommendations on the City of Jerusalem (See Part III. Section B below)
>
> Part III. City of Jerusalem
>
> A. Special Regime
>
> The City of Jerusalem shall be established as a *corpus separatum* under a special international regime and shall be administered by the United Nations. The Trusteeship Council shall be designated to discharge the responsibilities of the Administering Authority on behalf of the United Nations.
>
> B. Boundaries of the City
>
> The City of Jerusalem shall include the present municipality of Jerusalem plus the surrounding villages and towns. The most eastern shall be Abu Dis; the most southern, Bethlehem; the most western, Ein Karim (including also the built-up area of Mosta); and the most northern Shu'fat.]

The UN General Assembly reaffirmed on 11 December 1948 that the city should be "under effective UN control." The United Nations declared that Jerusalem must remain an international zone, but Israel refused to demilitarize her zone and Jordan refused to consent to the concept of Jerusalem as an international city.

The UN Security Council and General Assembly took firm resolutions throughout the years rejecting Israeli attempts to annex Jerusalem or to change its status. Both bodies adopted resolutions which condemned "Israel's continued occupation of Jerusalem," and asserting that such measures "violates the Charter of the United Nations, the principles of international law and the relevant resolutions of the United Nations." These resolutions affirmed that the acquisition of territory by force is inadmissible under the Charter of the United Nations and the principles of international law and hinders the achievement of a comprehensive peace. The UN General Assembly also determined that "the decision of Israel to impose its laws, jurisdiction and administration on the Holy City of Jerusalem is illegal and therefore null and void and has no validity whatsoever." Furthermore, it adopted resolutions which confirmed that "all legislative and administrative measures and actions taken by Israel, which purport to alter the status of Jerusalem, including expropriation of land and properties thereon, are invalid and cannot change that status."

Official policies of the United States, the European Union, Russia, Japan, the Arab League and the rest of the international community in general held that Israel should not unilaterally change the status of Jerusalem, nor claim West Jerusalem or United Jerusalem as its capital. For many years, Israel had been anxious to see the American Embassy moved from Tel Aviv to Jerusalem. "Committed as it was to the UN Palestine partition resolution of 1947, the United States initially resisted Israel's requests because Jerusalem and its adjacent area had been designated as an international, UN-controlled territory. Later, Israel's annexation of Arab East Jerusalem further reinforced America's unwillingness to move its embassy to Israel's capital" (Lenczowski year: 269) .

The 'Venice Declaration on the Middle East' adopted by the European Council on June 13, 1980 affirmed a similar position on Jerusalem:

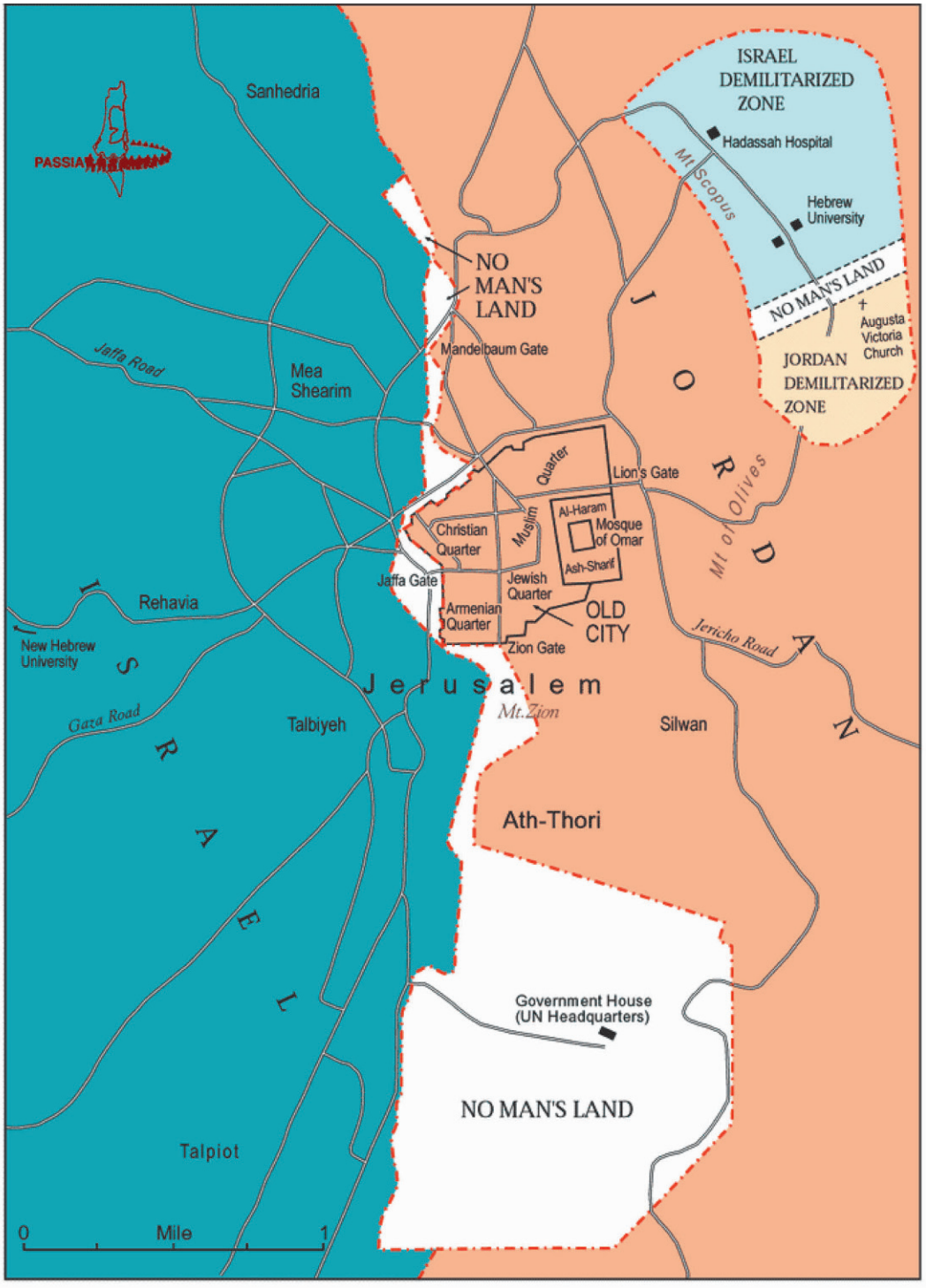
> The Nine recognize the special importance of the role played by the question of Jerusalem for all the parties concerned. The Nine stress that they will not accept any unilateral initiative designed to change the status of Jerusalem and that any agreement on the city's status should guarantee freedom of access for everyone to the Holy Places.

The following shows the *de jure* status of Jerusalem as reflected by the principles of international law and the Charter of the United Nations:

1. The acquisition of territory by force, as well as, all legal, legislative and administrative actions and measures taken by the occupier (Israel) to annex occupied territories (Jerusalem), to impose its sovereignty and jurisdiction, to alter its status either by expropriation of land and properties, or by the transfer of population and imposition of Israeli legislation, violates the principles of international law. It contradicts The Hague Agreement of 1907, the Stimson Doctrine of 1932, and Declaration of Lima of 1938. It is inadmissible under the 1945 UN Charter. Thus, Israel's continued occupation of the city of Jerusalem [West sector occupied in 1948 and East Sector occupied in 1967], is in violation of the international law, UN Charter and the relevant UN resolutions.
2. Israeli unilateral measures to alter the status of Jerusalem are totally null and void since they contradict the principles of international law.
3. Any transfer of diplomatic missions by members of the United Nations to the city of Jerusalem is considered in violation of international law and UN resolutions.

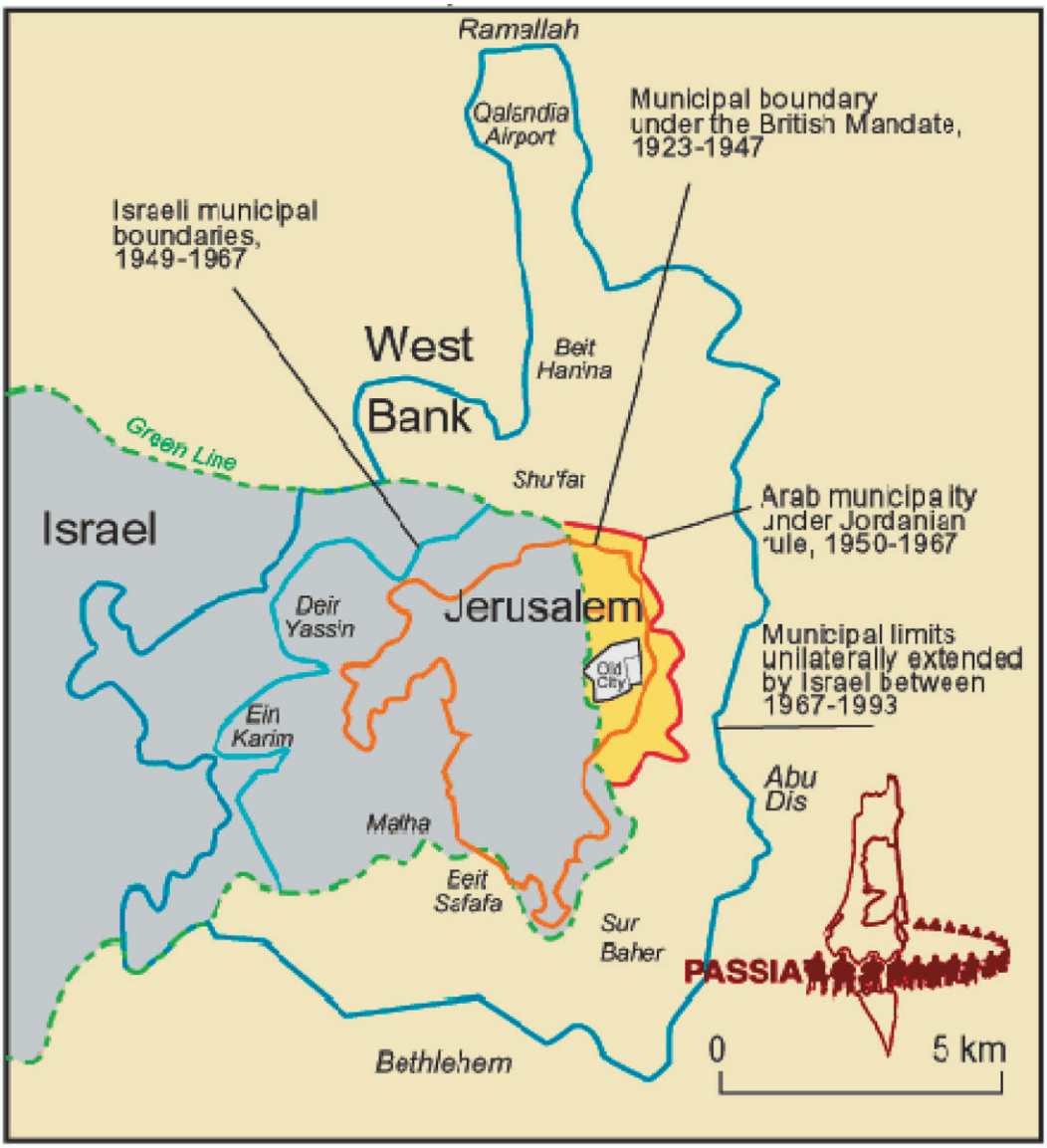
Although resolutions by the UN General Assembly are not legally binding to member states, yet they do carry moral power since they reflect the will of the international community. States applying to membership of the UN organization pledge to abide by UN

Figure 25.5: Partitioned Jerusalem (1948-1967). **Source:** Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www.passia.org/palestine_facts/MAPS/images/jer_maps/PartitionedJerusalem.html>.



resolutions once they become members. Here, one should not forget that the legal rationality for the existence of the State of Israel is based on the 1947 UN Partition Resolution.

Figure 25.6: Change in the Municipal Boundaries of Jerusalem (1947-2000). **Source**: Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www. passia.org/palestine_facts/MAPS/images/jer_maps/Jlem1947-2000.html>.



25.4.3 *De Facto* Borders

In 1948, more than 30,000 Palestinians fled from their homes or were forced to flee from West Jerusalem, leaving in the process more than 10,000 fully furnished homes. Jerusalem was divided into an Arab and Israeli sector, and on 1 December 1948, Jordan established its administration in Arab Jerusalem and that area of the city became territorially demarcated by the armistice line that has been in effect since 1949. The Israel-Jordan Armistice Agreement of 3 April 1949 finalized the physical partition of Jerusalem and left the city divided into two parts with barbed wires and cement barriers cutting across it. The Israeli sector included the Western and Southern parts of the new city. The city was extended westward and Jerusalem became the administrative centre of Israel.

In 1949, a number of Israel's ministries were moved from Tel Aviv to Jerusalem and in December of that year the Knesset met in Jerusalem for the first time. In January 1950, Israel proclaimed Jerusalem as its capital. All government offices moved there except the ministry of foreign affairs, which remained in Tel Aviv to keep in touch with foreign diplomats whose

governments refused to officially recognize Jerusalem as the capital of Israel.

On 24 April 1950 Jordan officially annexed the West Bank, including East Jerusalem, which created a political boundary between the two sectors of the city. In 1966, 190,000 persons resided in Jewish Jerusalem and 60,000 resided in Arab Jerusalem. In June 1967 the boundary line was eradicated and in the aftermath of the war, Israel formally united the two sectors. The barriers, cement walls, blocks and barbed wires that had divided the city were removed. Israeli leaders declared that this act was permanent and non-negotiable.

On the basis of an amendment to the 1948 'Law and Administration Ordinance' adopted by the Knesset, the Government of Israel decreed on 28 June 1967 that Israeli law, jurisdiction and administration applied to a 70 square kilometre area east of the 1948 armistice line. In addition to the old city and the municipal area of Arab Jerusalem, this area included some villages that had previously enjoyed independent status. In July 1967, the Arab municipality of Jerusalem was dismantled and East Jerusalem annexed. In his letter to President Jimmy Carter, the Prime Minister of Israel, Menachem Begin, stated that "Jerusalem is one city, indivisible, the capital of the State of Israel. Thus shall it remain for all generations to come."

Palestinians view the borders of the city of Jerusalem to include the area east of the demarcation line of 1949. They consider that there is a need to review the present status of the districts and villages located outside the borders of the 1967 municipality of Jerusalem.

The *de facto* situation on the ground is that in the aftermath of the 1948 war, Israel had full control and occupation of the 'new Jerusalem'; and in the aftermath of the 1967 war, Israel had full control and occupation of united Jerusalem. However, according to international law, occupation and control as a result of the use of force do not necessarily result in legal legitimacy. Furthermore, the operation of diplomatic missions from Jerusalem as a result of the *de facto* situation does not imply the *de jure* recognition of Israeli sovereignty over united Jerusalem.

25.4.4 *Status Quo* Borders

The *status quo* borders refer to the psychological boundaries that separate the Arab East sector of Jerusalem from the Jewish West sector of the city. Three key factors determine psychological boundaries: a) perception; b) a sense of belonging; and c) emotional affiliation. When East Jerusalem was under Arab sovereignty, Palestinians took good care of their city. However, when the Arab part of the city fell under Israeli occupation, the Israelis never felt that the East sector of the city belonged to them. The Municipality of Jerusalem neglects to develop the Arab Jerusalem sector in par with the Jewish Jerusalem as a general policy.

Since the early days of their occupation of Arab Jerusalem in 1967, the Israelis erected a *cordon sanitaire* around the Arab sector of Jerusalem. Palestinians were granted Israeli blue identity cards as residents of Jerusalem while some remained Jordanian nationals. The Israeli law was imposed but the Palestinian Arab curriculum was in use in the municipal and private high schools in the Arab sector of Jerusalem.

In the Israeli political rhetoric, Jerusalem was one united city not to be redivided. However, in their psyche as well as in their day-to-day practice, two cities existed. One neglected Arab ghetto in which Palestinians resided under tremendous social, political, legal, and economic pressures, in addition to poor health, educational and sanitary conditions; the other in which Israelis resided was a flourishing modern style well-maintained beautiful clean city. High in the clouds, Jerusalem's universal spirit roamed with no borders.

No doubt, there is a growing high degree of national polarization affecting daily activities in the city of Jerusalem where two main focal identities exist – a national Arab/Israeli focal identity, and a religious Moslem-Christian/Jewish identity. The Arab national identity used to attract Palestinians from the West Bank and the Gaza Strip for their prayers, shopping, business, commerce, and entertainment. Similarly, the Jewish focal identity attracted Jews for similar reasons. Both are dominantly inhabited by their respective constituencies. Residency in each is highly segregated while commerce, labour and trade are moderately so depending on the political temperature. While some Palestinian Jerusalemites walk to the Jewish sector for shopping, many seek work opportunities there. Few Jews shop in the Arab sector while none seeks job opportunities there. Palestinian Arabs, who between 1948 and 1967 formed the absolute majority of the population of East Jerusalem, became a minority in their own city. In 1967, the demographic balance was 70/30 per cent while today it is 66/34 per cent.

Figure 25.7: Israeli Settlements and Palestinian Neighbourhoods in East Jerusalem (2000). **Source**: Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www.passia.org/palestine_facts/MAPS/images/jer_maps/Settlements.html>.

25.4.5 Administrative Borders

The administrative borders mark the municipal boundaries of the city of Jerusalem. While the political, cultural and psychological borders separating Arab Jerusalem from Israeli Jerusalem were beyond Israel's power to erase by law or force, the administrative line marking the borders of separation between both sectors of Jerusalem was erased. However, Palestinians define the geographical boundaries for the Jerusalem administrative district as they were during the period 1948–1967.

According to the Jordanian regulation 125 issued based on Article 120 of the Jordanian constitution, the district of Jerusalem included the following cities, villages and tribes:

i. a. The district of Jerusalem comprised 36 cities, villages and tribes.

b Jericho: 6 cities, villages and tribes

c. Bethlehem: 15 cities, villages and tribes

ii. a. Sub-district of Ramallah which comprised 9 cities, villages and tribes.

b. Nahiet al-Nabi Saleh: 9 cities, villages and tribes

c. Nahiet Deir Kadis: 9 cities, villages and tribes

Accordingly, the Arab municipality of Jerusalem under Jordanian authority (1951–1967) included the following localities:

1. The City centre and its environs which include the Old City, Musrarah, the American Colony, Salah ed-Din Street, Bab al-Zahra, al-Thouri, Al-Tur, Sowaneh, Wadi el-Joz, Sheikh Jarah, Silwan, Ras el-Amoud, Shufat, Beit Hanina, Kufr Aqab, Sur Bahir, Um Tuba. Israel excluded the following three localities from the Jordanian municipal boundaries of Jerusalem: (1) Beit Safafa, which was annexed to the Bethlehem district; (2) Gilo Settlement, which was annexed to Ramallah district; (3) Jerusalem Airport near Qalandia, which was annexed to the Ramallah district.

Israeli settlements were constructed in this Arab territory on confiscated land, among them: Neve Ya'acov, Pisgat Ze'ev, Ma'alot Dafna, Giva'at Hameftar, Giva'at Hamatos, Ramot, French Hill, Talbiot, Rekhes, Atarot Industrial Zone, Gilo, Har Choma, and Ramat Eshkol.

25.4.6 Municipal Borders

In 1967, the municipal boundaries of East Jerusalem were enlarged 10.5 times of its original size from 6.5 km^2 to 70.5 km^2. The municipal boundaries of the city of Jerusalem reflected the political geography of the city from the Israeli perspective, rather than its urban structure. In an effort to maintain and preserve its power position in Jerusalem. Israel consistently manipulated the city boundaries for its own advantage to meet its political and religious ambitions. The Israeli Government tended to distort the popular constituency of Jerusalem by implementing the American practice of gerrymandering, i.e. redrawing congressional districts to favour the interests of the political party or persons in power.

The Israeli Municipality of Jerusalem copied skilfully the science of gerrymandering in drawing the map of the united city of Jerusalem. Gerrymandering aimed to keep the Arab heavily populated neighbourhoods such as Al-Ram outside the borders of the city while including the unpopulated areas under full Israeli control and thus corrupting the districting process. Gerrymandering took advantage of the ethnic and religious distinction of Jewish and Muslim/Christian constituencies. The municipal boundaries were drawn in a zig-zag manner in order to include as much as possible of the unpopulated land and to exclude as much as possible the Palestinian populated suburbs of Jerusalem.

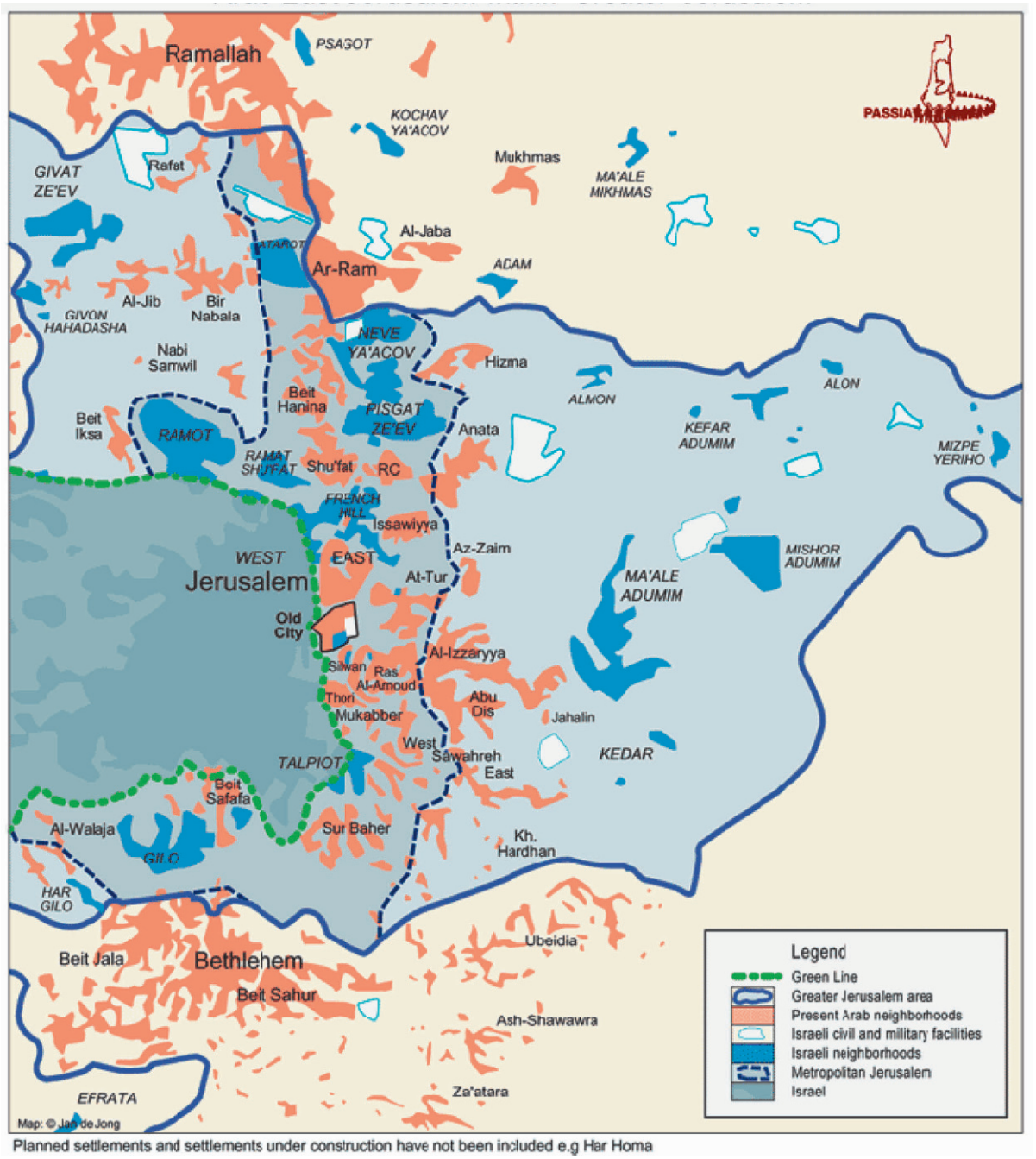
Were the Arab neighbourhoods on the periphery of the city of Jerusalem included when the boundaries of the city were extended, then the percentages of the Palestinian residents would have risen in equity with the increase in the size of the municipal area. However, Arab neighbourhoods on the periphery of the city were excluded when the boundaries of the city were extended. The skilful art of gerrymandering succeeded in lowering the percentage of Palestinians living within the municipal boundaries of the city, making them a one-third minority in comparison with the two-third Jewish majority.

One result of this gerrymandering distortion is that the interests of Palestinian residents of the city have been largely curtailed and neglected as they were discriminated against by the Israeli Municipality of Jerusalem in almost everything from education to health to taxing abuses and even to garbage collection.

In addition to the 1967 municipal borders and the localities annexed to it since 1967, the future borders of Arab Jerusalem should include the following heavily populated Arab localities. Many of these places were part of the Jordanian district of Jerusalem in the pre-1967 period: Issawiyeh, Eizariya, Abu Dis, Dahiet al-Barid, al-Ram, Qalandia, Beir Nabala, al-Jib, Beit Iksa, Beit Sourik, Qubaiba, Beit Anan, Beit Ijza, Katana, Mikhmas, Beit Safafa, Anata, Beit Duqqu, Hizma, Jaba', Nabi Samuel, Judeira, Rafat, Bidu. Israeli settlements constructed on confiscated Arab land such as Ma'ale Adumim, Qidar, Site, Giv'at Binyamin, Mishor Adumim, Kefar Adumim, A'lmon, Kokhav Ya'acov, Giva'at Haradar, Ramot Allon, Giv'on Hadasha, Giva'at Ze'ev, Nahal Anatot are subject to negotiations to determine their future status (figure 25.7).

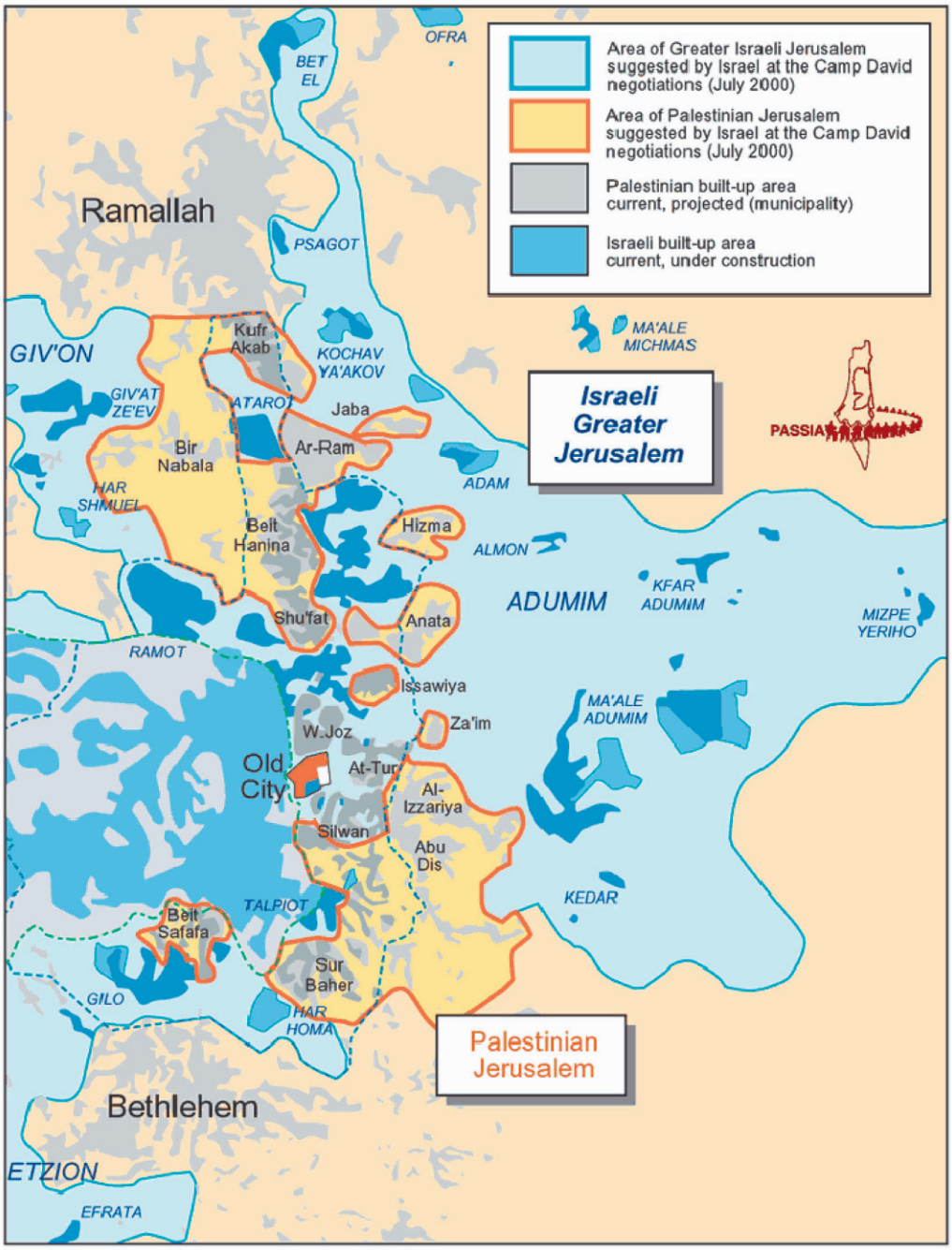
Without having a fair part of the city votes, it is difficult for Palestinian candidates to get elected to the Israeli municipal council. Two suggestions were proposed to bring some justice to the equation. Former

Figure 25.8: Arab East Jerusalem with 'Greater' Jerusalem. **Source:** Palestinian Academic Society for the Study of International Affairs (PASSIA).



Mayor of Jerusalem Teddy Kollek suggested after he left office the idea of 'occasional concessions'; others suggested 'equitable representation.' However, when drawing the municipal boundaries of the two sectors of the city, the following three principles should be adopted: compactness; homogeneity of popular interests; and equality of populations.

Figure 25.9: Projection of the Israeli Proposal for Jerusalem's Final Status, Camp David, July 2000. **Source**: Palestinian Academic Society for the Study of International Affairs (PASSIA); at: <http://www.passia.org/palestine_facts/MAPS/images/jer_maps/Jlem_camp_david.html>.



25.5 Models Proposed for the Future of Jerusalem

There is one question that preoccupies all those concerned about the future of Jerusalem. What is the most practical and useful model for power sharing and division of responsibilities for the future City of Jerusalem? These three models had been proposed for the future of the City:

Figure 25.10: Expanding Jewish settlements in East Jerusalem. **Source:** © Philippe Rekacewicz, Le Monde Diplomatique (February 2000); at: <http://mondediplo.com/IMG/arton2066.jpg>. Reprinted with permission of the author.

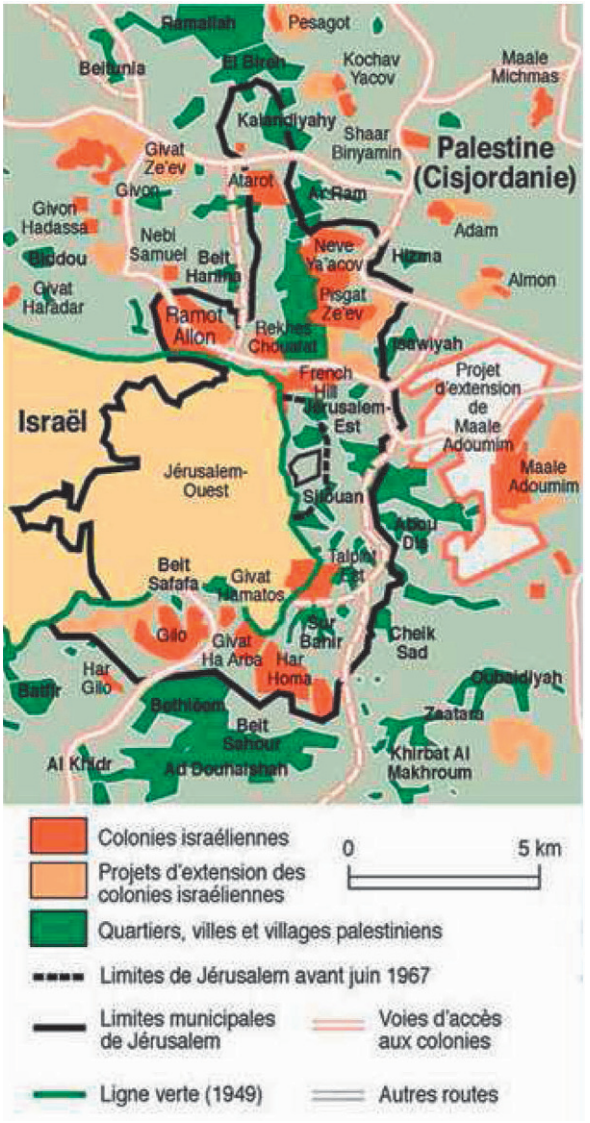
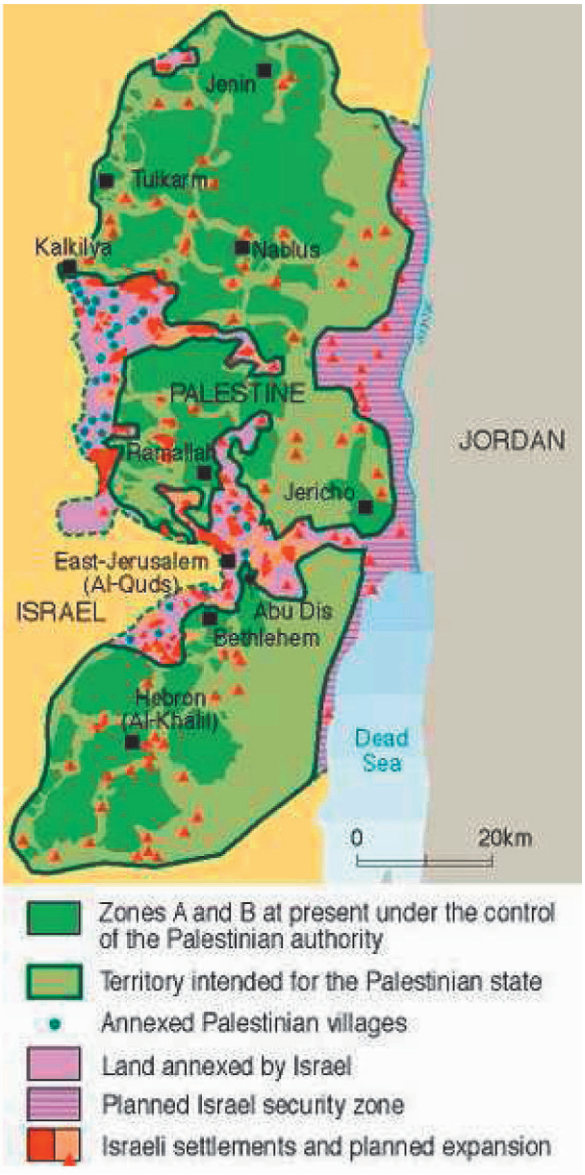


Figure 25.11: Mapping the Conflict. Israeli proposals made at the Camp David talks in July 2000. **Source:** © Philippe Rekacewicz, Le Monde Diplomatique (February 2000); at: < http://mondediplo.com/maps/mappingtheconflict200109>. Reprinted with permission of the author.



- Model I (International): An international united city; or a bi-national undivided condominium city;
- Model II (Israeli): One national united city;
- Model III (Palestinian): Two national divided cities; or a bi-national twin politically separate but geographically undivided city.

25.5.1 International Model

The first model of an international united city of Jerusalem is not new. Britain, France and Russia initially conceived it in the Sykes-Picot Agreement of 1916. The United Nations again suggested the concept of Jerusalem as a separate area *(corpus separatum)* in its Partition Plan of 1947 (figure 25.5). In December 1949, the UN General Assembly restated its intention to establish an 'international regime' in Jerusalem, which would provide adequate protection for the holy

places. However, the plan for internationalizing Jerusalem presented by Count Folke Bernadotte, the UN mediator in Palestine, was never approved by the United Nations and the international community withdrew this proposal given the strong opposition from both Israelis and Arabs.

Another model is that of a bi-national undivided *condominium* city. Condominium is a Latin term formed of two words: *con*, meaning together, and *dominium*, meaning ownership, thus 'joint ownership'. It also means joint administration over a given territory or unit in a multi-unit structure. It implies joint sovereignty by two or more nations and refers to 'a regime in which two or more states control a particular area on a basis of equality and in accordance with a specific arrangements to which they have agreed'. Precedents of condominiums are Chandigarh, the joint undivided capital of two neighbouring Indian states, Sudan, a condominium of Britain and Egypt for half a century prior to its independence in 1956. Then there are the New Hebrides Islands in the South Pacific, now the independent nation of Vanuatu, which during colonial times were under the joint undivided sovereignty of Britain and France. Finally, there is the example of Andorra, a tiny republic in the Pyrenees between France and Spain, which was under the joint French and Spanish undivided sovereignty.

The British journalist Michael Adams proposed the 'condominium' model in 1968 as a way to reconcile Arab-Israeli competing claims for sovereignty over Jerusalem. A number of scholars have adopted this model, among them John V. Whitbeck, a Paris-based international lawyer. Its main points include a joint sovereignty over an undivided city, i.e. "the city would be a condominium of Israel and Palestine." In the context of a two-state solution, united Jerusalem would form an undivided part of both states and constitute the capital for both states. An umbrella municipal council and local district councils would administer the city; a borough system modelled on the French-style *arrondissements* 'could bring municipal government closer to the different communities in the city'.

The advantages of this model are: 1) The City of Jerusalem would remain undivided; 2) Both Palestinians and Israelis would have a say in the future of Jerusalem; 3) Both Palestinians and Israelis would name the city as their national capital; 4) Both Palestinians and Israelis would jointly own and jointly govern the territory of united Jerusalem, but with dual administrative and legal arrangements. The weakness of the model lies in its impracticality in terms of implementation.

The 'condominium' model for Jerusalem distinguishes between political sovereignty over one city and functional sovereignty pertaining to the municipal administration of two cities: one Arab and the other Israeli. The scheme implies either a joint Israeli-Palestinian shared sovereignty over the united city of Jerusalem, which Israel strongly rejects, or a joint Israeli and Palestinian shared sovereignty over 'ambiguous' certain areas of Arab Jerusalem, which the Palestinians strongly reject.

In late December 2000, US President Bill Clinton proposed Jerusalem would "encompass the internationally recognized capitals of two states - Israel & Palestine," with Palestinians having some "form of sovereignty over Haram al-Sherif as well as over Arab neighborhoods in East Jerusalem....Israel would annex the giant settlement blocs adjoining Jerusalem." An "international presence" would monitor enforcement of agreement. The Clinton Plan divided the city into a checkerboard of different sovereignties.

25.5.2 Israeli Model of One National United City

The concept of the city of Jerusalem as 'one city united and undivided under Israel's full sovereignty' is the official Israeli policy on Jerusalem. In the aftermath of its occupation of East Jerusalem in June 1967, Israel formally annexed the Arab sector of Jerusalem and enlarged the municipal area of the city more than ten times its original size. Israel succeeded in the *Camp David Framework for Peace in the Middle East* (1978) on the principles governing a comprehensive peace settlement to place occupied Jerusalem totally outside the scope of the powers and responsibilities of the projected 'self-governing' authority.

In its 1996 election platform, the Likud outlined its position on Jerusalem as follows: "United and undivided Jerusalem is the capital of the State of Israel. Activities which undermine the status of Jerusalem will be banned, and therefore the PLO and Palestinian Authority institutions in the city, including the Orient House, will be closed."

After the election of Prime Minister Benjamin Netanyahu the guidelines of the Israeli government on Jerusalem were: "Jerusalem, the capital of Israel, is one city, whole and united, and will remain forever under Israel's sovereignty... The Government will prevent any action which is counter to Israel's exclusive sovereignty over the city." Likewise, in its 1996 elec-

Figure 25.12: Arab Jerusalem Airport in 1962. **Source**: Photo from the personal photo archive of the Dajani family.

tion platform, the Israeli Labour Party claimed: "Jerusalem, the capital of the State of Israel and the focal point of the Jewish people, will remain undivided, under Israeli sovereignty." Various Israeli experts, such as former Mayor of Jerusalem, Teddy Kollek, political geographer Saul Cohen, Mapam Party leader Ya'akov Hazan, and many others, proposed a number of plans for the city, which reiterated the Israeli official line of advocating Jerusalem as "one city united and undivided under absolute Israeli sovereignty." Israeli policies viewed Palestinian presence in Arab East Jerusalem as purely functional; the city would be divided into boroughs in which the Arabs will be guaranteed some social, cultural and educational autonomy.

The main characteristics of the Israeli model are the following:

1. It keeps the city of Jerusalem united under Israel's full control and assigns the sovereignty over the entire city exclusively to the Israelis, and thus allows the continuation of the domination of one people over another in defiance of international law. In addressing the Jordanian Parliament on 23 November 1993, late King Hussein of Jordan reflected Arab views when he asserted: "A just and comprehensive peace will not be realized until Jerusalem becomes a city of peace and its occupied Arab land is returned to its owners. ... A full settlement is impossible as long as Israel demands sole sovereignty over Jerusalem."
2. It enjoys general support from the Israeli public.
3. It allows Israeli political national considerations to remain the cardinal cornerstone with regard to future planning and development of the united city.
4. It promotes a city government structure that taxes one segment of the population (Palestinian Arabs) much more while spending much less in response to its needs.
5. It advocates a process of local government system, which allocates public resource among the various services and functions in a manner that would benefit one segment of the community (Jews) more than others (Muslims and Christians). It is a system in which political and religious factors make an important difference in determining the level of services delivered and the manner of their distribution (who gets what?).
6. It lacks support of the Palestinians as it only grants them purely 'functional sovereignty' rather than 'political sovereignty' over Arab Jerusalem while retaining Israel's political sovereignty over the united city. Moreover, it grants Palestinian residents of Arab neighbourhoods in Jerusalem a special status within the framework of the municipal government that will only allow them to have a

minimum say in the responsibility of the administration of their lives in the city.
7. It contradicts the spirit and letter of the Oslo Accords signed by Israel with the PLO and the Jordan-Israel Peace Agreement, which stipulated that permanent status negotiations should include Jerusalem among other issues. Thus Israel's claim of exclusive sovereignty over Jerusalem pre-empts any genuine future negotiations on the status of the city.

25.5.3 Palestinian Model of Two National Units

Since its establishment in 1964, the *Palestine Liberation Organization* (PLO) adopted a firm policy aiming at the establishment of a political, religious, spiritual and administrative capital in al-Quds al-Sharif, (the holy) city of Jerusalem for a Palestinian state. The proclamation of independence announced by the *Palestine National Council* (PNC), meeting in Algiers on 15 November 1988, called for the establishment of the Palestinian state with Jerusalem as its capital. Consequently, the *Palestinian National Authority* (PNA) continued carrying this banner.

The official Palestinian position on Jerusalem may be summarized as follows:

1. Arab Jerusalem is an integral part of the Palestinian Territories occupied in 1967. Therefore, UN Security Council Res. 242 of 22 November 1967, and Res. 338 of 22 October 1973 that called for Israeli withdrawal from all Arab territories (including Jerusalem) occupied in the 1967 war, should be implemented.
2. The main aim of the Palestinian people is the establishment of the state of Palestine with al-Quds al-Sharif (the holy city of Jerusalem) as its capital.
3. The Israeli unilateral decision to annex Arab Jerusalem and enjoy full exclusive political sovereignty over Jerusalem is totally denied and categorically rejected.
4. Palestinians in the Palestinian Territories, including Jerusalem, have the right and desire for self-rule and self-determination in accordance with international law and the basic principles of democracy.
5. There should be no separation between political sovereignty over Jerusalem and the custodianship over the holy places in the City.
6. There should be a guaranteed freedom of worship at the holy places for all faiths.
7. A removal of all Israeli settlements built in Arab Jerusalem since 1967.
8. The Jerusalem of the future should be an umbrella city for two capitals, one Palestinian in East Jerusalem, the other Israeli in West Jerusalem.
9. There should be free access between the two capitals within the city, which will remain functionally united.
10. Cultural, social, and economic ties should be established between both communities living in the city.
11. No one party should impose its will on the other, or dictate its views regarding the future status of the city.
12. Jerusalem's diversity and its multicultural character must be maintained in any future settlement.

The alternative model is that of a bi-national twin 'separate and undivided' city. *Webster's New Collegiate Dictionary* (1987) defines 'twin' as "made-up of two similar, related, or connected members or parts; paired in a close or necessary relationship; having or consisting of two identical units; being one of a pair." This relates to the future model of Jerusalem as the concept of a twin city – separate and undivided – as proposed by many Palestinian scholars and international experts as an imaginative durable solution for the Jerusalem issue that would realize both Palestinian and Israeli aspirations. Professor Walid Khalidi (1988) of Harvard University proposed these ten points as a solution for the future status of Jerusalem:

1. East Jerusalem would be the capital of Palestine, with its own municipality in the extended municipal borders of 1967; West Jerusalem would be the capital of Israel.
2. The borders between West and East Jerusalem would follow the 1967 lines, but be open both ways – 'sovereignty without walls' – subject to agreed security arrangements.
3. The Jewish quarter in the old city, the Wailing Wall plaza, and the Jewish cemetery on the mount of Olives would have extraterritoriality.
4. An agreed number of Jewish residences of East Jerusalem would remain, as Israeli citizens, with their own boroughs within the Palestinian municipality of East Jerusalem.
5. Each religion would be in exclusive charge of its own holy places and institutions, but an ecumenical council with a rotating chairmanship would promote interfaith harmony.
6. Central structures with rotating chairmanships would exist at both an interministerial and an

Figure 25.13: Dome of the Rock, Christian churches, and Jewish cemetery outside the wall. Holy Sites of Muslims, Jews and Christians in Jerusalem. **Source**: Photo by Úrsula Oswald Spring (Mexico). Printed with permission.

intermunicipal level to address the political and infrastructural issues respectively between East and West Jerusalem.
7. Land acquired by Israel but not built upon in East Jerusalem would be returned to the Palestinians.
8. The choice of compensation or return would be accorded to Palestinian Jerusalemites.
9. Jewish colonies outside the extended 1967 municipal borders would be addressed in the final status negotiations on the settlements in the West Bank.
10. There would be an agreed transitional period.

Professor Sari Nusseibeh (1991), President of Al-Quds University, proposed the following 'mixture of separation and integration' in which Palestinians and Israelis have 'separate sovereignty' over Jerusalem:

1. The Palestinians will have sovereignty over eastern Jerusalem and the Israeli over western Jerusalem in an undivided city.
2. Jerusalem would have an extended and joint municipal government, or joint function of two separate municipal governments, which would operate both sectors, such as sewage, fire-fighting, street lighting, tourist aid and facilities, public health, whose enjoyment by the citizens and benefit is non-exclusive.
3. Matters such as the culture, political and religious affairs would be operated by two separate municipal governments.
4. Jerusalem would be the seat of two capitals and systems of government.
5. The city would have its own single court of law, supervised by a judiciary body whose members are seconded respectively by the two states and whose legal framework is adjusted to address the unique states and dealings of the city's Israeli and Palestinian residents.
6. The outlying metropolitan borderline endowing the city with a special status to be enhanced.
7. The porosity of the city borders should allow the free movement of capital, goods, and persons, to make it possible for residents, whatever their nationality, and wherever they reside, to move freely.
8. The city is to be declared a violence-free and demilitarized zone, a sanctified area that provides free access to all pilgrims and visitors at all times.
9. To introduce an honorary role for a distinguished international public figure to be appointed as UN representative with a special Jerusalem title.
10. To adopt a massive renovation programme in the Old City.

25.6 Proposed Troika Model for Jerusalem

Previous proposed models reflect the interests of one community at the expense of the other. Each demands exclusive sovereignty rights over Jerusalem as a united city or as a divided city. In the scheme where the united city is internationalized, the Israeli and Palestinian sovereignty claims over the city are ignored and thus the model is rejected. In the scheme where the city remains united under Israeli control, Palestinian sovereignty claims are ignored. In the scheme where there is joint sovereignty, the interests of the international community are ignored. Thus, we are proposing a model, which meets the requirement of what has been earlier defined as a 'sustainable resolution' since it aims to fulfil the needs, demands, hopes, and aspirations of the three major players, namely, the Israelis, the Palestinians, and the international community – Jews, Moslems, and Christians.

Our proposal aims to overcome the political hurdles and to provide political attractiveness that makes it promising for all three monotheist religions for which Jerusalem is a holy city. In this context, 'Jerusalem' is composed of the one square kilometre area that falls inside the walls of the Old City. We suggest for a future settlement that the walled Old City be declared a *corpus separatum* subject to a 'special status troika regime', and that the rest of the city of Jerusalem would be divided to two sectors – West/Israeli and East/Palestinian. The arrangements to be determined for the administration of the city would take the interests of all the inhabitants into account including those of the Jewish, Christian, and Muslim communities. East Jerusalem excluding the Old City would be under Palestinian sovereignty; while West Jerusalem would fall under Israeli sovereignty. Those who lost properties in consequence to the 1948 conflict would receive compensation for it.

The 'special troika status' of the Old City of Jerusalem have the following advantages:

1. It meets the claims of both Palestinian and Israeli to Jerusalem as the capital of their nations;
2. It resolves the thorny issues of sovereignty as it bestows sovereignty rights related to governmental matters to each state in the sector where it has the major population weight;
3. It takes into account the desires of both the Palestinians and Israelis to have each community take responsibility of dispensing with functional needs of residents in their respective sector of the city;
4. It has the potential to enjoy support from the international community;
5. It satisfies the needs for identity and recognition for both antagonists;
6. It places emphasis on urban considerations and human needs as the cardinal cornerstone with regard to city planning and development rather than religious zeal, politics and nationalism;
7. It meets the requirements of international law and UN resolutions;
8. It allows the city to become fully accessible to the international, regional, and local communities; and,
9. It provides peace, prosperity, and security to the city, its inhabitants and visitors.

This model fulfils the symbolic, religious, spiritual and psychological needs of both Israelis and Palestinians. While the Israeli and Palestinian sole claims to Jerusalem are exclusive claims to the total city, this plan reflects a limited realistic and practical inclusive future plan for the city.

25.6.1 Sovereignty

In searching for a practical, realistic, and pragmatic answer for the future of Jerusalem, the major element in this complex formula of sovereignty must be de-emphasized. Attempts to resolve the Jerusalem issue in the past have failed because they have invariably hinged on the question of sovereignty and nationalism since these claims were mutually exclusive and diametrically opposed. Jean Bodin (1530–1596) in his theory of sovereignty defined the term as, "the absolute and perpetual power of a republic." *A Concise Dictionary of Law* (1991) defines sovereignty as: "Supreme authority in a state. In any state, sovereignty is vested in the institution, person or body having the ultimate authority to impose law on everyone else in the state and the power to alter any pre-existing law. How and by whom the authority is exercised varies according to the political nature of the state."

The rising tide of democratic ideals in the 19th and 20th centuries caused political thinkers to re-evaluate the concept and demand it to be replaced with other concepts that were more fitting with the new spirit of the century. New developments in the law of the sea led to the emergence of the concept of functional sovereignty, i.e. "situations in which the State has sovereign powers to undertake only certain activities in a specific sea area." (Source year: page) Similarly, a more flexible attitude to the concept of sovereignty is required. Here, the traditional concept of sovereignty,

as an 'all-embracing and indivisible quality', needs to be revised. In this particular case, the idea of sovereignty ought to be fragmented and the notion of divided sovereignty or fragmented sovereignty should be introduced and developed to become a divided triple sovereignty. While shared sovereignty and scattered sovereignty refer to territorial sovereignty on the vertical and horizontal level, 'an absolute indivisible sovereignty', fragmented sovereignty deals with distribution of authority and power in the city of Jerusalem into various horizontal components. It calls for the division of sovereignty in theory and practice among three different components to be divided among three entities i.e. to have sovereignty vested in three bodies, a governing body, an administrative body, and a religious body.

- *Spiritual sovereignty (to include religious sovereignty)*: The ultimate source of authority in the walled Old City of Jerusalem, as King Hussein of Jordan emphasized, should be for God and for God alone. It is within those walls that the religious sites which Jews, Christians, and Moslems revere. No state, institution, person or body should have ultimate control over the Old City exclusively.
- *Governance Sovereignty*: General governance sovereignty over the Old City of Jerusalem would be vested in an umbrella: a *Troika Governance Council*. The Troika will be formed from three equal constituencies: members representing both, the State of Israel and the State of Palestine, and members selected by the Security Council of the United Nations.

The city of Jerusalem would be comprised of three entities: Arab East Jerusalem (*al-Quds*); Israeli West Jerusalem (*Yerushalayim*); the walled Old City (*Yerushalayim/al-Quds*) with three separate municipal entities. Palestine would practice direct sovereignty over Arab East Jerusalem and shall declare it its religious and political capital. The State of Israel would practice direct sovereignty over of Israeli West Jerusalem and shall declare it its religious and political capital. The state of Palestine would recognize the governance sovereignty of the state of Israel over West Jerusalem and recognize it as its religious and political capital. In reciprocation, the State of Israel would recognize the governance sovereignty of the State of Palestine over East Jerusalem and recognize it as its religious and political capital. Governance sovereignty would encompass executive, legislative, and judicial jurisdiction in the assigned territories for each state outside the walled city. Both states of Israel and Palestine would recognize the special troika status of the Old City as 'holy status' under God's sovereignty and international auspices.

- *Spiritual Sovereignty*: As the holy city of God, the spiritual sovereignty over the Old City of Jerusalem will be for God and for God alone.
- *Religious Sovereignty* over the Walled Old City of Jerusalem will be vested in a Troika Council formed from the three faiths, Muslim, Christian and Jewish. Religious Sovereignty would not encompass legislative and judicial powers in the area within the walled city.
- *Administrative Sovereignty*: The *Troika Administrative Council* would have broad powers over administrative matters for the Old City of Jerusalem. Administrative sovereignty would encompass the power and authority to administer the municipal affairs of the city. It would include functional sovereignty. The Troika would enjoy extensive powers of supervision over the functioning of the subsidiary units. The Troika would be entrusted with the responsibility of providing common services for the subsidiary units.
- *Arab/Israeli Jerusalem Municipal Council*. An elected *Municipal Council* would manage the Arab East Jerusalem. And a similar Israeli council would manage West Jerusalem. Both would retain a general coordinating authority and specific controlling joint powers in certain spheres. Both would have the powers to provide specific functional city needs. Members of each municipality including both mayors would be elected by taxpayers that had habitually resided in the city. The powers of each *Municipal Council* would include education, health, social services, sewage, water supply, electricity, garbage collection, fire protection, local transport, communications, parks and recreational facilities.
- *Subsidiary Units*. The locally elected subsidiary municipal units would enjoy powers of local government and administration. Each subsidiary unit would have a micro-municipal status and would enjoy autonomy in the day-to-day administration of its affairs in certain areas such as education, health, sports etc. The basis for the division of subsidiary units within the boundaries of each municipality would be geographical.

25.6.2 Borders

The sad memories of conflict over borders among nations provide strong motivation to exert all efforts to obliterate borders in general and to belittle their significance. As the Berlin Wall failed to prevent people from crossing over to West Berlin, a similar wall around Jerusalem is not preventing Palestinians living outside the municipal boundaries of the city from crossing over to East Jerusalem. Any borders constructed around Jerusalem to prevent people and goods from entering will be a denial of human rights to access religious holy places for prayers and seeking God; some Palestinians living in the West Bank, whether Moslems or Christians, slip by them on their holy feasts to perform their prayers in their holy sites. Thus there should be no physical borders dividing the twin city of Jerusalem and the Old City. However, for functional purposes, a municipal border will demarcate the boundaries of Arab East Jerusalem and Israeli West Jerusalem.

The municipal boundaries of Arab Jerusalem would include as a core the pre-1967 Jordanian boundaries excluding the Old City, the localities officially added to it since 1967, as well as those Palestinian localities, which should have been included within these boundaries but were excluded for political reasons. In addition, the future boundaries would be extended to meet the acute housing, economic and social demands of the Palestinians. Municipal boundaries of Israeli Jerusalem would comprise mainly West Jerusalem, west of the walls whose population is Jewish. A further expansion of the Eastern and Western sectors of the city is recommended, not affecting the Jewish-Arab population mix as much as to accommodate the social and economic needs of the residents of close neighbourhoods and to balance the geographical distribution of the urban structure of the city.

25.6.3 Urban Planning and Future Development

The idea of administering a city under separate functional sovereignties is feasible, possible and practical. New residential, commercial and industrial development would continue in the city and in its surrounding areas. Some face lifting would be undertaken in all sections of the central city, and the physical infrastructure of the city (water and sewage systems, streets, alleys, buildings) which are experiencing deterioration today, would be renovated and perhaps replaced due to their age and long-deferred maintenance. The train would become one of the predominant modes of transportation, with public transit continuing to play a significant role, more so in the Jewish sector than in the Arab sector of the city.

The process of developing Jerusalem as a sustainable city of the future will involve a major cultural change, which for many would mean a change in lifestyle where public transportation, car-pooling, and taxi services would prevail. Restrictions on modern-style high rise buildings would be more strictly enforced in the centre of the city and less so in the periphery. The movement of the people of Jerusalem to suburbia and the fringes of the city would be encouraged to relieve the core city of further high density, condensed and highly populated cells. Crime and drugs are not expected to constitute serious problems because of the smaller proportion of the type of entertainment centres located inside the city that breeds crime and violence (gambling, casinos, sex clubs, etc.) and the strict enforcement of law and order. Improvement in community relations between the two communities would be enhanced. Housing within the boundaries of the city would remain in short supply. Unrest and feelings of insecurity among Palestinians will diminish as Israeli policies and programmes to evacuate and deport them outside the city are expected to cease.

The main activities in each sector of Jerusalem would focus on cultural, educational, touristic, technological, and commercial aspects. The residents of Jerusalem would work mainly in jobs, such as education, tourism, health, engineering, law, commerce, trade, handicraft, photography, and as gold and silver smiths. The mainstay of the economy would be tourism, diaspora investments in the economy, trade, education, banking, and construction. Artistic crafts would play an important role in the beautification of the city.

Significant changes would occur in the existing governance pattern, with the Palestinians having their say in the administration and management of the Arab sector of the city, and with Israelis having their say in the administration and management of the Jewish sector of the city. Joint public decision-making in matters of delivery of services would become highly decentralized. Local district and village elected municipal councils would intervene more effectively in community affairs. A fragmented process of policy formulation would be created to encourage local action. Coordination among the joint municipal units, single municipal units, and local village councils would increase and become an effective tool of governmental

machinery. There will be no restrictions on the movement of people and goods between both sectors of the City. Rights, immunities and privileges of religious denominations and religious institutions with respect to the Holy Places would be preserved, and free access to Holy Places would be protected.

25.6.4 Management of the Old City

The management basis for governing the Old City would have to be a trilateral Palestinian, Israeli and International Governance Council of Jerusalem (Troika) that should be given the following general authorities, functions and responsibilities within the walled area of Jerusalem: a) protecting the holy places, religious buildings and sites; b) supervising and regulating public services within its boundaries; c) taking all necessary measures and precautions to protect people and property from danger due to malicious incidents that would arise due to violence and terrorism; d) designing strategies and establishing plans for the protection of inhabitants from outside dangers (civil defence); e) taking all measures to prevent damages caused by natural disasters and catastrophes then provide relief for victims of earthquakes and other natural disasters; f) taking precaution to prevent public hazards and fires, control fuel combustible material, regulate its sale and storage, operate and maintain vehicles and appliances for extinguishing big fires; g) adopting legislation for residency laws and regulations to grant immigration and residency permits within boundaries of the walled city; and h) implementing laws for environmental protection.

25.6.5 Healing, Confidence and Trust Building Measures

Healing, conciliation, trust and confidence-building measures reflecting the new spirit of peace and cooperation between the Palestinian and Israeli communities, Moslems, Christians, and Jews, would be undertaken to create a healthy peaceful, prosperous, and secure environment. Joint educational, cultural, economic and social activities may be organized to enhance the spirit of living together and to undermine the spirit of living separately apart. Both sides would refrain from making any activity or taking any measures that may infringe on the rights or interests of the other or touch his sensitivity.

25.7 Concluding Remarks

In recent times, many solutions to the Jerusalem problem have been suggested. These many proposals failed to lead to a breakthrough because they promoted exclusive national agendas. The wealth of proposals reflected different maximum positions that never led to an agreement based on mutual respect and common interests. The arguments on the future of Jerusalem should drift from focusing on the doomed maximal win-lose resolution scenarios towards taking a more positive attitude of mutual win-win often painful compromise scenarios. Here, it must be recognized that such sacrifices by the people on both sides of the conflict would not go unrewarded. Although it took military force to tear down the walls which divided Jerusalem, it will surely take profound moral power and deep human commitment to bridge the chasm between Moslems and Jews on Jerusalem. Nevertheless, this should not stop the people in Jerusalem from aspiring to achieve a dream of a Jerusalem sailing in peace beyond the troubled horizons of the 20th century into the rainbow of the 21st century. Thus, the enduring question persists: Will the balance tilt away from a vision of sorrow and death to a vision of life and festivity?

While religion and nationalism based on power have often contributed to hate, violence, and wars, the very goals of the three monotheist religions of the sons of Abraham addressing peace would suggest a shift towards mutual compromise from the maximalist dreams to the small realistic hopes. By referring to a different notion of religions as forbearers of peace and cooperation, and of mutual trust and respect, a solution of the religious aspect could possibly open a different avenue that is hardly present where the Hobbesian vision of the old testament seems to prevail by a thinking on tooth by tooth, action and counteraction as the tragic events in Gaza have shown once more, the impossibility for peace without painful sacrifices. This proposal aims to overcome this fundamental obstacle and could open a different road to peace.

No doubt, the outcome of the peace process will depend on the path that Palestinians and Israelis take in their negotiations on the future of Jerusalem. According to our optimistic scenario the Jerusalem of tomorrow would look much different from the Jerusalem of today.

There is still a very wide religious, political, emotional and psychological divide between Palestinian and Israeli views on Jerusalem, what makes it ex-

Figure 25.14: Al-Haram Sharif and Wall of Mourning: Holy Sites of Jews and Muslims in Jerusalem. **Source**: Photo by Úrsula Oswald Spring (Mexico). Printed with permission.

tremely painful to have both to make historic concessions on the city of Jerusalem. John Whitbeck (2000: 52) had observed: "The future status of Jerusalem is a bit like death. Everyone knows that it is at the end of the road, but virtually no one wants to talk about it because no one can see any solution or happy ending." Similarly, Meron Benvenisti (1996: 11) wrote: "Jerusalem is an enigma without a solution." This chapter takes the optimistic view that should there be good will to reach a win-win solution, there will be a way to achieve this solution.

Perhaps in the complex elements of religion, culture, psychology, and rationality hides the window of opportunity, which might lead to an imaginative solution *sui generis*. An emotional appeal is voiced to awaken the creative spirit of the decision-makers to strive to build bridges of cooperation and understanding for the sake of future generations – our children and our grandchildren. Jerusalem in this case may become what the Camp David 'framework' declared as a goal of Arab-Israeli peace: 'a model for coexistence and cooperation among nations' – an oasis of peace in a troubled sea of conflict.

The good city is the place where one finds home at the end of a long journey. The future city of Jerusalem, should a sustainable resolution be achieved, would be just to the extent that it would offer its residents the missed opportunities of enjoying its beauty and charm.

Under conditions of peace, the urban future of the city of Jerusalem holds many promising prospects. There would be a period ahead where peace would provide an impetus for both communities to expand their capacities and potentials to promote the city's responsiveness to human civilized needs. At a time when many old cities are in trouble, Jerusalem would be one city, which would have the potential to cope with the challenges of the 21st century.

Cooperation of Moslems, Christians, and Jews would tilt the balance towards a more optimistic vision as it would bridge the gap between the two divergent and conflicting views on the future of Jerusalem. It would offer fresh opportunities for imaginative solutions for the problems over Jerusalem. This would help bring the two peoples together, as well as, deepen and strengthen the cooperative spirit between them, leading inevitably to a solid and sustainable peace.

We do believe that citizens could help shape the future of their society by having faith that the future

of Jerusalem will see the fulfilment of Herman Kahn's (1979) technological optimism, which held that technological advances would assure sufficient resources to sustain rapid economic expansion for another 200 years. The future is what humans make of it. As human beings we certainly can shape the future of our society. We do have control over our destiny and so we should design a better future for Jerusalem.

We close with the famous words of Robert Kennedy: "Some men see things as they are and ask 'why' I dream of things that never were and ask 'why not'!" All those who fell in love with the city of Jerusalem should dream of things that never were and ask 'why not'. The dream is creating a joint future for present and future generations by jumping out of the perennial cycle of conflict, hate, despair and violence to an oasis of peace, harmony, tranquillity, and security. No doubt, the fruit of peace would bring a period of prosperity, tranquillity, and coexistence which Jerusalem dearly deserves.

26 Global Climate Change Impacts for the Mediterranean in the 21st Century: Challenges for Human and Environmental Security

Hans Günter Brauch

26.1 Introduction[1]

There is no generally accepted definition of the Mediterranean nor are there any common criteria of the Mediterranean Sea, its space, region, climate or way of life. It is a 'sea' whose shores combine the three continents: Europe, Africa and Asia. There is a consensus that it is a 'region' that once has been a centre of the world that was the cradle of several high civilizations and of three monotheistic religions of Jews, Christians and Muslims.[2]

This chapter focuses on the global environmental and climate change that has been projected in the scientific literature and – under certain assumptions - on the probable societal, economic and political and economic impacts for the Mediterranean region and on the possible – primarily environmental and human – security impacts these may pose for the Mediterranean region by 2020, 2050 and possibly by the end of the 21st century.

However, this analysis faces major scientific and methodological constraints:

- The models of climatologists on future changes in temperature, sea-level rise, precipitation and of the number and intensity of hydro-meteorological hazards are based on different assumptions on future GHG emissions.
- So far, in IPCC publications no joint assessment of the Mediterranean region has been conducted, rather this tricontinental region has been analysed in the context of Southern Europe, North Africa and West Asia. The projected future trends are more detailed for Europe compared with North Africa and in the Eastern Mediterranean. Thus, the quality of the projections for these three subregions is rather uneven.
- The awareness of these global environmental challenges, the political commitment of the elites and the economic, political and administrative coping capacity have differed significantly between Mediterranean EU and non-EU countries in South-Eastern Europe as well as riparian countries in North Africa and in the Eastern Mediterranean.
- The analysis of these *global environmental change* (GEC) and *global climate change* (GCC) challenges and of their possible socio-political impacts has been rather fragmented.
- The scientific discourse and the policy debate on their possible implications for international or regional; national but also for the environmental, human as well as water, soil, food, health and energy security is just starting.[3]
- There are several possible political frameworks for the scientific and policy debate on the security im-

1 This chapter builds on previous publications by this author that focused primarily on the Mediterranean space and the political frameworks (Brauch 2001, 2001a, 2003), on confidence and security building measures (Brauch 1994, 1994a, 2000, 2000a, 2000b), on natural hazards (Brauch 2002d, 2003c), on regional environmental challenges (Brauch 1998), on the socio-political impacts of climate change (Brauch 2006c, 2007f, 2009a, 2009c, 2010), on desertification (Brauch 2006d, 2006e, 2006f; Brauch/Oswald 2009), migration (Brauch 1997b, 1997d, 1998a, 2000/2001, 2008, 2010) and on renewable energy policy (Brauch 1994, 1997, 1997c, 2001b).

2 See Reynaud and Sid Ahmed (1991); Balta (1992); Braudel (1949, 1966, 1969, 1972, 1990); Braudel, Duby and Aymard (1993); Cano and Muñoz (1997); Crouzatier (1988); Girón and Pasjovic (1998); Grenon and Batisse (1989, 1989a, 1990); Institut Català de la Mediterrània (1999); Naïr (1995); King (1997); Sid Ahmed (1996); Fabre and Ilbert (2000); Vidal-Beneyto and de Puymège (2000); Wagner (2001).

3 See BMU (2002); WBGU (2007, 2008); EU (2008, 2008a); Brauch (2006f, 2007f, 2009, 2010); Maas and Tänzler (2009); Maas, Briggs, Cheterian, Fritzsche, Lee, Paskal, Tänzler and Carius (2010); MEDSEC (2009).

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plications of GEC and climate change issues: the UN context (Brauch 2001, 2003), the OSCE framework (Wohlfeld/Abela 2000; Wohlfeld 2008; Maas/Briggs/Cheterian/Fritzsche/Lee/Paskal/Tänzler/Carius 2010), the NATO dialogue (De Santis 2003; Bin 2008; Winrow 2000) and the Euro-Mediterranean Partnership (Brauch/Marquina/Biad 2000) that was relaunched as the *Union for the Mediterranean* (UfM) on 13 July 2008.

This chapter will address the following key research questions: What have been the GHG emissions and the climate policy commitments of the Mediterranean riparian countries? What are the projected climate change impacts in Southern Europe, in North Africa and in the Eastern Mediterranean? What are possible societal, economic and political impacts of climate change in the Mediterranean region? Which dangers and concerns may be posed by both the physical and societal impacts of GEC and climate change for international, national, environmental and human security? Which are possible options for proactive coping strategies and which political frameworks and actors may prepare, adopt and implement both reactive and proactive coping strategies.

After a brief discussion of the regional focus on the Mediterranean and its subregions (26.2), the available knowledge on the projected physical (26.3) and societal (26.4) impacts of climate change will be reviewed. Then, past migration trends within the Mediterranean region will be assessed and the possible impact of GEC and GCC on future migration trends during the 21st century will be analysed (26.5). This will be followed by a brief discussion whether the potential impacts of GEC and GCC may lead to conflicts (26.6) and by a systematic analysis as to whether these developments may pose specific security dangers and concerns during the 21st century (26.7) and finally which proactive strategies (26.8) are foreseeable for coping in cooperative and peaceful ways with these developments.

26.2 Mediterranean Region: Southern Europe, North Africa and the Eastern Mediterranean

For millennia, the Mediterranean has been a unique geographical space but – except for the Roman Empire – it has been a divided region politically, economically and culturally. Most authors agree that the 'Mediterranean' is characterized by both *unity* and *diversity*, by periods of cooperation and conflict, of tolerance and violent conflicts, by intensive cultural exchange and cultural clashes, of close economic cooperation, interdependence but also by exploitation, unequal exchange and dependence. These contradictions challenge any uncritical application of social science concepts and approaches.[4]

After a brief discussion of the different spatial regionalization of the Mediterranean (26.2.1), the *greenhouse gas* (GHG) emissions and the legal commitments as well as their implementation will be reviewed for the Mediterranean EU countries (26.2.2), the South-Eastern European non-EU Mediterranean countries (26.2.3), for the North African countries (26.2.4) and for the Eastern Mediterranean countries (26.2.5).

26.2.1 Definitions of the Mediterranean

The definitions of the Mediterranean have differed for a) various time periods, b) scientific disciplines, c) based on the conceptual lenses of the scientist that are influenced by national perceptions and traditions, and d) according to specific purposes and goals of the analyst. In order to avoid a total confusion both definitional and conceptual clarity are essential. A consensus exists that the Mediterranean is a 'sea', a 'space' and possibly a 'region' with narrow, medium and wider boundaries. Based on this differentiation of the Mediterranean Sea or basin, space and region three geographic concepts have been generally used:

a) the *narrow concept* of the Blue Plan of the administrative units with a Mediterranean coastline, of the watershed or of the cultivation areas of the olive;
b) the *medium concept* of a Mediterranean perspective that includes all countries with Mediterranean coastlines plus Portugal and Jordan;
c) the *wide concept* of the Mediterranean that includes the Black Sea, the Red Sea and the Per-

4 See the many contributions in the previous four volumes of the Hexagon Book Series: vol. I: Brauch, Liotta, Marquina, Rogers and Selim (2003); vol. II: Shuval and Dweik (2009); vol. III: Brauch, Oswald Spring, Mesjasz, Grin, Behera, Chorou, Kameri-Mbote and Liotta (2008); vol. IV: Brauch, Oswald Spring, Grin, Mesjasz, Kameri-Mbote, Behera, Chorou and Krummenacher (2009). The lists of contents of these are at: <http://www.afes-press-books.de/html/hexagon.htm>; see chap. 8, 20–25, 37–38, 44–45, 53–55 and 90 in this volume.

sian/Arab Gulf region, recognizing the ecological, cultural and economic similarities.

In addition a fourth political concept of the Euro-Mediterranean region is extensively being used in the policy debate that comprises the member countries of the *Barcelona Process* (BP) and of the expanded *Union for the Mediterranean* (UfM) that replaced the *Euro-Mediterranean Partnership* (EMP, figure 26.1).

Geographers like Wagner (2001) pointed to regional features of *unity* (climate, ecology, vegetation, agriculture, urban culture, traditional economy, one-sided industrialization, emigration, tourism, similar social attitude, interaction of historic, cultural and economic activities) and historical *diversity* due to demography, migration, religion, ethnicity, colonialism and particularism. The contemporary spatial differences emerged from natural and economic differences within the region due to increasing ecological risks, growing economic distances, different demographic patterns, social change, cultural and religious identities, fundamentally different political systems, and impacts from outside due to globalization (processes of economic deregulation, free trade, modest movements towards political liberalization, Westernization, global economic integration) and the regional differentiation is still stronger than trends towards unity.

According to King (1997: 1) only few geographical texts treat the Mediterranean "as a relatively homogeneous regional unit". He believes that defining the Mediterranean is impossible while *Mediterranean identity* is a powerful concept. "The Mediterranean is a sea, a climate, a landscape, a way of life." King, Cori and Vallega (2001: 1–17) reviewed definitions of the Mediterranean based on ecological and physical-geographic criteria (certain species of plants, crops and wildlife), and by geographers and meteorologists who stress the specific climate. The term *Mediterraneanism* (Durell 1956, 1962, 1969; Houston 1964; King 1997) refers to the close interaction between the physical and human realms influenced by the climate, the sea, the land, the vegetation, the long tradition of urban life and the resources offered by the Mediterranean environment "with links to diet, history, landscape, farming systems and ways of life" (King/Cori/Vallega 2001: 4). King referred to aspects of *unity* (climate, ecology, cultural traditions, economy, and strategic location for transporting hydrocarbons) and *diversity* (heterogeneous political regimes, coexistence and confrontations of religions and cultures, economic division) in the modern Mediterranean.

Major unifying elements are: a) common ecological features (climate landscape) and a shared environmental responsibility, that is challenged by urbanization, demography, tourism that have contributed to an 'environmental crisis' (Thornes 2001), b) a common history (Braudel 1972), c) a distinct Mediterranean economy, and d) relatively homogeneous cultures. Beyond this classic dichotomy (unity vs. diversity), King, Cori and Vallega (2001: 4–11) discussed several subdivisions of the Basin: the *North* vs. the *South* in economic, cultural and religious terms, the *Western* vs. the *Eastern* Mediterranean divided by the channel between Sicily and Tunisia; and the division into four land-based sub-regions: a) the *north-west* (EU countries) with low fertility; b) the *south-west* (Maghreb) with high demographic pressures; c) the *south-east* (Mashreq, Gulf countries, Israel) with the Middle East conflict, and d) the *north-east* (Turkey, post Yugoslav states, Albania) with ethnic and religious conflicts, or the juxtaposition of the *First, Second* and *Third Worlds*. Brunett (1995) referred to seven models of the Mediterranean: 1) the closed basin; 2) the straits model; 3) the lake model; 4) the bridge or isthmus model; 5) the hostile barrier or frontier model; 6) the focal model of poles of development; and 7) the model of zones of uneven development. For King, Cori and Vallega (2001: 11) "the Mediterranean is a plural space of overlapping and hazy boundaries and complex economic, political, socio-demographic, cultural and environmental relations."

While the geographical space remained unchanged for millennia, during the past 5,000 years of human history the spaces of rule were in a permanent flux. Different political spatializations due to functional cooperation in different issue areas have emerged since 1990. Empirically, cooperation in the Mediterranean may be analysed for different *actors* (states, economic, societal organizations) at several *levels of analysis* (international, state, and sub-state) for *degrees of intensity* (organizations, regimes, dialogues) and *issue areas*: security and military, political, economic and environmental. The existing institutions of cooperation in the narrow, medium and wide Mediterranean space point to different institutional boundaries (table 26.1).

Anderson (2001: 18–27) analysed the Mediterranean as "a geopolitical fracture zone", arguing that the old East-West divide "has been replaced by a fracture zone between North and South", across the Mediterranean. From his geopolitical perspective, Anderson listed as key issues of a 'macro-political agenda': migration, non-proliferation, terrorism and international debt as sources and consequences of conflicts.

Table 26.1: Actors, Levels and Issue Areas of Cooperation in the Mediterranean Space. **Source:** Adapted and updated from Brauch (2003).

	Security	Political	Economic	Environmental
State world				
• international organizations	UN, OSCE, NATO,	OSCE, EU and Arab League	WB, IMF, UNDP, OECD, EU, AMU,	UNEP-MAP OSCE
• functional regime	non-proliferation regime, UfM	EMP, UfM ↓	EMP, UfM ↓	Barcelona Convention, EMP, UfM
• dialogue fora	NATO, UfM	↑ EMP	↑ EMP	Mediterranean Committee on Sustainable Development EU-Mediterranean Environment ministerials
Economic world	Multinational companies, international chambers of commerce and industry			
Societal world	Civil society and non-governmental (scientific) organizations			

Among the "deep-seated causes of insecurity", he mentioned the different demographic structures on either side of the Mediterranean and concludes: "The Mediterranean is to Europe what the Rio Grande is to the United States." Ragioneri (2000: 81–82) argued that the Mediterranean area can hardly be defined as a region based on cultural and political homogeneity, economic exchange and institutional integration. Rather, Europe and the *Middle East and North Africa* (MENA) could be defined as two different "security complexes" (Buzan 1991: 190) that affect each other and are connected by Russia and Turkey.

These two assessments illustrate how authors with different worldviews and mindsets come to contrasting assessments of the fundamental security issues in the Mediterranean area. But both agree that during the 1990's, in security, political and economic terms the Mediterranean region has been highly fragmented. Since 1995, the Euro-Mediterranean partnership and since 2008 the UfM have been a channel for an increasing cooperation on different issue areas.

The oldest and only truly pan-Mediterranean regime emerged from the Convention for the Protection of the Marine Environment and Coastal Region of the Mediterranean (*Barcelona Convention*) of 16 February 1976 that entered into force on 12 February 1978.[5] This environmental *Barcelona regime* is based on several related protocols, and an amendment to the Convention adopted on 10 June 1995. Major steps have been the development of the *Mediterranean Action Plan* (MAP),[6] of the *Blue Plan*, the setting up as one of nine *Regional Seas Programmes*, of the UNEP *Co-ordinating Unit for the Mediterranean Action Plan* (MEDU) in 1982 in Athens, and finally in 1995 the establishment of the *Mediterranean Committee on Sustainable Development*. It was the first regional environmental regime that evolved from the first global environmental summit in *Stockholm* in June 1972.

Between the EEC, EC and EU and its Mediterranean partners four stages may be distinguished: a) the emerging relationship (1958–79); b) the protocol period (1979–89) and c) the MEDA period (1995–2006) with so far three budget cycles MEDA I (1996-1999), and MEDA II (2000–2004), MEDA III (2005–2006) and since 2006 as part of the European Neighbourhood and Partnership Instrument.

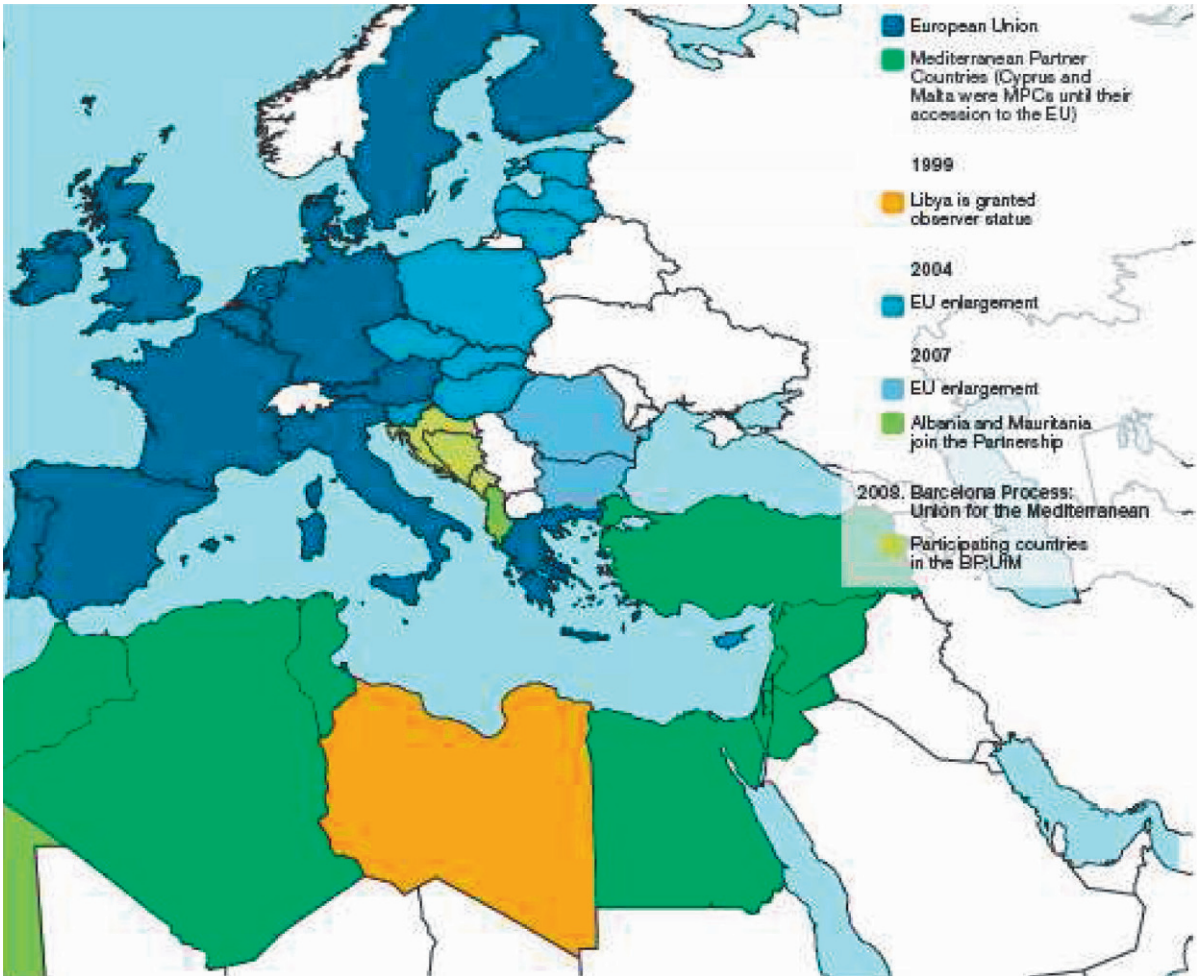
After the relaunch of the EMP on 13 July 2008 in Paris as the *Union for the Mediterranean* (UfM, table 26.2) a joint secretariat was established in Barcelona. The UfM has identified these six priority projects for: a) the de-pollution of the Mediterranean Sea; b) the establishment of maritime and land highways; c) civil protection initiatives to combat natural and man-made disasters; d) a Mediterranean solar energy plan; e) the inauguration of the Euro-Mediterranean University in Slovenia; and f) the Mediterranean Business Development Initiative focusing on micro-, small- and medium-sized enterprises. Of these the first, third and the fourth are directly related to environmental and the latter two to GEC impacts and coping efforts (Brauch 2010).

While for the analysis of the physical and societal impacts of GCC, the IPCC distinguishes among the three continents: Europe, Africa and Asia, for the analysis of the political framework for coping strategies four sub-regions will be distinguished (table 26.3).

5 The text of the Barcelona Convention is at: <http://www.unep.ch/regionalseas/regions/med/t_barcel.htm>.

6 For details on the MAP see at: <http://www.unepmap.org/>.

Figure 26.1: Member Countries of the Union for the Mediterranean (November 2009). **Source:** Brauch (2010: 21) that was provided by the IE in Barcelona.



In May 2010 only 25 (except Malta and Cyprus) of the 27 *European Union* (EU) countries had quantitative reduction obligations under the Kyoto Protocol (1997).

The riparian states of these four sub-regions of the Mediterranean may be distinguished with regard to their degree of environmental and social vulnerability, and with regard to their political and economic capability for coping with the impacts of GEC and GCC (table 26.4).

26.2.2 Southern Europe and EU Mediterranean Countries

Of the eight EU Mediterranean countries, all have ratified the UNFCCC (1992) and the *Kyoto Protocol* (KP) and six had quantitative reduction obligations under the KP. Three of these six countries were permitted as part of the internal EU arrangement to increase their emissions by 15 per cent (Spain), by 25 per cent (Greece) and by 27 per cent (Portugal) until 2012 with regard to 1990 as the base year. Among these six countries only France and Greece fulfilled their obligations, while the performance of Spain, Portugal and Italy failed to achieve their reduction targets (table 26.5). Six Mediterranean EU countries submitted all four national communications required by the UNFCCC secretariat, Malta only the first and Cyprus so far none. In 2005 the GHG emissions per person ranged from 6.5 tons in Malta to 11.5 tons in Greece.

26.2.3 South-Eastern European Countries

All South-eastern European countries have ratified the UNFCCC and the KP but only Croatia, as an Annex 1 state under UNFCCC, has reduction obligations it failed to meet by the end of 2007. Croatia submitted only the first and fourth national communication

Table 26.2: Phases in the EU - MED Relationship. **Sources:** COWI (1998: 6) and on UfM; at: <http://ec.europa.eu/external_relations/euromed/index_en.htm> (6 February 2010).

Name of period	Emerging relationship	Protocol Period (1-4)		MEDA I, II. III	UfM GNP
Period	1958-1979	1979-1989	1990-1995	Since 1995 -	Since 2008
Political framework	*Global Mediterranean Policy* (GMP) of 1972		*New Mediterranean Policy* (NMP)	Barcelona Declaration *Euro Mediterranean Partnership* (EMP)	*Union for the Mediterranean* (UfM)
Cooperation framework	Association agreements (with Cyprus, Malta and Turkey). Trade accords	Cooperation agreements with Maghreb, Mashreq countries and Israel		*Euro-Mediterranean Association Agreements* (EMAA) replacing cooperation agreements)	
Funding framework	Protocols for the countries with Association Agreements	1st - 3rd Protocol	4th Protocol	MEDA Regulations	*European Neighbourhood and Partnership* (ENP) Instrument (26.10.2006)

Table 26.3: Sub-regions for climate change impacts in the Mediterranean. **Source:** Author.

	Mediterranean EU countries	South-Eastern European countries	North African countries	Eastern Mediterranean countries
Countries	Portugal Spain France Italy *Greece* Slovenia Malta Cyprus	Croatia Bosnia-Hercego-vina Montenegro Albania [Serbia, FYR Macedonia]	Morocco, Algeria Tunisia Libya Egypt	Turkey Syria Lebanon Jordan Israel Palestine
International organizations	UNEP-MAP OSCE, NATO *HSN* [in *italics*]	UNEP-MAP OSCE	UNEP-MAP Arab League AMU, UMA	UNEP-MAP Arab League
IPCC coverage	Europe: Southern Europe		North Africa	Western Asia
UNEP-MAP Blue Plan	Coverage of the whole Mediterranean region			

Table 26.4: Vulnerability and coping capacities of Mediterranean countries. **Source:** Brauch (2007f: 6).

	Social	Ecological	Political	Economic
	Vulnerability		Problem Solution Capabilities	
	With regard to GEC, GCC and natural hazards			
Southern Europe	low	increasing	high (integration)	high (GNP/capita)
South Eastern Europe (Balkans)	medium	increasing	limited	constrained
North Africa	high	high	low	low (GNP/capita)
East Mediterranean	high	high	low	low (GNP/capita)

while Albania and the former Yugoslav Republic of Macedonia submitted the first two reports. In 2005 the GHG emissions ranged from 2.9 tons per person in Albania to 6.9 tons in Croatia (table 26.6).

Table 26.5: Emission reduction obligations of Mediterranean EU Countries. **Source:** Columns 1-12: UNFCCC, at: <http://unfccc.int/parties_and_observers/items/2704.php> (6 February 2010). Column 11: GHG emissions in tons/person (2005) without land-use change, at: <http://en.wikipedia.org/wiki/List_of_countries_by_greenhouse_gas_emissions_per_ca-pita>. Column 12: The greenhouse gas emissions data for 2007 and the changes since 1990 exclude land-use changes LULUF). UNFCCC: *National greenhouse gas inventory data for the period 1990.2007,* FC COC/SBI/ 2009/12 (21 October 2009): 9.

States	UN Climate Change Convention (UNFCCC)			Kyoto Protocol (KP)			National Communications (NC)				Reduction obligations		GHG Emissions	
	Signed	Ratified	Status	Signed	Ratified	Status	1	2	3	4	KP (%)	Real (%)	tons/ person (2005)	1990-2007 in %
Portugal	13.6.92	12.12.93	An. 1	29.4.98	31.5.02	An. B	x	x	x	x	-8	+27	7.9	+38.5
Spain	13.6.92	21.12.93	An. 1	29.4.98	31.5.02	An. B	x	x	x	x	-8	+15	10.1	+53.5
France	13.6.92	25.3.94	An. 1	29.4.98	31.5.02	An. B	x	x	x	x	-8	0	9.0	-5.3
Italy	5.6.92	15.4.94	An. 1	29.4.98	31.5.02	An. B	x	x	x	x	-8	-6.5	9.7	+7.1
Greece	12.6.92	4.8.94	An. 1	29.4.98	31.5.02	An. B	x	x	x	x	-8	+25	11.5	+24.9
Slovenia	13.6.92	1.12.95	An. 1	21.10.98	2.8.02	An. B	x	x	x	x	-8	-8	10.1	+1.9
Malta	12.6.92	17.3.94	—	17.4.98	11.11.01	—	x	—	—	—	—	0	6.5	
Cyprus	16.6.92	15.10.97	—	—	16.7.99	—	—	—	—	—	—	0	10.5	

Legend: An. 1: Country listed in the Annex 1 to the *UN Framework Convention on Climate Change* (UNFCCC); An. B: Country listed in the Annex B to the *Kyoto Protocol* (KP).

Table 26.6: Emission reduction obligations of South-eastern European countries. **Source:** Columns 1-10: UNFCCC; at: <http://unfccc.int/parties_and_observers/items/2704.php> (6 February 2010); sources for columns 211 and 12 see table 26.5.

States	UN Climate Change Convention (UNFCCC)			Kyoto Protocol (KP)			National Communications (NC)				Reduction obligations		GHG Emissions	
	Signed	Ratified	Status	Signed	Ratified	Status	1	2	3	4	KP	Real	tons/p (2005)	1990-2007 (%)
Croatia	11.6.92	8.4.96	An. 1	11.3.99	30.05.07	An. B	x	—	—	x	-6	-6	6.9	+3.2
Bosnia-Hercegovina	—	7.9.00	—	16.4.07	15.7.07	—	—	—	—	—	—	0	4.3	
Montenegro	—	23.10.06	—	—	4.6.07	—	—	—	—	—	—	0	4.8	
Albania	—	3.10.94	—	1.4.05	30.5.05	—	x	x	—	—	—	0	2.9	
Serbia[a)]	8.6.92	12.3. 01	8.6.92	19.10.07	17.1.08	—	—	—	—	—	—	0	4.8	
Macedonia[a)]	—	28.12.98	—	10.11.04	16.2.05	—	x	x	—	—	—	0	5.2	

a) In November 2009 Serbia and the Former Yugoslav Republic of Macedonia did not participate in the UfM.

26.2.4 North Africa

While all five North African countries have signed and ratified the UNFCCC and the KP, none has reduction obligations. Four countries submitted so far only the first of four national communications to the UNFCCC Secretariat. Thus, climate change issues seem to have only a low political priority for the governments in North Africa. Here the subregional variation in GHG emissions ranged in 2005 from 1.6 tons per person in Morocco to 8.3 in Libya.

Table 26.7: Emission reduction obligations of East Mediterranean countries. **Sources:** See table 26.5.

States	UN Climate Change Convention (UNFCCC)			Kyoto Protocol (KP)			National Communications (NC)				Reduction obligations		GHG Emissions	
	Signed	Ratified	Status	Signed	Ratified	No obligations	1	2	3	4	KP	Real	tons/p (2005)	1990-2007
Morocco	13.6.92	28.12.95	–	25.1.02	16.2.05	–	x	–	–	–	–	–	1.6	?
Algeria	–	3.10.94	–	16.2.05	17.5.05	–	x	–	–	–	–	–	4.2	?
Tunisia	13.6.92	15.7.93	–	22.1.03	16.2.05	–	x	–	–	–	–	–	2.3	?
Libya	29.6.92	14.6.99	–	24.8.06	22.11.06	–	–	–	–	–	–	–	8.3	?
Egypt	9.6.92	5.12.94	–	15.3.99	12.1.05	–	x	–	–	–	–	–	3.0	?

Table 26.8: Emission reduction obligations of East Mediterranean countries. **Source:** See table 26.5.

States	UN Climate Change Convention (UNFCCC)			Kyoto Protocol (KP)			National Communications (NC)				Reduction obligations		GHG Emissions (2007)	
	Signed	Ratified	Status	Signed	Ratified	Status	1	2	3	4	KP	Real	tons/p (2005)	1990-2007 (%)
Turkey		24.2.04	An.1	–	2009	AnB	x	–	–	–	–	–	5.5	+119
Syria		4.1.96	–	–	27.1.06	–	–	–	–	–	–	–	2.7	–
Lebanon	12.6.92	15.12.94	–	–	13.11.06	–	x	–	–	–	–	–	4.4	–
Jordan	11.6.92	12.11.93	–	–	17.3.03	–	x	–	–	–	–	–	4.2	–
Israel	4.6.92	4.6.96	–	16.12.98	15.3.04	–	x	–	–	–	–	–	11.5	–
Palestine	No state party of UNFCCC			–	–	–	–	–	–	–	–	–	–	–

26.2.5 Eastern Mediterranean Countries

Of the seven countries in the region, the *Occupied Palestinian Territory* (OPT) is no sovereign state and therefore can be no party to the UNFCCC and to the KP. Of all Mediterranean countries Turkey had the worst performance by increasing its GHG emissions by 119 per cent from 1990 to 2007. The GHG emissions per person varied from 2.7 tons/person for Syria to 11.5 for Israel.

The UNFCCC Secretariat supplied a detailed overview on the changes in the emissions of all Annex I countries under the UNFCCC from 1990 (as the base year) to 2007 without or with land use changes and forestry) that show slight variations in the performance of state members.

26.3 Projected Physical Impacts of Climate Change

The IPCC did not systematically assess the climate change impacts in the Mediterranean.[7] Its fourth *Assessment Report* (AR4) reviewed the literature for Southern Europe; North Africa and West Asia (IPCC 2007, 2007a, 2007b) and its Synthesis report (IPCC 2007c: 50) concluded that

> in Southern Europe, climate change is projected to worsen conditions (high temperatures and drought) in a region already vulnerable to climate variability, and to reduce water availability, hydropower potential, summer tourism and, in general, crop productivity. Climate

7 The SAR (IPCC 1996a) dealt in more detail with the impacts, adaptation options and assessment of mitigation options. In the IPCC's (1998) *Regional Impacts* study, Mediterranean issues are covered under Africa, Europe and the Middle East and arid Asia. In the TAR (IPCC 2001a), the African chapter reviewed climate change impacts on water, food security, natural resource management, human health, settlements, infrastructure and desertification (IPCC 2001a: 525). The Asian chapter dealt with physical and ecological features, scenarios for future climate change and key variables for sensitivity and adaptability. The European chapter offered an overview of future European climate change scenarios (IPCC 2001a: 653).

> change is also projected to increase the health risks due to heat waves and the frequency of wildfires.

The IPCC (2007c: 50) noted that Africa will be most severely affected "because of low adaptive capacity and projected climate change impacts" and "new studies confirm that Africa is one of the most vulnerable continents because of the range of projected impacts, multiple stresses and low adaptive capacity".

However, no systematic and integrated scientific assessment exists of the physical climate change impacts for the Mediterranean and especially for the *Middle East and North Africa* (MENA) region. Several research projects, conferences and publications have covered selected impacts.[8] The conference report of a regional seminar organized by the Plan Bleu Regional Activity Centre in October 2008 on climate change in the Mediterranean considered it "essential to develop a Mediterranean ocean-atmosphere regional climate model, taking into account the change in sea surface temperature".[9] The conference report further suggested that priority should be given to "adaptation and emissions reduction" and that the Mediterranean countries "should continue to develop advanced interdisciplinary research programmes". The consensus among the participating experts was that the "resolution of the models should be in the range of 1 to 2 km within the ten years", and that "the refining of the models should be accompanied by the production of more qualitative climate change monitoring indicators".

The Copenhagen Climate Science Conference of March 2009 concluded for the global level that "many key climate indicators are already moving beyond the patterns of natural variability within which contemporary society and economy have developed and thrived", and its authors warned that "with unabated emissions, many trends in climate will likely accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts". Thus, the climate change impacts may be much more severe for the Mediterranean region than the assessments of the IPCC and the Blue Plan have indicated that will be reviewed below.

26.3.1 Observed and Projected Temperature Increases

Depending on the assumptions of the global circulation models assessed by the IPCC (2007; 2007c) the level of increase in greenhouse gas emissions and the temperature increase differ widely. There is a wide consensus among climatologists that a global increase in temperature of 2°C is virtually certain, of up to 4°C is possible and up to 6°C cannot be excluded if business-as-usual trends continue. As COP 15 in Copenhagen failed to agree on binding constraints on GHG emissions, the possibility of a "dangerous climate change" (Schellnhuber/Cramer/Nakicenovic/Wigley/Yohe 2006) may be more likely during this century if no stringent reduction measures are agreed and also implemented in the near future.

On GHG emissions per capita there is a clear differentiation among the northern and the southern Mediterranean countries. The European chapter foresaw that for the Mediterranean due to rising temperature (IPCC 2001a: 651) and declining summer precipitation (IPCC 2001a: 652) the risk of forest fires may increase further. The risk of severe water shortages in the Mediterranean would also have severe effects on freshwater ecosystems in the region (IPCC 2001a: 666).

The UNEP-MAP (2009) report on the *State of the Environment and Development in the Mediterranean* noted that "over the 20th century and with a clear acceleration since 1970, South-Western Europe (the Iberian Peninsula, South of France) recorded an increase in temperature of almost 2°C. The same increase can also be noticed for the North of Africa". On future trends, the UNEP-MAP (2009) report claimed:

> By the end of the century, the average annual temperature increase is likely to be between 2.2°C and 5.1°C for 2080–2099, compared with 1980–1999. The probability of temperatures rising by between 3 and 4°C is estimated at 50 per cent. The expected rise in surface temperature varies from one region to the next – in the Sub-Saharan regions it could well be as much as 4°C in summer. On the other hand, on the northern shores, the rise is likely to be more marked in winter, at around 3°C. Nonetheless, this overall rise in temperature could

8 See the Report of the Regional Seminar on Climate Change in the Mediterranean, Plan Bleu Regional Activity Centre, Le Pharo, Marseilles (France) 22–23 October 2008; UNEP-MAP (2009: 13–28).

9 It referred to three major projects: a) the CIRCLE MED research initiative on water management in coastal sectors; b) the CIRCE project on physical impacts of climate change on the environment, their implications for society, the economy and the adaptation strategies; see at: <http://www.circeproject.eu/>; c) the SESAME project (Southernmost European Seas: Evaluation and Modelling of Ecosystem Change) on how the changes in hydro-climate characteristics have influenced the evolution of the zooplankton over the last 50 years in the northern Mediterranean region. See also the ENSEMBLE project; at: <http://ensembles-eu.metoffice.com>.

> well hide some local falls in temperature relating to changes in air mass. ... The greatest rises in temperature ... are likely to be recorded in the Mashreq (Palestinian Territories, Jordan, Lebanon, Syria and Iraq). Higher temperatures should thus produce summers with an increasing number of very hot days.

These projections referred to by the IPCC (2007) and by UNEP's MAP (2009) apply not only to the increase in temperature but also to projected changes in precipitation.

26.3.2 Observed and Projected Precipitation Changes

The Mediterranean and especially the MENA area is one of the most water scarce regions of the world. The water availability per capita in the Maghreb countries declined significantly between 1960 and 1990 and it has been projected to decline further until 2025 (Berkoff 1994: 68; Jellali/Jebali 1994: 150; chap. 20 by Chourou). The third IPCC Report (2001a: 651) foresaw for the Mediterranean an increase in the variability of water flows with summer flows reduced and in coastal areas, the risks of flooding and erosion will increase substantially (IPCC 2001a: 652):

> Southern Europe will be more adversely affected than Northern Europe. ... In particular, the Mediterranean region appears likely to be adversely affected [... e.g. by] increased variability of river flow; increased flood risk; decreased summer runoff and recharge of aquifers; and reduced reliability of public water supply, power generation, and irrigation. Increased fire hazards affecting populated regions and forests and heat stress on humans, crops and livestock may occur. ... There is greater vulnerability, in general, in Southern than in Northern Europe (IPCC 2001a: 680).

According to the *IPCC Synthesis Report* (2007c: 30), from 1900 to 2005 trends have been observed in precipitation amount in many large regions that "precipitation declined in the Sahel, the Mediterranean...." According to the IPCC (2007c: 50) "in Southern Europe, climate change is projected to worsen conditions". Furthermore, changes in precipitation and temperature lead to changes in runoff and water availability that is projected to

> decrease by 10 to 30 per cent over some dry regions at mid-latitudes and dry tropics, due to decreases in rainfall and higher rates of evapotranspiration. There is also high confidence that many semi-arid areas (e.g. the Mediterranean Basin, western United States, Southern Africa and north-eastern Brazil) will suffer a decrease in water resources due to climate change. Drought-affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, e.g. agriculture, water supply, energy production and health. Regionally, large increases in irrigation water demand as a result of climate changes are projected (IPCC 2007c: 49).

In addition climate change will affect "Mediterranean-type ecosystems because of reduction in rainfall". Working Group II of the IPCC referred to the following water availability and droughts during the 2020's, 2050's and 2070's. Around the Mediterranean the hydropower potential "is expected to decline ... by 20 to 50 per cent" (IPCC 2007a: 743). The chapter on Africa in the IPCC's AR4 (2007a: 443) has only few references to the Mediterranean that reinforce the claims in the European chapter, especially "with the SRES A1B emissions scenario and for 2080–2099, mean annual rainfall is very likely to decrease along the Mediterranean coast (by 20 per cent), extending into the northern Sahara and along the west coast to 15°N" (Christensen/Hewitson/Busuioc/Chen/Gao/Held/Jones/Koli/Kwon/Laprise/Rueda/Mearns/Menéndez/Räisänen/Rinke/Sarr/Whetton 2007). This chapter noted specifically the increased water scarcity:

> in North Africa, considering that estimates for the average annual growth of the population are the world's highest: 2.9 per cent for the period 1990–2002. The Water Exploitation Index is high in several countries in the subregion: >50 per cent for Tunisia, Algeria, Morocco and Sudan, and >90 per cent for Egypt and Libya (Gueye/Bzioul/Johnson 2005). Until recently, these countries have adopted a supply-oriented approach to managing their water resources (IPCC 2007a: 441–441).

This is repeated in the chapter on Asia that stated on water scarcity (IPCC 2007a: 477):

> In arid Central and West Asia, changes in climate and its variability continue to challenge the ability of countries in the arid and semi-arid region to meet the growing demands for water (Abu-Taleb 2000; UNEP 2002; Bou-Zeid/El-Fadel 2002; Ragab/Prudhomme 2002). Decreasing precipitation and increasing temperature commonly associated with ENSO have been reported to increase water shortage, particularly in parts of Asia where water resources are already under stress from growing water demands and inefficiencies in water use (Manton/Della-Marta/Haylock/Hennessy/Nicholls/Chambers/Daw 2001).

This assessment was reinforced by the UNEP-MAP (2009: 13) report on the *State of the Environment and Development in the Mediterranean* noting that "rainfall ... has ... diminished in Southern Europe. In the Mediterranean, some regions to the south have recorded a 20 per cent drop in rainfall. The trend is less even as far as North Africa is concerned."

In the MENA water is extremely scarce. Since 1960, the water per person has dropped and population growth will reduce the water available for irrigated agriculture and the amount of food produced (chap. 50 by Galil). In the 21st century, MENA countries will be confronted with physical, technical and economic constraints. Depending on growth rates, water conservation and efficiency improvements, the water demand in North Africa may fluctuate.

By the year 2000, in North Africa about 63 to 79 per cent of the fresh water was used for agriculture. Only in Algeria this share was 47 to 63 per cent and the share of domestic use was 15 to 30 per cent, while it was below 15 per cent for the other four countries. In all five North African countries between 0 to 16 per cent of the water was used for industrial purposes. In Southern Europe only in Spain and Greece 63 to 79 per cent of the water was used for agriculture, in Italy this share was 31 to 47 per cent and in France it was below 16 per cent.

According to the scenarios of the Acacia project in South Europe precipitation will decline until 2020 in summer in parts of Central Spain by 13–14 per cent and in the northern part of Greece by 10 per cent. Up to 2050 the projected precipitation decline in summer will drop in Greece by 14–20 per cent, in South France by 13–15 per cent and along the Spanish Mediterranean coast by 21–23 per cent. By the year 2080 the decline in summer precipitation in Greece will be between 18–27 per cent, in South France between 17–20 per cent and in Spain between 27–42 per cent. According to the A-2 scenario of the Acacia project a decline of summer precipitation is projected for Spain amounting to 51–73 per cent and to Greece by 41–52 per cent (Parry 2005). According to the data of the Acacia project for parts of the Atlas mountain region in North Africa precipitation may decline in summer until 2020 by 20–25 per cent, until 2050 by 31–49 per cent, and by 2090 by 47–75 per cent.[10]

According to the Blue Plan (Benoit/Comeau 2005: 87) in Morocco 5.7 million people had no direct access to drinking water and 9.1 million lacked access to appropriate sanitary installations. In Algeria the equivalent share was 3.3 million for drinking water and 3.0 million for sanitary units, in Tunisia 1.9 and 1.5 million, in Egypt 1.98 and 1.32 million and in Libya 1.7 or 0.18 million respectively. In Southern Europe in the early 1990's the renewable water supply per person and year was the lowest in Spain and Italy while Portugal had sufficient precipitation. In Mediterranean Spain from 2000 to 2025 the share of the used water will increase from 50 to 75 per cent to above 75 per cent while it was below 25 per cent for Portugal, France, Italy and Greece. In Egypt and Libya the water use will remain above 75 per cent, while it is projected to rise in Mediterranean Morocco from 25 to 50 per cent in the year 2000 to 50 to 75 percent by the year 2025 and along the Algerian Mediterranean coast from below 25 per cent to 25 to 50 per cent (Benoit/Comeau 2005: 87).

During the 21st century, climate change may have significant impacts on precipitation, soil erosion and desertification in the Mediterranean. These climate-related factors will have a significant impact on agricultural prospects: on the availability of arable land and on yields.

26.3.3 Observed and Projected Sea-level Rise

The population in coastal cities of the Mediterranean region has grown between 1950 and 2000 from 25 to 70 million and it has been projected to rise up to 90 million by 2025. In Southern Europe the coastal population doubled between 1950 and 2000 from 20 to 40 million and it will probably stabilize at this level by 2030, while it is projected to rise in the MENA region from 40 to 50 million between the year 2000 and 2030. This will most seriously affect the deltas of the major rivers, most particularly the Nile Delta.

The UNEP-MAP report (2009: 17) noted "between January 1993 and June 2006 ... an obvious east-west differentiation, with a clear trend towards a sea-level rise in the Eastern Mediterranean". The projections on the average sea-level rise have been disputed in the preparation of the IPCC's AR4, which could only agree on an average global increase during the 21st century of 18–59 cm. Rahmstorf referred to recent studies of an observed average increase of the sea level by 1.6 mm/year between 1961 and 2003 and 2.5 mm/year between 2003–2008.[11] Depending on the

10 Carlo Buontempo reminded the author that "this is a common problem when looking at drought in the Mediterranean. An even large percentage decrease in summer precipitation for any Mediterranean country may not be as negative as it sounds as long as winter precipitation doesn't change much. The average number of rainy days in July for the central Mediterranean is 1.2. A reduction of even 50 per cent would only mean few less hours of rain per month."

11 Stefan Rahmstorf: "Sea Level Rise", Copenhagen Climate Science Conference, 10–12 March 2009; at: <http://climatecongress.ku.dk/speakers/stefanrahmstorf-plenaryspeaker-10march2009.pdf/>.

achieved GHG stabilization level and an increase of global mean temperature between 2°C and 4°C, according to the IPCC chairman Pachauri[12] the global sea level may rise between 0.4 and 2.4 metres until 2100. In the Nile Delta, according to Sherif and Singh (1999; WBGU 2006: 45) "an increase of 50 cm would imply that the salty water would intrude about 9 km into coastal aquifers". Without protective countermeasures a sea-level rise of 50 cm would affect in the administrative districts of Alexandria and Port Said about "1.5 million people" (El-Raey/Dewidar/El-Hattab 1999; El-Raey 1991, 1993, 1994, 2000; see chap. 45; WBGU 2006: 48).

26.3.4 Observed and Projected Climate-Related Hazards

The IPCC's Working Group II referred to climate-related natural hazards such as droughts, forest fires and heatwaves as well as storms, floods and landslides. The chapter on Europe (IPCC 2007a: 543) noted that "warmer, drier conditions will lead to more frequent and prolonged droughts, as well as to a longer fire season and increased fire risk, particularly in the Mediterranean region". Beniston, Stephenson, Christensen, Ferro, Frei, Goyette, Halsnaes, Holt, Jylhä, Koffi, Palutikof, Schöll, Semmler and Woth (2007) estimated "that Mediterranean droughts would start earlier in the year and last longer" (IPCC 2007a: 548). Polemio and Casarano (2004) claimed that the Mediterranean "may experience an increase in dry periods by the late 21st century". Further, "the regions most prone to an increase in drought risk are the Mediterranean (Portugal, Spain) [Döll 2002; Donevska/Dodeva 2004]" (IPCC 2007a: 750). This will have severe impacts for agriculture as the crop productivity is likely to "decrease along the Mediterranean and in South-eastern Europe" (IPCC 2007a: 743).

> In particular, in the European Mediterranean region, increases in the frequency of extreme climate events during specific crop development stages (e.g., heat stress during flowering period, rainy days during sowing time), together with higher rainfall intensity and longer dry spells, are likely to reduce the yield of summer crops (e.g., sunflower). Climate change will modify other processes on agricultural land (IPCC 2007a: 755).

The number, intensity and duration of extreme weather events (heatwaves, summer drought, floods in winter) will also increase. Up to 2025 the Blue Plan expects that climate change will lead to an "intensification of extreme weather events". The danger of droughts has increased in this region during the past three decades and it is projected to further rise until 2050 and 2080 (table 26.9).[13]

According to the *IPCC Synthesis Report* "Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods and more frequent coastal flooding and increased erosion (due to storminess and sea-level rise)" (IPCC 2007c: 50).

These four physical effects of anthropogenic climate change, of an increase in temperature, a change in precipitation, rise in sea level and changes in the number and intensity of climate-related hazards have triggered and may cause societal impacts in the Mediterranean region.

26.4 Projected Societal Impacts of Climate Change

The major human-induced challenge both for the governability of the states and for the survivability of the MENA countries will remain the projected population growth, urbanization and the emergence of urban conglomerations for this region (UNPD 2001a, 2002, 2008; preface essay by Zlotnik).

26.4.1 Growing Demand: Populations Growth and Urbanization

Besides the projected physical effects of climate change, population growth in the MENA region will be a major factor that determines the demand for water, soil and food during the 21st century. Table 26.10 focuses on Mediterranean countries for 1850 to 2005 with a projection up to 2050. Since 1950 until 2005, the population of 11 countries in North Africa and in the Eastern Mediterranean increased from 72 to 266

12 R. Pachauri, keynote speech, conference of German Foreign Ministry in Freiburg, 6–7 November 2008 on "Climate Change as a Security Threat"; at: <http://www.freiburg-konferenz.de/downloads/R.K.Pachauri.pdf>.

13 This author's expert study for the WBGU (Brauch 2007f) and a more recent report refers also in detail to issues of soil erosion, degradation and desertification (Brauch 2010) as well as on water scarcity and on the impact of water scarcity and soil infertility on a decline of agricultural crop yield and a drop in the self-sufficiency of the MENA countries with cereals and its impacts on food insecurity in the MENA region.

Table 26.9: Impact of climate change on water availability, drought and flood occurrence in Europe for various time slices and under various scenarios based on the ECHAM4 and HadCM3 models. **Source:** IPCC (2007a: 550).

Time slice	Water availability and droughts	Floods
2020's	Increase in annual runoff in Northern Europe by up to 15 per cent and decrease in the south by up to 23 per cent.[a] Decrease in summer flow.[b]	Increasing risk of winter flood in Northern Europe, of flash flooding across all of Europe. Risk of snow-melt flood shifts from spring to winter.[c]
2050's	Decrease in annual runoff by 20-30 per cent in South-eastern Europe.*	
2070's	Increase in annual runoff in the north by up to 30 per cent and decrease by up to 36 per cent in the south.[a] Decrease in summer low flow by up to 80 per cent.[d, b] Decreasing drought risk in Northern Europe, increasing drought risk in Western and Southern Europe. Today's 100-year droughts return every 50 years (or less) in Southern and South-eastern Europe (Portugal, all Mediterranean countries, Hungary, Romania, Bulgaria, Moldova, Ukraine, Southern Russia).[c]	Today's 100-year floods occur more frequently in Northern and North-eastern Europe (Sweden, Finland, Northern Russia), in Ireland, in central and eastern Europe (Poland, alpine rivers), in Atlantic parts of Southern Europe (Spain, Portugal), and less frequently in large parts of Southern Europe.[c]

[a)] Alcamo, Floerke and Maerker (2007); [b)] Santos, Forbes and Moita (2002); [c)] Lehner, Döll, Alcamo, Henrichs and Kaspar (2006); [d)] Arnell (2004).

million and is projected to grow until 2050 by an additional 148 million people. While from 1950 to 2050 the population for eight Mediterranean EU countries is projected to increase by 66 million, the comparable figure for the MENA states has been an increase by 342.239 million (UNPD 2009, table 26.10). However, the possible migration from Turkey and the MENA region to the EU countries will partly counter the projected aging of the European Mediterranean countries.

The urbanization trends between Southern Europe and North Africa have differed between 1950 and 2005. While in Southern Europe the relative urban population will still grow and the rural population will decline, in North Africa the rural population will stabilize while nearly all projected population growth will be in the cities (table 26.11). This rapid and often chaotic urbanization has resulted in rapidly growing megacities where the people are highly socially vulnerable to natural hazards (table 26.12).

These population growth and urbanization trends pose different demands for water and food.

26.4.2 Growing Demand for Food Imports in the MENA

In North Africa the agricultural land is limited by the Sahara, in Egypt to 2.6 per cent, in Libya to 1.2 per cent, in Tunisia to 10.0 per cent, in Algeria to 3 per cent and in Morocco to 20 per cent. Morocco has about 8.4 million ha agricultural land, Algeria more than 7.5 million ha and Tunisia more than 4.6 million ha. The overuse of the land as a consequence of the intensification of agricultural methods has eroded the soils. Salinization and water erosion are partly a result of the deforestation and of the change in the use of fertile land (chap. 30 by Chourou; chap. 50 by Galil).

While the North may adapt to declining precipitation more easily with a slightly growing population, for the countries on the southern and eastern shore the declining precipitation will require major efforts that will affect the water available for irrigation and food production (chap. 21 by Hayek/Al Hmoud; chap. 22 by Haddad; chap. 23 by Salem; chap. 24 by Issar). Self-sufficiency in cereals will drop in MENA countries and the need for food imports or 'virtual water' will rise. In reaction to a region-wide economic crisis in the mid-1980's Algeria, Morocco and Tunisia launched agricultural reforms to reduce their food imports and food subsidies that contributed to increases in foreign debt.

However, with the increasing global and regional demand in the MENA countries for rising food imports the food prices may rise further as will be the financial resources needed to pay for these imports. While the Maghreb region and the Levant supported their population for millennia, their environment was transformed by human activities, especially by deforestation, land clearance and overgrazing. The rapid population growth in the 20th century put the environment under serious stress. In Morocco between 1987 and 1991, the cropland increased from 4.4 to 5.4

Table 26.10: Population growth of eight South European EU, six South-east European and 11 Mediterranean partner countries (in million). **Source:** UNPD (2009a): *World Population Prospects: The 2008 Revision*; at: <http://esa.un.org/unpp/p2k0data.asp>; McEvedy/Jones (1978) for 1850, 1900; for projections to 2050: UNPD (2009).

	Real population change						Projections Med. var.	Changes	
	1850	1900	1950	1965	1980	2005 (2008 Rev.)	2050 (2008 Rev.)	1950-2050 (2008	2005-2050 Rev.)
Mediterranean Europe (8 of 27 EU countries)									
France	36.0	41.0	41.832	48.771	53.950	61.013	67.668	25.836	6.655
Greece	3.5	4.5	7.566	8.551	9.643	11.064	10.939	3.373	-0.125
Italy	25.0	34.0	46.367	51.481	56.307	58.645	57.066	10.699	-1.579
Portugal	3.5	5.5	8.405	8 999	9.766	10.547	10.015	1.610	-0.532
Spain	15.0	18.5	28.009	32.056	37.527	43.060	51.260	23.251	8.200
- Cyprus	0.15	0.23	0.494	0.582	0.611	0.836	1.175	0.681	0.339
- Malta	0.13	0.19	0.312	0.305	0.328	0. 403	0.413	0.101	0.010
- Slovenia	?	?	1.473	1.630	1.832	2.001	1.954	0.481	-0.047
Total	**83.26**	**103.92**	**133.652**	**142.489**	**169.025**	**186.330**	**200.077**	**+64.769**	**+12.921**
South-eastern European Mediterranean countries									
[Yugoslavia]	7.25	9.5							
- Bosnia Hercegovina			2.661	3.396	3.914	3.781	3.008	0.347	-0.773
- Croatia			3.850	4.122	4.377	4.443	3.825	-0.025	-0.618
- Montenegro			0.399	0.507	0.576	0.625	0.618	0.219	-0.007
- FYR Macedonia			1.230	1.481	1.795	2.035	1.857	0.627	-0.178
- Serbia			6.732	7.889	8.946	9.856	9.193	2.461	-0.663
Albania	0.5	0.8	1.215	1.870	2.671	3.111	3.303	2.088	+0.192
Total	**7.75**	**10.3**	**15.688**	**18.758**	**21.703**	**23.226**	**21.186**	**5.709**	**-2.039**
Eleven Non EU-Mediterranean Partners									
Algeria	3.0	5.0	8.753	11.923	18.811	32.855	49.610	40.857	16.755
Morocco	3.0	5.0	8.953	13.323	19.567	30.495	42.583	33.630	12.088
Tunisia	1.0	1.5	3.530	4.630	6.457	9.878	12.711	9.181	2.833
Libya	0.6	0.8	1.029	1.623	3.063	5.923	9.819	8.790	3.896
Egypt	5.5	10.0	21.514	31.573	44.433	77.154	129.533	108.019	52.379
Only North Africa	**13.1**	**22.3**	**43.779**	**63.072**	**92.331**	**156.305**	**244.256**	**200.477**	**87.951**
Jordan	0.25	0.3	0.472	1.106	2.225	5.566	10.241	9.769	4.675
Israel			1.258	2.563	3.764	6.692	10.649	9.391	3.957
Palestine Authority	0.35	0.5	1.005	1.199	1.476	3.762	10.265	9.260	6.503
Lebanon	0.35	0.5	1.443	2.184	2.785	4.082	5.033	3.590	0.951
Syria	1.50	1.75	3.536	5.399	8.971	19.121	36.911	33.375	17.790
Turkey	10.00	13.0	21.484	31.997	46.161	71.169	97.389	75.905	**26.220**
Eastern Med.	**12.45**	**16.05**	**28.726**	**43.342**	**65.382**	**110.392**	**170.488**	**141.762**	**60.096**
11 Partner countries			**72.505**	**106.414**	**157.713**	**266.697**	**414.740**	**342.239**	**148.077**

Table 26.11: Changes in the urbanization rate for North African and the East Mediterranean countries (1950-2050). **Source:** UNPD (2007); at: <http: //esa.un.org/unup>.

	1950	1960	1970	1980	1990	**2005**	2010	2020	2030	2040	**2050**
Algeria	**22.2**	30.5	39.5	43.5	52.5	**63.3**	66.5	71.9	76.2	80.1	**83.5**
Morocco	**26.2**	29.4	34.5	41.2	48.4	**55.0**	56.7	61.0	65.9	70.9	**75.4**
Tunisia	**32.3**	37.5	43.5	50.6	57.9	**65.3**	67.3	71.2	75.2	78.8	**82.0**
Libya	**19.5**	27.3	49.7	70.1	75.7	**77.0**	77.9	80.3	82.9	85.2	**87.2**
Egypt	**31.9**	37.9	42.2	43.9	43.5	**42.6**	42.8	45.0	49.9	56.3	**62.4**
North Africa	**24.8**	30.4	36.3	40.3	44.7	**50.2**	52.0	56.2	61.3	66.8	**72.0**
Turkey	**24.8**	31.5	38.2	43.8	59.2	**67.3**	69.6	74.0	77.7	81.1	**84.0**
Syria	**30.6**	36.8	43.3	46.7	48.9	**53.2**	55.9	59.0	64.0	69.2	**73.9**
Lebanon	**32.0**	42.3	59.5	73.7	83.1	**86.6**	87.2	88.6	90.00	91.3	**92.4**
Jordan	**37.0**	50.9	56.0	59.9	72.2	**78.3**	78.5	79.6	82.0	84.3	**86.4**
Israel	**71.0**	76.8	84.2	88.6	90.4	**91.6**	91.7	92.2	93.0	93.9	**94.6**
Palestine	**37.7**	44.0	54.3	62.4	67.9	**71.6**	72.1	74.1	77.2	80.3	**83.0**
West Asia	**28.6**	36.0	44.6	51.9	61.0	**65.0**	66.3	69.1	72.5	76.0	**79.2**
Southern Europe	**45.2**	50.4	57.6	62.2	63.8	**66.4**	67.5	70.5	74.3	77.9	**81.2**
Total urban population (millions) 1950-2050											
North Africa[a])	**13.232**	20.441	31.208	44.858	64.305	**95.189**	107.312	134.654	164.519	195.119	**223.281**
West Asia[b])	**14.646**	24.171	39.221	60.518	93.858	**137.940**	153.870	188.995	225.909	261.882	**294.884**
Southern Europec)	**49.252**	59.547	73.279	85.703	90.817	**99.759**	103.170	108.430	113.089	116.833	**118.815**

a) North Africa includes these countries: Algeria, Egypt, Libya, Morocco, Sudan, Tunisia and Western Sahara
b) West Asia includes these countries: Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Turkey, United Arab Emirates and Yemen,
c) Southern Europe includes these countries: Albania, Andorra, Bosnia Herzegovina, Croatia, Gibraltar, Greece, The Holy See, Italy, Malta, Montenegro, Portugal, San Marino, Serbia, Slovenia, Spain and The Former Yugoslav Republic of Macedonia

million ha primarily by extending to marginal rangeland (200 mm rain). This contributed to overgrazing in poorer land and increased the potential for soil erosion. The same development can also be observed in Algeria. Swearingen (1996: 89) concluded that the "agricultural policies implemented during the 1980's have substantially increased the risk of drought in North Africa". The major reason is the strife for self-sufficiency in food. It is difficult to imagine any agricultural technology capable of sustaining such a large population, given the region's limited and deteriorating resource base.

The solution to the Maghreb's shortfall in food production ultimately lies in population control (World Bank 1988). In the 21st century, many Southern and Eastern Mediterranean countries will be affected by two negatively reinforcing trends: the continued high population growth in an area that cannot produce enough food (chap. 50 by Galil). The projected *global* climate change will make the *regional* challenges of population growth, urbanization, pollution, desertification, water and food scarcity more severe. All MENA countries must spend more for importing cereals and for making potable water available to their people, to tourists and for irrigation. Due to oil exports all countries but Morocco gained assets to pay for these imports. However, this source of foreign income is limited.

A recent report on environment and security issues in the southern Mediterranean region briefly discusses the "pressures on water, agriculture, desertification" but it does not meet systematic requirement

Table 26.12: Growth of the population in the megacities in Southern Europe and in North Africa in millions (1950-2025). **Source:** UNPD (2004), [a)] UNPD (2008); [b)] UNPD (2002.

Metropolis	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2025[a]
Southern Europe															
Athens	1.78	2.00	2.25	2.39	2.52	2.74	3.05	3.07	3.0	3.12	3.18	3.24	3.29	3.33	3.3
Barcelona	1.56	1.74	1.95	2.27	2.66	2.87	3.10	3.57	4.20	4.33	4.38	4.42	4.45	4.47	5.2
Lisbon	0.78	0.84	0.90	0.97	1.04	1.17	1.31	1.54	1.83	1.91	1.94	1.98	2.02	2.06	3.1
Madrid	1.55	1.86	2.23	2.74	3.38	3.82	4.30	4.56	4.81	4.93	5.04	5.15	5.22	5.27	5.9
Milan	3.63	4.05	4.50	4.99	5.53	5.53	5.33	4.98	4.60	4.37	4.18	4.00	4.00	3.99	2.9
Marseille	0.62	0.74	0.89	1.02	1.13	1.19	1.23	1.27	1.31	1.33	1.36	1.38	1.41	1.43	1.5
Naples	2.75	2.96	3.19	3.40	3.59	3.62	3.59	3.42	3.21	3.01	3.00	2.90	2.90	2.89	2.2
Oporto	0.36	0.40	0.44	0.45	0.47	0.50	0.54	0.76	1.10	1.21	1.25	1.30	1.35	1.40	1.5
Rome	1.57	1.91	2.33	2.64	2.91	3.00	3.01	3.00	2.97	2.86	2.74	2.63	2.62	2.61	3.3
Turin	0.88	1.05	1.25	1.43	1.62	1.64	1.60	1.50	1.39	1.32	1.25	1.18	1.18	1.18	1.6
North Africa															
Alexandria	1.04	1.25	1.50	1.75	1.99	2.24	2.52	2.83	3.07	3.28	3.51	3.760	4.07	4.67	5.7
Algiers	0.50	0.62	0.81	1.08	1.28	1.51	1.62	1.67	1.91	2.30	2.76	3.26	3.74	4.17	4.5
Benghazi	0.05	0.07	0.10	0.15	0.22	0.31	0.40	0.51	0.64	0.80	0.91	1.03	1.15	1.26	1.6
Casablanca	0.63	0.78	0.97	1.20	1.50	1.79	2.11	2.41	2.69	2.99	3.34	3.74	4.17	4.58	3.9
Cairo	2.43	3.04	3.81	4.77	5.58	6.43	7.34	8.33	9.06	9.70	10.40	11.15	12.04	13.12	15.6
Fes	0.17	0.22	0.28	0.32	0.37	0.43	0.51	0.59	0.68	0.79	0.90	1.03	1.17	1.30	1.3
Marrakesh	0.21	0.23	0.24	0.28	0.32	0.37	0.42	0.49	0.58	0.69	0.82	0.95	1.08	1.20	
Rabat	0.15	0.18	0.23	0.34	0.49	0.64	0.81	0.98	1.16	1.37	1.61	1.86	2.10	2.33	2.2
Tunis	0.47	0.53	0.58	0.66	0.75	0.87	1.14	1.43	1.57	1.72	1.90	2.07	2.22	2.36	
Tripoli	0.11	0.14	0.17	0.24	0.40	0.61	0.80	1.06	1.50	1.68	1.88	2.09	2.30	2.50	2.9
Eastern Mediterranean (Urbanization Revision of 2001)[b]															
Adana	0.14	0.20	0.27	0.34	0.40	0.47	0.57	0.75	0.91	1.00	1.09	1.15	1.22	1.29	2.2
Aleppo	0.32	0,39	0.48	0.59	ß.72	0.88	1.07	1.29	1.55	1.87	2.23	2.62	3.05	3.49	4.0
Amman	0.09	0.14	0.22	0.30	0.39	0.50	0.64	0.78	0.94	0.99	1.15	1.31	1.48	1.65	1.4
Ankara	0.54	0.69	0.87	1.09	1.35	1.71	1.89	2.21	2.54	2.83	3.16	3.38	3.58	3.78	4.6
Beirut	0.33	0.43	0.56	0.72	0.92	1,06	1.21	1.39	1.58	1.82	2.07	2.28	2,41	2.50	2.2
Bursa	0.15	0.18	0.22	0.30	0.33	0.35	0.48	0.65	0.82	0.98	1.17	1.32	1.44	1.55	1.9
Damascus	0.37	0.46	0.58	0.73	0.91	1.12	1.38	1.56	1.73	1.92	2.14	2.43	2.78	3.17	3.6
Gaziantep	0.10	0.14	0.18	0.23	0.30	0.30	0.37	0.47	0.60	0.67	0.76	0.82	0.88	0.93	1.3
Homs	0.10	0.13	1.60	0.20	0.25	0.31	0.39	0,47	0.57	0.68	0,81	0.96	1.12	1.30	1.5
Istanbul	1.08	1.37	1.74	2.20	2.79	3.60	4.40	5.41	6.54	7.66	8.95	9.95	10.72	11.36	12.1
Izmir	0.48	0.56	0.67	0.77	0.89	1.05	1.22	1.47	1.74	1.97	2.21	2,39	2.55	2.70	3.2
Tel Aviv	0.42	0.56	0.74	0.88	1.03	1.21	1.42	1.62	1.80	1.90	2.00	2.13	2.27	2.39	3.7

of an authoritative IPCC assessment (MEDSEC 2009; chap. 47 by Brauch/Oswald Spring).

26.4.3 Need for a Pan-Mediterranean Assessment on the Physical Effects and Societal Impacts of Climate Change

The Mediterranean faces a major contradiction: The longer-term common environmental challenges are confronted with highly fragmented security, political and economic spaces. In the 21st century two pan-Mediterranean political 'spaces' exist: a) the environmental regime of the *Barcelona Convention* (1976), of the *Mediterranean Action Plan* (MAP) and of the Blue Plan, and b) the emerging political regime of the *Barcelona Declaration* (1995) and of the *Union for the Mediterranean* (UfM; 13 July 2008). While the *Barcelona Declaration* and the UfM reflect different attitudes of North and South, the *Barcelona Convention* refers to the common Mediterranean space that will be affected by environmental factors.

The *Mediterranean climate* implies complex interactions between global climate change and regional implications that will negatively reinforce ongoing processes of desertification (chap. 48 by Safriel; chap. 50 by Galil; chap. 53 by Mainguet/Dumas/Kabiri/Rémini; chap. 55 by Gómez/López-Bermúdez/Quiñonero Rubio). There are common non-military environmental challenges affecting the whole Mediterranean that will have socio-economic and political consequences that may affect the Euro-Mediterranean region.

A common long-term scientific agenda is needed to develop an early warning system for common challenges and concerns. Both climate change and desertification may constrain the supply side for water and food. For the analysis of population policy and urbanization national policies set the framework. While for the analysis of 'environmental security' issues only an environmental spatialization of the Mediterranean applies, for a policy of avoiding conflicts emerging from medium-term implications of long-term structural causes, early and joint action by the countries participating in the wider Euro-Mediterranean space of the Barcelona or the BP/UfM framework is needed.

The most likely societal, national and international impact of climate change in close interaction with the other five trends has been and will continue to be migration, primarily of the young generation from rural areas to the national urban centres (urbanization), distress, political and economic migration from the Sahel zone and Sub-Saharan Africa to North Africa or from South, Central and West Asia to Turkey, and labour migration from MENA countries and the Balkans to the EU that may be *pushed* by socio-economic and environmental conditions and *pulled* by the attractiveness of the North and by existing networks. Due to population decline in European countries, labour migrants will be needed to satisfy future manpower demand in all sectors of the economy.

So far no specific climate impact analyses that were assessed by the IPCC exist for the Mediterranean. Based on the reviewed available scientific evidence, the MENA countries will be confronted until 2050 with three structural challenges of population growth, desertification and climate change. The specific short-term interaction of these structural factors with short-term political events and medium-term socio-economic changes cannot be predicted. But based on past evidence it may be concluded that the interaction of these factors could intensify the domestic socio-economic and political crises in these countries.

On the global level, the first four assessment reports of the IPCC have evaluated the peer-reviewed scientific literature on the multiple impacts of global climate change, most particularly on fresh water resources and their management (IPCC 2007a: 173–210), on ecosystems, their properties, goods and services (IPCC 2007a: 211–272), on food, fibre and forest products (IPCC 2007a: 273–314), on coastal systems and low-lying areas (IPCC 2007a: 315–356), on industry, settlement and society (IPCC 2007a: 357–390), and on human health (IPCC 2007a: 391–432).

On the regional Mediterranean level various studies of the UNEP-MAP and of the Blue Plan reviewed the impacts beyond the requirements of the IPCC assessments. The report of the regional seminar of the Blue Plan on climate change in the Mediterranean (2008) addressed the impact on the environment and on human health, most particularly the vulnerability of Mediterranean coasts that are to take the more drastic sea-level rise into account. This report also addressed the migration of ecological niches and the shift of invasive species in the Mediterranean, the risks of spreading infectious diseases and the health impacts of heatwaves, such as the one of August 2003, when between 35,000 and 70,000 people died in Central and Southern Europe. Another focus was on the discussion of the impact on natural resources, especially on water resources, on natural risks and on forests as well as on anthropogenic activities (fisheries, tourism, agriculture, energy needs).

Table 26.13: Cereal balance for MENA countries. **Source:** Bruinsma (2003).

	Demand				Production	Trade	Self sufficiency rate %	Growth rates, % p.a.			
	Per capita (kg)		Total (million tons)						Demand	Production	Population
	Food	Total	Food	Total							
1964/66	174	292	28	47	40	- 5	86	1967-97	3.6	2.4	2.7
1974/76	190	307	40	64	55	- 13	85	1977-97	3.1	2.7	2.7
1984/86	203	365	56	100	65	-38	65	1987-97	2.1	2.0	2.4
1995/97	208	357	75	129	84	-43	65	'95/97-2015	2.0	1.4	1.9
2015	209	359	108	186	110	-76	59	2015-2030	1.5	1.2	1.4
2030	205	367	130	232	131	-102	56	'95/97-2030	1.8	1.3	1.7

26.4.4 Declining Supply: Soil, Water and Food

The UNEP MAP (2009: 17–21) analysis listed among the major climate change impacts "water availability, biodiversity and the economic activities on which they depend" and the implications of these projected changes on fisheries, on risk-prone forests also due to increase in the number and intensity of forest fires, tourism and on human health. These recent reports as well as the previous extensive studies of the Blue Plan (Grenon/Batisse 1989, 1989a; Benoit/Comeau 2005) did not discuss the implications of climate change on crop yields and food production as well as on the declining self-sufficiency rates in cereals for the MENA region countries (Brauch 2007f).

According to FAO analyses the cereal imports to the MENA region rose between 1964–1966 and 1995–1997 from 5 to 43 million tons, thus during drought years the balance of payment were negatively affected and foreign indebtedness increased. Given the projected increase in the need of cereal imports from 1995 to 2030 by about 150 per cent, this situation may become dramatic, especially when grain prices rise and the income form oil and gas exports will gradually decline or totally drop (as has already been the case in Tunisia, and may occur in this decade probably in Egypt and until 2050 probably also in Algeria).

Between 1964/1966 and 1997/1998 the self sufficiency rate in cereals in the MENA region has declined from 86 to 65 per cent and until 2030 it is projected to drop to 56 per cent. This deficit has been balanced by food imports or "virtual water" (Allan 2003, 2009). The food demand has grown much faster than the agricultural production and population growth (table 26.13; figure 26.2).

According to figure 26.2 until 2020 the crop yield may increase for France, Spain, and Portugal as well as for Morocco, Algeria and Egypt by 0 to 2.5 per cent, but it may decline for Italy and Libya by 0–2.5 per cent and for Greece by 2.5 to 5 per cent. For 2050 for Italy, Morocco and Tunisia a decline has been projected of 0 to 2.5 per cent and for 2080 the crop yields may decline by 2.5 to 5 per cent for all five North African countries. If one assumes for 2080 a CO_2 stabilization at 550 and 750 ppmv then the yields may decline by 0 to 2.5 per cent or more (figure 26.2).

Martin Parry (2005) pointed to the consequences of climate change for agriculture in Europe:

- It will be hotter in the North, drier in the South, flash floods will increase and the frequency of extremely hot days and of heatwaves.
- There will be more agricultural benefits in the North and more damages in the South.
- Water scarcity and heatwaves will rise in the South, more flooding in the North, in central Europe and in mountainous regions.
- Environmental problems will rise (desertification in the South; soil exhaustion in the North).
- Climate change problems should be mainstreamed into European development and environment (directives for water, combating desertification).
- Europe will experience less negative impacts than other continents and it will have to increase agricultural production to maintain global food security during this century.

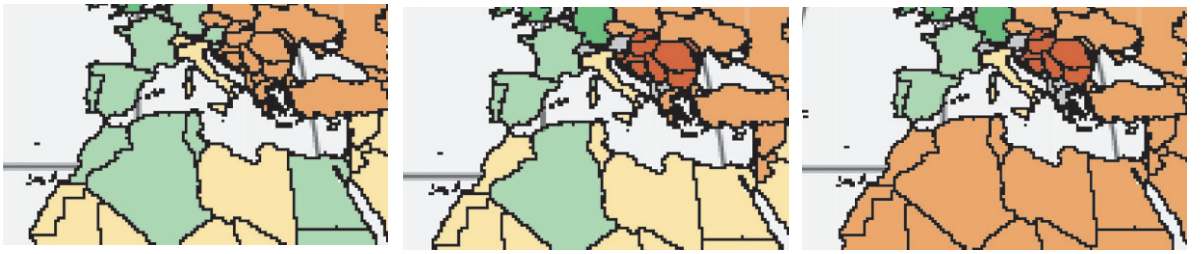
Do these physical impacts of climate change pose objective security dangers, directly or indirectly through the effects on the human system, or are these effects perceived as subjective security concerns by the Mediterranean states and by those countries par-

Figure 26.2: Climate change and food security in the Mediterranean space and changes in agricultural yields until 2020, 2050 and 2080. **Source:** WBGU (2006a).

Food security by **2020** (2010-2039) (HADCM3 GGa1).

Food security by **2050** 2040-2069 (HADCM3 GGa1).

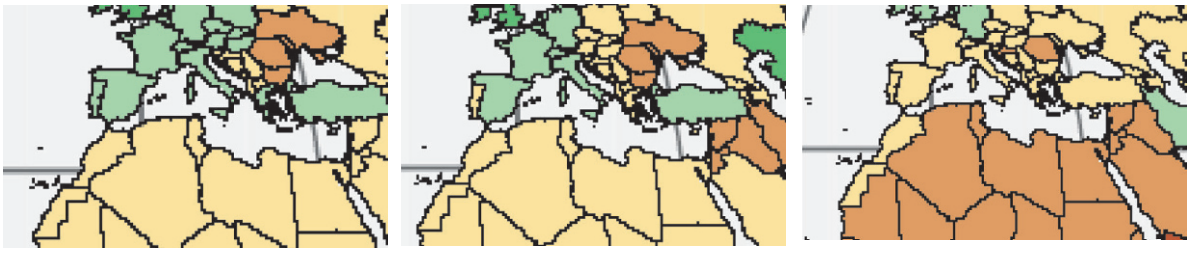
Food security by **2080** 2070-2099 (HADCM3 GGa1).

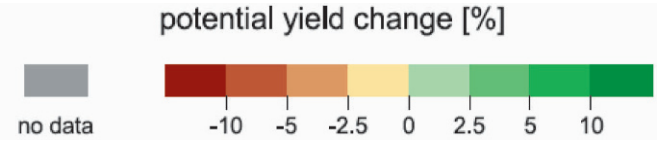


Food security by **2080** 2070-2099 (HADCM2), CO_2 stabilization at 550ppmv.

Food security by **2080:** 2070-2099 (HADCM2), CO_2 stabilization at 750ppmv.

Food security by **2080**: 2070-2099 (HADCM2 IS92a), CO_2 unmitigated.





ticipating in the Barcelona process and in the new UfM?[14] Two societal effects are most prominent that may also pose additional security threats, challenges, vulnerabilities or risks for security: migration and possible low-level conflicts.

26.5 Migration Trends and Future Migration Scenarios

So far international organizations and demographers specializing in migration issues have only peripherally addressed environmental causes of migration while environmental specialists have discussed conceptual issues of defining environmental and climate-related push factors often ignoring the work of demographers. A recently formed *Climate Change, Environment and Migration Alliance* (CCEMA) tries to bridge the gap of both communities.[15]

Migration covers different features of people's movements from a) rural to urban livelihoods (*urbanization*), b) temporary '*internal displacements*' due to a natural hazard, conflict or a complex emergency or c) permanent internal, regional or international South-North migration. Such migration may be *forced* (often due to push factors) or *voluntary* (often due to pull factors). Environmental factors due to GEC (water scarcity, soil degradation, climate change) may force people to leave their homes and traditional livelihoods to survive or to have better prospects for life and economic and human well-being.

The *International Association for the Study of Forced Migration* (IASFM) listed under forced migration these types: a) conflict-induced displacement, b) development-induced displacement, c) disaster-induced

14 See Chourou (2008, 2009); Selim (2009); Issar and Zohar (2009); Boulharouf and Pattie (2009); Ali (2009); Kapur, Kapur, Akca, Eswaran and Aydin (2009); Aydin and Ereker (2009); Hayek (2009); Selby (2009); Jägerskog (2009); Adly and Ahmed (2009); Newman (2009); Twite (2009); Dajani (2009).

15 See for details: <http://www.ccema-portal.org/>. Here recent free publications may be accessed.

displacement. It also distinguished these forced migrants as: i) refugees, ii) asylum seekers, iii) internally displaced persons, iv) development displaces; v) environmental and disaster displacees, vi) smuggled people, and vii) trafficked people. The fifth group is "sometimes referred to as 'environmental refugees' or 'disaster refugees' ... This category includes people displaced as a result of natural disasters (floods, volcanoes, landslides, earthquakes), environmental change (deforestation, desertification, land degradation, global warming) and human-made disasters (industrial accidents, radioactivity)".[16]

This 'environmentally-induced migration' has resulted in 'distress migrants', some have called 'environmental refugees' (El-Hinnawi 1985). Castles (2001) in his review of the debate on "Environmental Change and Forced Migration" concluded that "we clearly need a much broader approach, which recognizes the complex causes and the global dimensions of the crises that force people to flee their homes".[17] The report on the UNHCR/IOM/RPG (1996) symposium distinguished these types of environmentally-induced population movements:

- Acute onset movements, with and without the possibility of return;
- Slow onset movement, with and without the possibility of return due to the natural conditions of the area;
- Slow onset movement with predictability (for example, displacement caused by large-scale development projects) with no possibility of return because of human activities.

This Report suggested the term 'environmentally displaced persons' it defined as: "Persons who are displaced within their country or habitual residence or who have crossed an international border and for whom environmental degradation, deterioration or destruction is a major cause of their displacement, although not necessarily the sole one." Flintan (2001) listed among the main causes of environmental migration: a) human-induced environmental change (including land degradation, desertification), b) environmental catastrophes and/or natural disasters, c) military and political upheavals and d) socio-economic factors.[18]

To summarize, there seems to be an emerging consensus that soil degradation, erosion, desertification and drought contribute to distress migration. Disasters cause, trigger or contribute to migration, while migration may intensify disasters due to a high social vulnerability. No detailed data exist to quantify the environmental or climate-induced causes of migration.

Policy-oriented discussions have addressed conceptual issues of environmentally and climate-induced migration and the methodological issues of migration statistics in the Euro-Mediterranean, the Arab world and for the MENA region.[19] Despite these efforts environmental causes for migration have not been systematically covered in most recent migration statistics:

- *Trends in International Migrant Stock: The 2008 Revision* (UNPD 2009b);[20]
- *International Migration Report 2006: A Global Assessment* (UNPD 2009);[21]
- *2008 Global Trends: Refugees, Asylum-seekers, Returnees, Internally Displaced and Stateless Persons*;[22]
- *Trends in International Migration* (e.g. OECD, SOPEMI 2008, 2009).[23]

No major statistical source (UN, OECD, and IOM) has included a category of 'environmental refugees',

16 See for details at: <http://www.forcedmigration.org/whatisfm.htm>.

17 See: Stephen Castles: "Environmental Change and Forced Migration" (6 December 2001): at: *Preparing for Peace*: <http://www.preparingforpeace.org/castles_environmental_change_and_forced_migration.htm>, Stephen Castles: "Confronting the Realities of Forced Migration" (1 May 2004), at: <http://www.migrationinformation.org/Feature/display.cfm?id=222>.

18 See Flintan at: <http://www.ucc.ie/famine/GCD/Paper%20for%20Wilton%20Park.doc>.

19 See e.g. the 2006 "High-level Dialogue on International Migration and Development" and the subsequent creation of the "Global Forum on Migration and Development" have developed a: "United Nations Global Migration Database" that may be accessed at: <http://esa.un.org/unmigration/>. Further, the most recent "Eighth Coordination Meeting on International Migration, New York, 16–17 November 2009"; at: <http://www. un.org/esa/population/meetings/eighthcoord2009/eighthcoord2009.htm> that offers an overview of the migration-related activities of international organizations within the UN framework; see for references to many related documents; at: <http://www.un.org/esa/population/migration/index.html>.

20 See Report ESA/P/WP.209.

21 See at: <http://www.un.org/esa/population/publications/2006_MigrationRep/report.htm>.

22 See at: <http://css.escwa.org.lb/SD/1017/2008GlobalTrends.pdf>.

23 See at: <http://www.oecd.org/department/0,2688, en_2649_33931_1_1_1_1_1,00.html>. Since 2006 it has been published with the title: *International Migration Outlook*.

'environmental migrants' and 'environmentally-induced migration' or 'climate migrants' in their database. Thus, no reliable global statistics exist on environmentally triggered migration due to land degradation, desertification, drought or famine. Nevertheless, as many case studies by political scientists, social anthropologists or ethnologists have shown, issues reacted to global environmental change (due to natural and human-made causes) are new causes of migration while migration has also become a cause of environmental change.

While the percentage of the international migrants of the world population has grown from 2.1 per cent in 1975 to 3.0 per cent in 2005, the percentage of refugees of international migrants grew from 2.9 per cent in 1960 to 11.90 in 1985 and 1990 and has since then fallen to 7.1 per cent in 2005. A report of the *Global Commission on International Migration* (GCIM) on: *Migration in an interconnected world: New directions for action* as well as a report by the UN General Assembly on migration and development of 18 May 2006 for the high level meeting on this theme in mid-September 2006 did not mention environmental factors as a driver for migration. The GCIM commissioned some 50 research papers that focused on 8 thematic projects and regional studies but none dealt with environmental causes of migration. The third project on: "Irregular migration, state security and human security" examined:

> the use and adequacy of terms such as 'irregular migrants/migration', 'illegal migrants/migration,' 'undocumented migrants/migration' and 'unauthorized migrants/migration', and examines the potential for consistent and/or alternative terminology to be used in relation to the different phenomena commonly described in this manner.

While many studies were published on environmental refugees (El-Hinnawi 1985; Bächler 1994; Myers 1995) or more recently on climate migrants (IOM 2009, 2009a; Warner/Erhart 2009) and on the need to develop a legal regime (WBGU 2008; Biermann/Boas 2008), still no systematic and detailed statistical studies exist that permit a quantification of the environmentally triggered migration across the Mediterranean Sea. There are, however, case studies on specific events that have forced people to leave their livelihood in some countries (EACHFOR project).

From 1950 to 2000 a fundamental shift has occurred in the migration patterns of the Western Mediterranean countries that include besides Spain, Portugal, France and Italy also five small states (Andorra, The Holy See, Malta, Monaco, San Marino) and Gibraltar (Zlotnik 2003). From 1950 to 1970 there was a net emigration from Spain, Portugal and Italy but since 1970 there was a net inflow of migrants of a million during the 1970's and two million during the 1990's. However, the emigration from the Southern Mediterranean (North Africa) has steadily increased between 1950 and 1980, temporary declined during the 1980's and during the 1990's returned to the level of the 1980's (Zlotnik 2003: 599).

The rapidly increasing irregular migration from the Maghreb and Sub-Saharan Africa already poses manifold national, political, societal but also human security threats and challenges both for the recipient countries and for the migrants as well. For the source countries migration may reduce the potential for domestic protests among the hopeless and increase the prospects of remittances for those family members staying at home. However, for some recipient countries that are confronted with an emerging humanitarian catastrophe, the irregular South-North migration has become a major challenge for their national and internal security.

In Spain and Italy a significant increase in immigration has occurred during the past decade. In Spain the number of immigrants has increased from 299,953 (1975) to 4,790,074 (2005) or sixteen fold in 30 years (table 26.14). During the past decade, the migrant population has increased from 1 million to 4.8 million people or from 2.5 per cent to 11.1 per cent of the total population. At the same time the number of refugees remained stable at about 5,500 people. Between 2000 and 2005 Spain had an average annual net migration inflow of 405,000 migrants. As a result the Spanish population rose from 39,921,000 (in 1995) to 40,717,000 (in 2000) and 43,064,000 (in 2005).

This increase in statistically recorded immigrants in Spain and Italy are reflected in the changes in the UN population projections for both countries between the 2000 and the 2008 revisions. While the medium variant of the UN population projection (revision of 2000) projected a significant population decline for Spain (-9.6 million) and Italy (-14.6 million) between 2005 and 2050, the medium variant of the 2004 revision projected for Spain an increase of 1.8 million and for Italy a decline of 6.8 million. The 2008 revision projected for Spain a population growth of 8.2 million and for Italy a decline of 1.58 million people.

Thus, immigration has become a major political but also security challenge for the Spanish government and society. While this immigration cannot be interpreted as a direct outcome of environmental or

Table 26.14: Increase in number of migrants in Spain (1975-2005). **Source:** Population Division of the DESA of the United Nations: *Trends in Total Migrant Stock. The 2005 Revision*; at: <http://esa.un.org/ migration> (16 October 2006).

	1975	1980	1985	1990	1995	2000	2005
Estimated number of international migrants at mid-year	**299 953**	**240 906**	**405 869**	**765 585**	**1 009 021**	**1 628 246**	**4 790 074**
Estimated number of refugees at mid-year	17 000	23 750	9 600	8 490	5 607	6 851	5 507
Population at mid-year (thousands)	35 596	37 542	38 474	39 303	39 921	40 717	43 064
International migrants as a percentage of the population	0.8	0.6	1.1	1.9	2.5	4.0	11.1
Refugees as a percentage of international migrants	5.7	9.9	2.4	1.1	0.6	0.4	0.1
	1970-1975	**1975-1980**	**1980-1985**	**1985-1990**	**1990-1995**	**1995-2000**	**2000-2005**
Growth rate of the migrant stock (percentage)	-4.4	-4.4	10.4	12.7	5.5	9.6	21.6

desertification factors, nevertheless, the inflow has increased from those countries in North and Sub-Saharan Africa that are victims to desertification. It may be difficult to quantify the number of migrants that have left their homes and countries due to environmental causes, among them soil erosion, desertification, severe drought and famine.

Between 1950 and 1989 the net immigration to Middle and Western Europe was 14.61 million persons. In 1991 about 64 per cent of the 15.9 million foreigners in the then 12 EU states came from Non EU-states and of these alone 5.011 million came from five Non-EU Mediterranean countries: Turkey (2.248 million), Morocco (1.053 million), Yugoslavia (785,000), Algeria (641,000) and Tunisia (241,000; see table 26.15).

Which causes have contributed to this significant increase in migration? Two major reasons for migration are distinguished in the literature, so-called *pull factors* (e.g. the recruitment of foreign workers, economic disparity between South and North, family networks, etc.) and *push factors* (wars, violent domestic conflicts, economic hardship, hunger, poverty and environmental catastrophes). During the 21st century two push factors will increase in urgency, population growth (table 26.11) that will increase the demand for scarce resources, especially for soil, water and food, and the impacts of global environmental change, such as climate change, soil erosion and desertification, decline in precipitation and increase in evaporation what will reduce the water available per person dramatically.

These environmental 'root causes' often cannot at all or easily be changed by political decisions or by political decision-makers. Root or structural causes point to the third temporal level of policy analysis referred to by Braudel (1969, 19972) as "histoire du longue durée". From a Braudelian vantage point the *independent and intervening variables* of international migration can be classified in three groups of determining or root causes: a) *structural* or long-term factors, b) the *socio-economic* or medium-term factors and c) the *political* or short-term factors. According to Braudel's 'structures du longue durée' especially 'environmental conditions', and particularly two anthropogenically generated processes of environmental degradation are crucial: *regional desertification* and *global climate change*.

While in the past *population growth* was *the major cause of internal and international migration* from North Africa to Europe, the second *long-term root cause* is environmental degradation that will increase in urgency during the 21st century. Figure 26.3 outlines the possible impact of two long-term causes on the projected migration from North Africa to Western Europe up to the year 2020 or 2030 (medium-term) and up to 2050 or 2100 (long-term). If a *short-term reactive* migration policy of the EU states is to be avoided, these *root causes* must be addressed. These trends may possibly still be avoided if they become tasks of a cooperative effort and if they are successfully implemented in their respective countries.

Table 26.15: Migrants from five North African countries to five South European EU states. **Source:** Fargues (2006: 24-25) based on Fargues (2005).

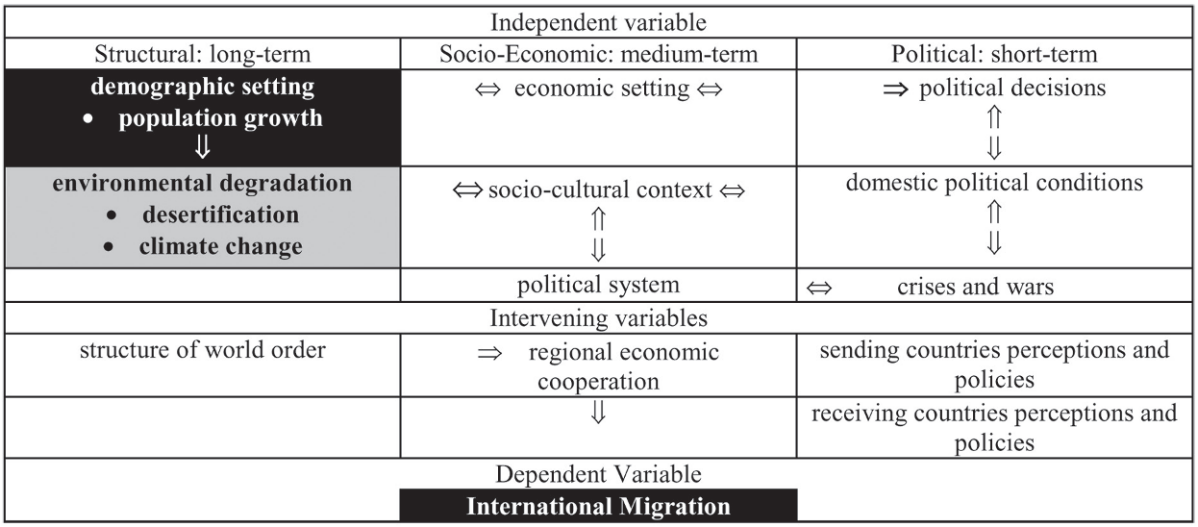
Target country (of immigration)	Country of origin (country of emigration)				
	Egypt	Algeria	Libya	Morocco	Tunisia
France	15 974	685 558	No data	725 782	260 622
Greece	7 448	267		526	231
Italy	40 879	15 750		223 661	58 628
Portugal	115	135		778	54
Spain	2501	46 278		511 294	1566
South European EU countries					
	127 060	789 459		1 8125 510	358 926
Statistics of countries of emigration	[Egypt 2000] 436 000	[Algeria 1995] 991 796		[Morocco 2004] 2 616 871	[Tunisia 2003] 695 765
Arab Mediterranean countries	131 961	24 209		25 394	10 457
Other countries	185 124	33 652		62 944	16 402
Total	444 145	847 320		1 900 848	385 785
Statistics of countries of emigration	[Egypt 2000] 2 736 729	[Algeria 1995] 1 072 246		[Morocco 2004] 3 089 090	[Tunisia 2003] 843 204

The projected population growth for the MENA region will increase the pressure on the environment. Due to the rural exodus and urbanization the ecological consequences will increase the pollution of the air and the contamination of soil and water and the health problems in large cities and 'bidonvilles' (Grenon/Batisse 1989, 1989a; Brauch 1998). Poverty and high unemployment rates among the young will also increase what may contribute to a political radicalization. With the population growth the demand for drinking water rose and for agriculture to feed the growing population. The extension of the agricultural areas and the overexploitation of the poor soil have already increased the ecological stress and contributed to an extension of soil erosion (chap. 47 by Brauch/Oswald Spring).

Several North African countries experienced major food protests. In Morocco droughts and the increase of food prices have resulted in 1984 and 1990 in bread riots that were repressed by force (Seddon 1986, 1988; Benjelloun 2005). While the trends of a growing demand for water soil and food can be projected for the MENA region based on a continuing population growth and urbanization, the decline in precipitation and in crop yields can also be foreseen based on different climate models. However, it is impossible to predict how the governments and unknown policy-makers will respond to these challenges and whether they will result in a drastic increase of migration and transmigration, and whether this will lead to conflicts within and between MENA countries and with the EU's Mediterranean countries. Many claimed that the Mediterranean has become the major demographic and economic dividing line, much deeper and extreme than the Rio Grande between the US and Mexico. Many experts have predicted that the migration pressure from the MENA to the EU will rise.

Given the many conceptual, theoretical and empirical problems and especially the statistical difficulties to assess the environmental and climate-induced rural-urban migration (urbanization), internal displacement and intraregional as well as intercontinental migration in general and for the Mediterranean region in particular, a discussion on future environmentally and GEC-induced migration pressures up to 2020 and 2050 or until the end of the 21st century remains highly speculative. Globally the number of estimated environmental migrants referred to by Myers (1995), humanitarian and environmental NGOs, by national governments (NIC 2008) and international organizations have varied "between 50 million and 350 million" (IOM 2007, 2009, 2009a). However, as no systematic and reliable data on environmentally and climate-induced migration exist it is impossible to offer any detailed estimates of the scope of this future migration both globally but also regionally for the Mediterranean region.

Figure 26.3: Framework for a causal analysis of migration dynamics**. Source:** Brauch (2000/2001: 111).



26.6 Conflicts in the Mediterranean

So far no specific climate impact analyses based on the climate models of the IPCC exist for North Africa. Based on the present scientific evidence – reviewed above – it may be assumed that the North African region will be confronted until 2050 with three structural challenges beyond the control of political leaders: population growth, desertification and climate change. The interaction of these structural factors with short-term political events and medium-term socio-economic changes cannot be predicted. Nevertheless based on past evidence – e.g. of severe droughts, environmental degradation, migration, domestic conflicts and interstate wars which were observed in the Sahel – it may be concluded that the interaction of these factors could intensify the domestic socio-economic and political crises in these affected countries.

Several studies assumed a correlation between high population growth and the likelihood of interstate conflicts, while others saw a causal relationship between environmental scarcity (e.g. of water and food) and environmental degradation (of air, soil, water) and domestic violence and interstate wars. Other authors have claimed a direct causal relationship between environmental degradation (pollution, desertification and climate change) and an increased pressure to migration. Both domestic and international violent conflicts have been major 'push factors' for migration. The migration pressure from North Africa to Western Europe may further be exacerbated by the 'pull factors' of existing family networks and the attractiveness of the North or the lack of competitiveness of the South.

26.6.1 Past Conflicts in the Euro-Mediterranean Region

Pfetsch (2003) offered an overview of the conflicts in the Mediterranean (1945–2001) where he distinguished among four regional conflict clusters that cover "three quarters (90) of the 121 conflicts" he counted for this 46 year period:

1. *Conflicts in the Middle East with Israel and its neighbouring Arab countries* with 35 conflicts that count for 42 per cent of the total weighted conflict occurrence in the Mediterranean.
2. *Colonial and post-colonial conflicts in the Maghreb countries* with 30 conflicts.
3. *Conflicts between and within Greece and Turkey* with 14 conflicts. Another complex of conflicts arises between Greece and Turkey over Cyprus and the Aegean Sea.
4. *Conflicts resulting from the dismemberment of Yugoslavia* with 11 rather severe conflicts.

Most conflicts in the reviewed period were severe crises (53), crises (28), latent conflicts (20) and wars (19). With regard to the intensity of conflicts, Pfetsch (2003: 151–152) concluded that

> the Mediterranean region is also fragmented in politics and conflict behaviour. ... Environmental conflicts are difficult to assess by quantitative empirical research. Some of them are included in the categories of resource and water. The map of political conflicts shows four

> sub-regional clusters of conflicts. Each of these sub-regions can be linked to the determining factors of stress/challenge, security/support and the capability to manage conflicts that contribute to explain the rather conflict laden region.

During the past nine years (2002 to May 2010) the Middle East conflict re-emerged after the collapse of the peace process, while the Greek-Turkish conflict declined, and in the post-Yugoslav space Bosnia and Kosovo became two quasi protectorates of the EU. During the first decade of the 21st century in no single case environmental reasons triggered a major violent conflict in the Mediterranean region.

The paper by the High Representative and the European Commission to the European Council of 14 March 2008 on *Climate Change and International Security* noted on the Middle East that water systems "are already under intense stress" and that "roughly two-thirds of the Arab world depends on sources outside their borders for water" (EU 2008). The report argues that "existing tensions over access to water are almost certain to intensify in this region leading to further political instability with detrimental implications for Europe's energy security and other interests". Due to the projected decline in water supply "a significant drop in crop yields is projected", especially for "Turkey, Iraq, Syria and Saudi Arabia and thus affect stability in a vitally strategic region for Europe" (EU 2008).

In its *Report on the Implementation of the European Security Strategy – Providing Security in a Changing World* the European Council (11 December 2008) referred to the previous report that claimed "climate change is a 'threat multiplier'", and it stated that "natural disasters, environmental degradation and competition for resources exacerbate conflict, ... with humanitarian, health, political and security consequences, including greater migration". The EU report stated that the Mediterranean

> still poses complex challenges, such as insufficient political reform and illegal migration. ... The ENP has reinforced reforms originally started under the Barcelona process in 1995, but regional conflict, combined with rising radicalism, continues to sow instability. The EU has been central to efforts towards a settlement in the Middle East ... In Lebanon, Member States provide the backbone of the UNIFIL peacekeeping mission (EU 2008a).

A scoping paper on "Regional Security Implications of Climate Change" in a synopsis of the policy-focused reports offered this assessment on the MENA region (Maas/Tänzler 2009: 4) pointing to "water and food scarcity, resulting in decreasing employment opportunities and potential economic downturns". This report argued that "climate change is likely to worsen divisions, particularly those running along social divisions and unequal wealth distribution and resource access". Further, "sudden food shortages may trigger violent riots and – if left unaddressed – could destabilize states and increase public support for extremist groups offering viable alternatives". They point to security implications of climate change: "when the combination of converging climate and socio-economic trends will reach critical thresholds, catalysing processes that lead to state fragility" that may lead to future food riots:

> The global food crisis in 2008 witnessed riots in the Maghreb region. With agricultural production likely to decrease in the region, dependency on food imports will increase and the impact of price hikes will be felt more drastically. In the future, riots could increase in size and scope. Popular discontent could be channelled by extremist groups, which in turn could result in further repressive actions by governments.

The Middle East has been one of the most conflict-prone regions due to the unresolved Israeli-Palestinian conflict and the crises in Iraq, over the Iranian nuclear programme and with the 30 years war in Afghanistan. Water scarcity will rise due to population growth and climate change and may intensify local water conflicts. During the Israeli-Palestinian peace process of the 1990's the water question has remained unresolved (Shuval/Dweik 2007; see chap. 21 by Hayek/Al Hmond; chap. 22 by Haddad; chap. 23 by Salem; chap. 24 by Issar). So far technical efforts on joint water management had no spillover on peace building (Jägerskop 2009; Selby 2009).

26.6.2 Discussion of Four Conflict Scenarios

In its report on *Climate Change as a Security Risk*, the German Advisory Council on Global Change (WBGU 2008) argued that if states fail to act early and proactively climate change may trigger "numerous conflicts between and within countries over the distribution of resources, especially water and land, over the management of migration, or over compensation payments between the countries mainly responsible for climate change and those countries most affected by its destructive effects". The report argued that "climate changes amplifies mechanisms which lead to insecurity and violence" affecting specifically countries in transition, those with weak governance structures, and poor countries affected by resource scarcity (land, water, food) and often with high population growth. These local or national conflicts may spill over and

destabilize neighbouring countries "through refugee flows, arms trafficking or combatant withdrawal". The social impacts of climate change can thus transcend borders and expand "the geographical extent of crisis and conflict regions".[24]

To address the possible linkages between climate change and conflict, the WBGU identified "four conflict constellations in which critical developments can be anticipated as a result of climate change and which may occur with similar characteristics in different regions of the world". These 'conflict constellations' were "defined as typical causal linkages at the interface of environment and society, whose dynamic can lead to social destabilization and, in the end, to violence". All four are relevant for the Mediterranean and the MENA region, the WBGU referred to as one of the major 'environmental hotspots'.

26.6.2.1 Conflict Constellation 1: Climate-induced Degradation of Water

The MENA region is already a region with high water scarcity and severe droughts. Due to the projected population growth and the precipitation decline, the access to safe drinking water and to green water for agriculture will decline. "This dynamic", the WBGU argues "triggers distributional conflicts and poses major challenges to water management systems in the countries concerned". Both in the MENA region and in the Nile River Basin "the countries which will suffer the greatest water stress are generally those which already lack the political and institutional framework necessary for the adaptation of water and crisis management systems. This could overstretch existing conflict resolution mechanisms, ultimately leading to destabilization and violence".

Due to the 95 per cent dependence of Egypt on the water of the Nile, the future division of its water can be a cause of survival and conflict for Egypt and the Nile riparian countries (Adly/Ahmed 2009; Kameri-Mbote/Kindiki 2009). For the Eastern Mediterranean the following conflicts on the access, control and distribution of water resources exist that have repeatedly resulted in political conflicts but in no 'water war':

- The Turkish GAP project has repeatedly resulted in conflicts with Syria and Iraq (Scheumann 2003: Aydin/Ereker 2009; Kapur/Kapur/Akca/Eswaran/Aydin 2009);
- The conflict between Israel and its neighbours on the water of the Jordan is not resolved (Dombrowsky 2003; Shuvall/Dweik 2007; Hayek 2009; Selby 2009; Jägerskog 2009; Newman 2009; Dajani 2009);
- The conflict between Israel and Syria on the control of the water resources of the occupied Golan Heights and between Israel and Lebanon on the Litany River is unresolved;
- The question of the access to the ground of the common aquifer water between Israel and the Palestinian Authority is still to be solved (chap. 24 by Issar and chap. 23 by Salem).

These interrelated water questions require a political solution of the Middle East conflict. The question of the drinking water may be solved as part of a comprehensive multilateral cooperation strategy and by new technologies, e.g. by using solar energy for the desalination of brackish and sea water. However, the massive desalination of sea water for agricultural purposes, especially for food production, may not yet be cost-effective. Thus, exporting surplus solar energy to Europe and importing cereals as virtual water may be more efficient in the near and medium future (Brauch 1994, 1997, 2000, 2000a, 2007, 2007a, 2010).

26.6.2.2 Conflict Constellation 2: Climate-induced Decline in Food Production

The second conflict constellation of a 'Climate-induced Decline in Food Production' is most pertinent for the MENA region, where the self-sufficiency rate in food and especially cereals has been declining rapidly since the 1960's and it is projected by the FAO to drop rapidly until 2030 and 2050 due to population growth and the physical effects of climate change. Climate change and bio-energy development will affect food security in its "four dimensions – availability, accessibility, stability and utilization". Globally, with a global warming of 2–4°C, a drop in agricultural productivity is anticipated worldwide WBGU 2008: 94–95).

> This trend will be substantially reinforced by desertification, soil salinization or water scarcity. In ... North Africa ..., the areas suitable for agriculture are already largely exploited. This may well trigger regional food crises and further undermine the economic performance of weak and unstable states, thereby encouraging

24 WBGU press release: "Report 'Climate Change as a Security Risk' - Climate change threatens international stability and security", Berlin, 6 June 2007; at: <http://www.wbgu.de/wbgu_jg2007_presse_engl.html>. The full report is for download at: <http://www.wbgu.de/wbgu_jg2007_engl.pdf>.

> or exacerbating destabilization, the collapse of social systems, and violent conflicts (WBGU 2008: 2).

This situation will become even more dramatic in the 10 countries in the Nile River Basin that are already severely affected by a vicious circle of repeated droughts, hunger and famine and that connect the militarily strong downstream country Egypt with the less powerful upstream countries which are already seriously affected (Brauch 2002, 2007f).

In the MENA the self-sufficiency rate with cereals has continuously declined since the 1950's due to the high population growth, the increase in meat consumption per person and due to observed climate change impacts, according to FAO projections the demand for imports of cereals will increase significantly until 2030 (FAO 2003). In these hyper-, semi- and arid regions of the MENA (chap. 50 by Galil) it will be impossible with traditional means to produce the food needed for its growing population. New methods for the economic use of the drylands are needed to enhance soil, water and food security (chap. 54 by García Lorca; chap 48 by Safriel; Brauch/Oswald Spring 2009; Brauch 2010).

26.6.2.3 Conflict Constellation 3: Climate-induced Increase in Drought and Flood

This third conflict constellation has also severely affected the Mediterranean region that has been confronted with drought throughout history. When the precipitation comes in autumn, it often comes in intensive flash floods causing a high number of casualties, affecting people and producing economic damages in many MENA countries due to the higher degree of social vulnerability (Brauch 2003, 2003a, 2010; chap. 90 by Quiñonero-Rubio/López-Bermúdez/Alonso-Sarría/Gomariz-Castillo). Both on the global and regional Mediterranean level an increase of the number and intensity of natural hazards has been projected that may affect "many cities and industrial regions in coastal zones". However, in the Mediterranean these extreme weather events may be less likely to become a direct trigger of violent conflicts.

For millenia, the MENA region has been vulnerable to severe and repeated droughts that were often instrumental for the collapse of civilizations (in Egypt, Mesopotamia, Asia Minor) and for triggering a massive movement of people. Very intensive flash floods have also hit many countries in the Western and Eastern Mediterranean and have caused human fatalities and economic damage. But due to the different level of social vulnerability and resilience the human death toll was much higher in the MENA countries than in South Europe.

26.6.2.4 Conflict Constellation 4: Climate-induced Increase in Migration

Migration from the MENA region to the European Union has already become a major issue of domestic or internal security and of the intergovernmental policy coordination on justice and home affairs. In some cases, massive environmentally-induced migration has increased

> the likelihood of conflict in transit and target regions. It can be assumed that the number of environmental migrants will substantially rise in future due to the impacts of climate change. ... The increase in drought, soil degradation and growing water scarcity in combination with high population growth, unstable institutions, poverty or a high level of dependency on agriculture means that there is a particularly significant risk of environmental migration occurring and increasing in scale (WBGU 2008: 3).

Transboundary environmental migration prevails as south-south migration, but Europe will face increased migratory pressure from Africa, West and South Asia most at risk from climate change. Figure 26.3 shows the present main migration roots between and via the MENA countries to the European Union.

Throughout history massive peoples' movements have occurred as a result of the natural variability of the climate primarily in cold periods (in climate pessima), e.g. in Europe between the fifth and eighth century AD. Even though the environmentally forced migration cannot be quantified it has become a reality that will become more urgent due to climate change, water scarcity, degradation and stress as well as due to soil degradation, desertification and drought. Elsewhere, this author has distinguished between five migration scenarios in the framework of the environmental dimension of human security and five on the environmental dimension of national security (Brauch 2007f).

The EU paper on "Climate Change and International Security" (2008) referred ten times to environmentally- and climate-induced migration issues that may pose security dangers. It claimed that "desertification could trigger a vicious circle of degradation, migration and conflicts over territory and borders that threatens the political stability of countries and regions". It listed 'environmentally-induced migration' among the seven security threats posed by climate change:

Box 26.1: Documents adopted by the EU on climate change and security (March 2008-November 2009). **Source**: European Commission: "Joint progress report and follow-up recommendations on climate change and international security (CCIS) to the Council" (25 November 2009); at: <http://register.consilium.europa.eu/pdf/en/ 09/st16/st16645.en09.pdf>.

- "Climate Change and Security: Recommendations of the High Representative on follow-up to the High Representative and Commission report on Climate Change and International Security", S412/08, 18 December 2008.
- "Community approach on the prevention of natural and man-made disasters. Communication from the Commission to the European Parliament and the Council", COM(2009)218, 23 February 2009
- "Reinforcing the Union Disaster response capacity. Communication from the Commission to the European Parliament and the Council", COM(2009)219, 23 February 2009
- "EU Strategy for supporting Disaster Risk Reduction in Developing Countries. Communication from the Commission to the Council and the European Parliament", COM(2009) 84 Final, 23 February 2009.
- "White paper - Adapting to climate change: towards a European framework for action" April 2009 (European Council, 16645/09, 25 November 2009).

Since 2008, the European Commission and its member states commissioned various studies and held many consultations that are documented in the joint progress report of 25 November 2009.

> Those parts of the populations that already suffer from poor health conditions, unemployment or social exclusion are rendered more vulnerable to the effects of climate change, which could amplify or trigger migration within and between countries. The UN predicts that there will be millions of 'environmental' migrants by 2020 with climate change as one of the major drivers of this phenomenon. Some countries that are extremely vulnerable to climate change are already calling for international recognition of such environmentally-induced migration. Such migration may increase conflicts in transit and destination areas. Europe must expect substantially increased migratory pressure (EU 2008: page)

In the framework of the EU's multilateral leadership to promote global climate security, the EU paper suggested among the three key actions to "consider environmentally-triggered additional migratory stress in the further development of a comprehensive European migration policy, in liaison with all relevant international bodies" (Raleigh/Jordan/Salehyan 2008).

26.7 Security Challenges Posed by Global Climate Change

These four conflict constellations indicate causal pathways that the projected physical effects of climate change in the Mediterranean and specifically in the MENA countries may pose severe security dangers and concerns during this century. However, it is impossible to predict if and when they will result in violent conflicts or whether they can be avoided by proactive and cooperative policy decisions within this region. The likely increase in human insecurity does not necessarily pose national and international security problems. In extraordinary cases they result in conflicts over scarce water, fertile soils and access to affordable food that may under certain conditions and in some cases escalate to violence.

26.7.1 Impacts of Climate Change for Mediterranean Security

In its implementation paper (EU 2008a) of the *European Security Strategy* (EU 2003) the 27 countries of the European Council concluded that "natural disasters, environmental degradation and competition for resources exacerbate conflict, especially in situations of poverty and population growth, with humanitarian, health, political and security consequences, including greater migration". The European Council noted that "climate change can also lead to disputes over trade routes, maritime zones and resources previously inaccessible". In the "Joint progress report and follow-up recommendations on *climate change and international security* (CCIS) to the Council" (25 November 2009) it was acknowledged that "CCIS has become a standard item on the agenda of third party meetings in the Mediterranean and Middle East Region at all levels and in a variety of bi- and multilateral formats". Since 14 March 2008 (S113/08), the European Union bodies adopted various documents on the linkage between climate change and international security that are relevant for the Mediterranean and the MENA regions (box 26.1).

However, these concerns have not yet been mainstreamed into the eight priority projects of the Union of the Mediterranean. During the third Euro-Mediter-

ranean ministerial conference on the environment on 20 November 2006, its Cairo Declaration only once referred to climate change welcoming an EU initiative for a "Communication establishing an environment strategy for the Mediterranean that outlines the approach of the European Commission regarding its environmental cooperation in the region for the coming years across a range of sectors such as climate change, desertification and biodiversity". Among the key pillars of the EU's environmental policy for the Mediterranean in the framework of activities of Horizon 2020 among its four key priorities: a) projects to reduce the most significant pollution sources; b) capacity-building measures to help neighbouring countries create national environmental administrations; c) using the Commission's research budget to develop and share knowledge of environmental issues; and d) developing indicators to monitor the success of Horizon 2020, climate change has not been specifically emphasized. The timetable of Horizon 2020 for the first phase (2007–2013) does not even once refer to climate change.

The Communication from the Commission to the Council and the European Parliament - Establishing an Environment Strategy for the Mediterranean (SEC(2006)1082/*COM/2006/0475 final) of 2006 only once referred to climate change in the framework of ongoing and completed research under the 5th and 6th Research Framework Programmes "addressing water issues under the EU Water Initiative's Mediterranean component and those covering accidental marine pollution, marine and coastal research and climate change impacts". Furthermore, "global environmental threats such as climate change and biodiversity loss" are identified in this Communication within a thematic programme for sustainable management of natural resources.

A literature synopsis for the DG External Relations on regional security implications of climate change (Maas/Tänzler 2009: 4) reviewed recent reports on the six target regions mentioned in the Commission Report, of which the MENA region is of special interest:

> In the Middle East and North Africa, climate change impacts will converge with socio-economic processes leading to water and food scarcity, resulting in decreasing employment opportunities and potential economic downturns. ... Climate change is likely to worsen divisions, particularly those running along social divisions and unequal wealth distribution and resource access. Crisis events such as sudden food shortages may trigger violent riots and – if left unaddressed – could destabilize states and increase public support for extremist groups offering viable alternatives. Given the geopolitical currents in MENA, this could have global repercussions.

This synopsis argued that "the two major sources of wealth, income and employment in the MENA region, oil and agriculture, will diminish", and that "climate change will likely decrease agricultural output due to heat stress and reduced available water". The unresolved water disputes and the high sensitivity to food price hikes resulted in violent conflicts in North Africa since the 1970's and most recently in 2008. While climate change impacts in the Mediterranean have been so far no major concern of EU environment policy, especially in the framework of the EMP and the UfM, the discussion on the security implications of climate change pertaining to the Euro-Mediterranean region have increasingly become a concern for the DG on External Relations that launched the EU roadmap process on the security impacts of climate change.

26.7.2 Assessment of Security Impacts from Different Security Perspectives

Besides migration, the physical and societal effects of climate change may pose many other security dangers for the Mediterranean region. These may be analysed from the perspective of international and Mediterranean security in the framework of the UfM, of the national security of riparian Mediterranean countries with regard to source, transition and host countries as well as for the affected human beings (human security). Last but not least, the above physical effects and their impacts on human systems produce also various environmental security impacts for the region, the states and the peoples.

So far water scarcity and degradation have not been the sole cause of any violent international conflict within the Mediterranean space and in the MENA region. It is unlikely that in the foreseeable future climate change will become the only cause of any war. Thus, the dramatizing references to water or climate wars have been misleading. Rather, climate change may become a 'threat multiplier' (EU 2008; UNSG 2009) that may intensify already existing conflicts in the four conflict clusters and within the conflict constellations referred to above.

However, climate change poses very severe security threats, challenges as well as many vulnerabilities and risks for coastal and delta regions, especially for Egypt where the homes and livelihoods of millions of people living in the Nile Delta will be threatened (chap. 45 by El Raey). The Nile is the key to Egypt's

survival. Any plans by the nine other riparian states to use more water of the Nile provoked nervous Egyptian reactions. Since the 1990's the *Nile Basin Initiative* (NBI) has become a focal point of regional cooperation on water issues among the 10 Nile countries. Until 2050, in the ten Nile countries population has been projected to increase from 280.8 million in 2000 by 575 million to 855.6 million by 2050 (UNPD 2001). Thus, the competition for water and the struggle for survival for millions of people will increase (Adly/Ahmed 2009: 643).

Thus Egypt will be confronted with severe human catastrophes that may be foreseen for the upstream Nile countries. Whether the severe challenges for distributing the water can be resolved peacefully, as the NBI aims at, whether in addition to the existing civil wars along the ethnic divide new types of conflicts, such as environmental conflicts or clashes with migrants fighting for their own survival may be added, cannot be predicted. However, these structural factors are distressing and conflict-prone constellations on the North-South axis may not be avoided. Whether the NBI can mitigate these trends will partly depend on the willingness of both donor and recipient countries to implement the needed strategy for survival. Migration from upstream Nile countries in Sub-Saharan Africa into Egypt will increase within the next decades. Thus, migration from Egypt to Europe may become a problem in the 21st century, especially due to the efforts of Sub-Saharan Africans to migrate first to Egypt and then from there to EU countries.

None of these challenges are of a military nature and none can be solved by military means or military forces. These non-military challenges posed by the struggle for survival of distress migrants at the individual, family or clan level will require short-term catastrophe relief (food aid, water supply, etc.) and in the long-term complex and interrelated counterstrategies of climate change and reproductive health. The best long-term mitigation efforts for all industrialized countries will be effective strategies of reducing GHG emissions, and to assist the countries that will be hit most but that lack the means for mitigating climate change impacts. This requires, development strategies that address the causes that may lead to the catastrophic projections.

The UN Secretary-General (UNSG 2009) noted that climate change will have many negative economic impacts. The most obvious trends are: the demand for the scarce water, soil and food will grow rapidly while the supply will decline due to climate change and its impact on declining crop yields. The water and food scarcity can be overcome by 'virtual water' or food imports that will impact negatively on the balance of payments of MENA countries.

Rising food prices directly affect the poor people in the MENA countries that are spending a large proportion of their earnings on purchasing food and water for drinking. Repeatedly droughts and increases of the global food commodity prices have resulted in mass protests and in some cases in food riots in several MENA countries to which the governments responded either by increasing the subsidies to maintain supply at stable prices or by repressing these protests by force which has resulted in several cases in human casualties.

Climate change will also pose manifold threats to environmental and human security by directly threatening the livelihood of human beings and thus also affecting their human security (chap. 2 by Brauch). Two major alternatives exist for a policy response: a) to postpone decisions and to wait until this challenge will become most urgent or b) to anticipate these challenges and to act proactively with the goal to reduce both the projected human victims and economic damages, what will be more cost effective (Stern 2006, 2009).

26.8 Proactive Policies for Coping with Climate Impacts

Both the EU and the UN debate on climate change impacts for security has followed the latter track, calling for early action to minimize the projected impacts by multilateral cooperation. Also the joint British and German approach on the linkages between climate change and security has pursued a proactive approach. However, preventive security considerations require complex transformation strategies that will offer the people in the hyper-, semi- and arid regions who face water stress, soil erosion, desertification and drought a perspective for survival in the drylands to counter the environmentally-induced pressure for migration.

One of several possible transformation strategies addresses the widely unused technical solar energy potential in the countries in the sunbelt of the MENA region. Plans for the exploitation of solar thermal electricity generation in the desert region are just being developed (e.g. the DESERTEC Industrial Initiative)[25] and within one or two decades an economy of scale

25 See for details at: <http://www.desertec.org/en/news>.

may be gradually developing (Trieb/Krewitt/May 2009). The large-scale use of concentrated solar photovoltaic power generation may offer another medium-term alternative (Faiman 2009). Once such an 'economy of scale' has been achieved, solar desalination plants may use either energy source thus avoiding the rising costs of oil and gas and the proliferation danger associated with the transfer of technologies for the peaceful use of nuclear energy.

The use of alternative and renewable energy sources may create new livelihoods and sources of income for millions of people living in drylands (chap. 47 by Brauch/Oswald Spring and chap 48 by Safriel) and thus create a new basis for human, social and economic but possibly also for national and international security. It may somewhat relieve the pressure on the access and control over the fossil sources of energy and provide the states with alternative sources of revenue, also for those fossil energy exporters whose reserves will be depleted within the next few decades.

In the long run (e.g. by 2020–2050) a common and joint strategy will be needed that offers for these countries new economic perspectives, e.g. as an exporter of energy based on renewable energies, such as fuel cells, hydrogen from solar energy. However, such a vision requires already now a scientific and technical cooperation in the energy sector, in manufacturing and in the area of electric engineering (Brauch 2010). Thus, a longer-term oriented cooperative and strategic rethinking is needed beyond declaratory and symbolic policies and the schemes offered by the neo-liberal concepts of globalization. The latter schemes may intensify the pressure to migrate from the South and increase the costs for the European Union to cope with its consequences. Thus, in the 21st century the migration issue will remain both a major cause of action for the European Union and its intensity an indicator of the success or failure of a cooperative problem solution.

26.8.1 Launching a Mediterranean Environmental and Human Security Initiative (MEH-SEC) in the UfM Framework

Within the Union for the Mediterranean or the OSCE a new *Mediterranean Human and Environmental Security Initiative* (MEH-SEC) could be launched to address the manifold challenges posed by global environmental and climate change for the security in the Euro-Mediterranean region. This MEH-SEC Initiative may combine the regional soft security approach of the Barcelona process and of the Union for the Mediterranean with ideas of the "human security doctrine for the European Union" (2004) and the environmental security approach of the *Madrid Declaration on Environment and Security* of the OSCE (2007).

According to the *Intergovernmental Panel of Climate Change* (IPCC 2007) the Mediterranean will be affected most by global climate change getting hotter and drier. The policy messages of the Scientific Climate Conference of Copenhagen in March 2009 were even more dramatic that the "climate system is already moving beyond the patterns of natural variability" and "temperature rises above 2 °C will be very difficult ... to cope with, and will increase the level of climate disruption through the rest of the century". A sea-level rise of 1 metre during this century puts Mediterranean coastal zones and millions of people living in deltas at risk.

The Mediterranean is already severely affected by climate change, water stress, desertification and land degradation. The number and intensity of droughts, forest fires, storms and flash floods has increased in Spain, Greece, Turkey and in many MENA states. The trends of projected climate change impacts, hydro-meteorological hazards and their effects on declining crop yields and food supply in the MENA pose challenges for international, regional, national and human security. The European Council has acknowledged that climate change will severely affect the Middle East.

In December 2008, the European Council adopted a report on the implementation of the *European Security Strategy* of 2003 noting that "natural disasters, environmental degradation and competition for resources exacerbate conflict, especially in situations of poverty and population growth, with humanitarian, health, political and security consequences, including greater migration". The EU stressed that "we have enhanced our conflict prevention and crisis management, but need to improve analysis and early warning capabilities".

At the Paris Summit of 13 July 2008 that launched the Union for the Mediterranean the states shared "the conviction that this initiative can play an important role in addressing ... climate change and desertification, with the view of promoting sustainable development". The representatives of the 43 participating governments stressed: "the importance of strengthening food security, especially taking into account the consequences of climate change on food crops". They adopted, among others, two policy initiatives on civil protection dealing with both geophysical and man-

made natural disasters and launched the Mediterranean Solar Plan.

The Marseille Meeting of the Euro-Mediterranean Ministers of Foreign Affairs in November 2008 agreed that "climate change could adversely affect the environment and human activities in the Mediterranean". The ministers "recalled the need to intensify co-operation on climate change through the establishment of a Euro-Mediterranean Climate Change Network to provide the forum for the sharing of information and experience ... to build relationships ... in support of regional efforts to combat climate change". The Horizon 2020 Steering Group addresses "questions of mitigation/adaptation to climate change, biodiversity protection and conservation of the Mediterranean seabed". But these policy declarations lack a sense of urgency.

Since the 1990's, migration across the Mediterranean was for many European partners a 'hidden' driver for the Barcelona process and it has remained so for the new Union for the Mediterranean. But many reactive policy measures could neither turn the tide nor did they address the root causes why millions of people are on the move. There is a need for a proactive securitization of climate change in the Mediterranean in terms of international, national, environmental and human security. This security threat has been posed by human energy consumption since the Industrial Revolution, especially since the 1950's.

The solutions for achieving climate, water and soil security in the 21st century are not offered by the military but by the ingenuity of scientists and the willingness of political elites to establish policy frameworks for a proactive coping with the projected climate change impacts, thus avoiding potential violent conflicts. The Mediterranean is a fault line of political, economic, societal and environmental insecurity that pushes or pulls hundreds of thousands of distress migrants to Europe. A more ambitious, forward looking strategy for an economic co-development across the Mediterranean is needed in the framework of a 'survival pact' (26.8.6) that requires a long-term strategy of political and economic cooperation on commodities that are crucial for human and economic survival. Thus, a North-South strategy of confidence and partnership-building measures and projects is needed to achieve this longer-term goal.

Such a long-term initiative requires a sense of urgency on the mind of policy-makers. This idea requires a strategy that is delinked from the Middle East conflict. A policy framework for promoting such a long-term strategy could be a new *Mediterranean Environmental and Human Security Initiative* (MEH-SEC), modelled after the ENVSEC initiative of OSCE, UNDP, UNEP, with NATO as an observer, for Central Asia, the Caucasus and the Balkans. This MEH-SEC initiative should include besides the OSCE, UNDP, UNEP, FAO, WMO, IPCC also the Secretariat of the UfM to avoid policy competition and guarantee funding.

Within the framework of this MEH-SEC initiative all relevant conceptual activities of the different DGs of the European Commission and the Council dealing with the Mediterranean region and addressing human and environmental security dangers and concerns should be horizontally coordinated with a clear policy goal to develop an integrated strategy for addressing the security implications of regional climate change, desertification and water stress as well as the direct humanitarian effects due to increased climate related hazards and mutual needs for an uninterrupted supply for food and sustainable energy.

The MEH-SEC Initiative should develop a joint policy agenda that enables proactive policies for coping with *short-term effects* (natural hazards such as drought, heatwaves, forest fires, as well as flash floods), *medium-term impacts* (on precipitation, water stress, desertification, agriculture through declining crop yields, climate induced people's movements) and coping with *long-term consequences* (sea-level rise in deltas and coastal regions) of climate change in the Euro-Mediterranean region by developing joint adaptation and mitigation capacities.

26.8.2 Assessing Climate Change Impacts in the Mediterranean

The first four IPCC assessment reports (1990a, 1995a, 2001, 2007) dealt with climate change impacts only in the context of Africa, Asia and Europe. Therefore, no integrated research assessment exists for the whole Mediterranean region that addresses the huge knowledge gaps for many MENA countries, compared with higher resolution models and more detailed climate change impact studies for Europe as a whole.

In 28 October 2009 the European Union became an observer of the *Intergovernmental Panel on Climate Change* (IPCC) what permits representatives of the European Commission to introduce proposals. After consultation with the 43 member states of the UfM, the *European Commission* may propose a special report of the IPCC's three working groups on assessing:

- The *physical basis of climate change research* for the whole Mediterranean region thus combining South Europe, North Africa and the Middle East;
- The *impacts and vulnerabilities* of different sectors of human activity to climate change;
- The national efforts for adaptation and mitigation against short-, medium- and long-term physical impacts and societal consequences of climate change.

As no similar systematic regional assessment exists for the Mediterranean region, such a report could become an important policy instrument for addressing knowledge gaps, research needs, thus enhancing European research activities and fostering research cooperation with partners from the Euro-Mediterranean region. At the same time it would offer an independent scientific assessment of the outcome of many cooperative research projects on climate change in the Mediterranean. The scope of this independent science assessment should not be limited to the physical effects but should include the research on the societal effects and on the possible security implications during this century.

26.8.3 Environmental and Climate-induced Migration and Developing Alternative Livelihoods for People in Drylands

There are a few research institutes and projects that address migration issues with a regional focus on the Mediterranean but none deals in a systematic way with issues of environmentally- and climate-induced migration within the Euro-Mediterranean region.

Since 2004 Philippe Fargue has directed at the European University Institute in Florence the Euro-Mediterranean *Consortium for Applied Research on International Migration* (CARIM). Its Mediterranean migration reports (2005, 2006–2007, 2008–2009) address the demographic, economic, legal, political and social dimensions of migration but they do not analyse environmental factors that may cause, trigger or affect migration. The *Mediterranean Migration Observatory* (MMO) at Panteion University of Athens focuses primarily on Greece.

Two symposia at Almería (1994, 2006) addressed the linkage between desertification and migration. At the second Almería Symposium (2006) various proposals were made for establishing an international research centre on the linkages between soil erosion, desertification and migration in the Euro-Mediterranean context, for developing alternative livelihoods for people in drylands by using sustainable renewable energies. As desertification and migration had its greatest impact in Spain, it was suggested to set up such a research body in Almería to analyse these linkages in cooperation with the *Plataforma Solar de Almería* (PSA) in Almería, a leading research centre on solar thermal technology development.

The transformation of Almería from a poor province of labour emigration to a region of immigration due to the small-scale plastic agriculture (chap. 54 by Garcia Lorca) could be an ideal location for a Euro-Mediterranean training centre on creating small-scale alternative livelihoods in drylands and for developing knowledge for small-scale solar thermal installations for desalination of brackish and salty water in cooperation with the existing PSA.

26.8.4 Civil Protection in the Euro-Mediterranean Region

At the initiative of Italy civil protection was added as an area of cooperation among disaster response agencies with the goal "to build the Euro-Mediterranean Area for Civil Protection by progressively integrating the Southern partners into the European Civil Protection Mechanism". Civil protection has been made a priority area of the UfM that aims at the *Prevention, Preparedness and Response to Natural and Man-made Disasters Programme* (PPRD) to enhance the collaboration between civil protection institutions in EU member states and Mediterranean Partner countries in the field of training and on the operational level.

Within the European Union, civil protection gradually evolved as a new "functional security" area (Ekengren 2008) among the EU member states that was coordinated by the DG Environment in response to various natural hazards (earthquake in Turkey in 1999; Elbe flood in Germany, 2002; forest fires in Greece and Spain). With the solidarity clause of the Lisbon Treaty, this new task was further upgraded. Various international crises resulted in the creation of new EU agencies, such as the *Centre for Disease Prevention and Control* and the *European Maritime Safety Agency* (EMSA).

Building on present and planned activities and depending on the interest of the partner institutions from MENA countries, the cooperation on civil protection in the Euro-Mediterranean could be gradually expanded to facilitate joint research, capacity-building and training of civil protection officials and practitioners to enhance the monitoring of droughts and the

early warning of impending hydro-meteorological hazards.

Gradually the focus should expand from short-term disaster response, to disaster preparedness and disaster prevention activities with regard to rapid disaster response for rapid onset disasters such as earthquakes, volcano eruptions and tsunamis and hydro-meteorological events (storms, floods, forest fires) and slow onset extreme events (droughts) and long-term changes (sea-level rise). A goal should be to reduce the high social vulnerability of the poorest people in the MENA countries by improved early warning systems and technical and administrative capabilities and capacities that permit a rapid response.

The activities on civil protection may result at a later stage in the establishment of joint training centres in Southern Europe, North Africa and in the Near and Middle East that could benefit from a research centre monitoring droughts, forest fires and sea-level rise based on the most modern methods and the assessment of best practice in rapid disaster response to encourage improvements in the effectiveness of national disaster response forces and to ensure effective cooperation with outside rescue and assistance teams.

To move from disaster preparedness to disaster prevention requires a long-term institutionalization to monitor, analyse and assess in a systematic way the changes in the number and intensity of natural climate-related hazards in the Euro-Mediterranean region. This requires the active involvement of meteorologists, weather experts, agricultural specialists who can advise farmers in their adaptation to drought and landscape and city planners in the development of adaptation and mitigation measures to flash floods, landslides and water and wind erosion of agricultural land.

As the number and intensity of hydro-meteorological hazards in the Euro-Mediterranean region has significantly increased since 1950 and most particularly since 1975 (Brauch 2003, 2003c) and is projected to increase further during this century resulting, e.g. in more frequent heatwaves such as the one of August 2003, this requires a preparedness of the social and medical system of all countries (e.g. doctors, hospitals, etc.).

In moving from disaster response to disaster prevention a wide variety of national and international agencies, humanitarian assistance organizations and the research community would have to be involved in the MENA region. This functional cooperation among practitioners, public officials, assistance teams and experts from many different professions and scientific disciplines may be able to enhance the performance to the benefit of the affected people, reducing social vulnerability and the number of killed and affected, and the economic damage.

26.8.5 Mediterranean Solar Plan and Desertec Industrial Initiative

Several Arab countries in the MENA highly rely on the export of fossil energy sources (oil, gas); while a few other countries have already shifted from oil and gas exporting to importing countries or totally rely on imports of fossil fuels. Due to their geographic location in the sun-belt they have very high solar intensity especially in the deserts. For many decades visionary natural scientists have suggested to use this technical potential for a sustainable energy generation to reduce the emissions from the burning of hydrocarbons (Trieb/Krewitt/May 2009; Faiman 2009; Nitsch/Staiß 1997; Knies/Czisch/Brauch 1999; Brauch 1994, 1997, 1997c, 2000, 2010).

As long as oil and gas were relatively cheap there was no economic incentive for the coastal regions and sun intensive drylands to invest in the development of various renewable energy sources, especially in wind power and in solar (thermal, photovoltaic and solar concentration technologies) energy for the generation of electricity and hydrogen and for the desalination of brackish and seawater for both 'blue' (drinking) and green (agricultural) water.

Since the 1990' senergy system specialists of the DLR in Stuttgart have suggested to supply a part of Germany's electricity demand by importing electricity from solar energy installations from Southern Spain and from the Sahara Desert via long-distance *high-voltage direct currents* (HVDC). These conceptual ideas were developed further in three research projects funded by the German Federal Ministry on the Environment, Nature Protection and Nuclear Safety (Trieb/Krewitt/May 2009).

These conceptual and technical ideas resulted in the *Trans-Mediterranean Renewable Energy Cooperation* (TREC) concept that was endorsed by the Club of Rome under the leadership of HRH Prince Hassan bin Talal (foreword by HRH Prince Hassan bin Talal). Since 2003 the experts involved in the TREC project have developed the DESERTEC concept. On 13 July 2008 with the establishment of the UfM the EU Solar Plan was chosen as one of six key projects and developed further during the meeting of the foreign minis-

ters of the 43 participating countries in November 2008.

For two decades the Spanish research establishment CIEMAT and the energy department of DLR have closely cooperated in the development of solar thermal technologies and since 2006 they are being built in different locations of Andalusia (Seville, Granada). Based on previous activities in the Euro-Mediterranean region,[26] the EU and the *Union for the Mediterranean* (UfM) may create a long-term cooperative framework where the development of sustainable energy sources will aim at achieving simultaneously various policy goals by:

- Reducing the greenhouse gas emissions in the energy and transport sectors by developing first a political framework for a long-term Euro-Mediterranean survival pact that links two essential commodities, a sustainable food and energy production.
- Sharing renewable energy technologies with countries in the EU-MENA region by building centres of excellence but also establishing technical training centres to create a local expertise to install and maintain renewable energy systems thus creating an economy of scale.
- Focusing these activities initially on countries that lack fossil fuels (Morocco, Jordan) or whose reserves are rapidly declining (Tunisia, Egypt) but also increasingly on those countries (e.g. Algeria, Libya) that rely primarily on fossil exports to assist them in the mid- and long-term transformation of their energy system.
- Taking the severe water scarcity in the Nile River Basin into account that will become more severe due to the dual impact of continued high population growth rates and the impacts of climate change.
- Helping Egypt to reduce its high dependence (ca. 95 per cent) on the water resources of the river Nile with the gradual build-up of desalination plants based on renewable energy sources thus reducing one of the causes that may lead to conflict.

Such a sustainable development initiative may not only reduce the probability of violent domestic or regional conflicts on the access and control of water and food but by developing alternative livelihoods for people living in the drylands of the MENA region the environmentally-induced migration pressure may also be reduced. This may also create a political framework within the UfM building on the technical activities within the EU Solar Plan by creating a stable economic and geopolitical environment that facilitates the massive investments foreseen in the framework of the *Desertec Industrial Initiative* (Dii).

26.8.5.1 Mediterranean Solar Plan (MSP)

During the Spanish EU Presidency a MSP Strategy Paper[27] was considered in February 2010 and a conference was held in Valencia on the MSP on 11–12 May 2010 after a meeting by the European Investment Bank on 10 May 2010 on "Energy in the Mediterranean Region: the challenges ahead". [28] The MSP Strategy Paper outlined the goals and referred to two comple-

26 A Strategy Paper on the *Mediterranean Solar Plan* (MSP) <http://ec.europa.eu/energy/international/international_cooperation/doc/2010_02_10_mediterranean_solar_plan_strategy_paper.pdf> listed earlier initiatives on the Euro-Mediterranean energy co-operation contained in the "Priority Action Plan" (2008–2013): "A series of programmes supported by the European Union directly aim at integrating the Maghreb and Mashrek energy markets (e.g. MED-EMIP2, MEDREG3 projects) and at co-operation in the field of energy efficiency and renewable energy (MED-ENEC project 4). These projects also closely collaborate with the *Regional Centre for Renewable Energy and Energy Efficiency* (RCREEE) based in Cairo. Additionally, EU Member States together with UfM Partner Countries support a number of relevant initiatives, such as the *Mediterranean Renewable Energy Centre* (MEDREC) based in Tunis as the focal point of the MEDREP Initiative. Other regional initiatives such as the *Mediterranean Energy Observatory* (OME) or MEDELEC have also provided a very important contribution."

27 See at: <http://ec.europa.eu/energy/international/international_cooperation/doc/2010_02_10_mediterranean_solar_plan_strategy_paper.pdf>.

28 The Spanish EU Presidency held a Conference on the Mediterranean Solar Plan, Valencia, 11–12 May, 2010; at: <http://www.mediterraneansolarplan-conference.es//index.php/idmenu.1034>; and on 10 May 2010, the *European Investment Bank* (EIB) hosted a conference focusing on solutions to the energy challenge being faced by the Mediterranean Region, where the EIB presented new instruments for boosting energy efficiency, discussed how to integrate the Mediterranean's potentially large renewable capacity into the national and international grids, and announced the results of the FEMIP Trust Fund Study on the Mediterranean Solar Plan. See at: <http://www.eib.org/attachments/valence-programme-en.pdf>. However, the Euro-Mediterranean Summit that was planned for 7 June 2010 was postponed on 20 May 2010 to November 2010 to commemorate the 15th anniversary of the Barcelona Process.

mentary targets: "(i) developing 20 GW of new renewable energy production capacities and (ii) achieving significant energy savings around the Mediterranean by 2020, thus addressing both supply and demand". These goals include the transfer of know-how and technology, including activities on education, training, research and developing and local manufacturing capacities in cooperation with the existing institutions, such as *Mediterranean Association of National Energy Agencies* (MEDENER), the *Mediterranean Energy Observatory* (OME), the *Regional Centre for Renewable Energies and Energy Efficiency* (RCREEE) in Cairo and the *Mediterranean Renewable Energy Centre* (MEDREC) in Tunis. The partners of the MSP also aim at creating favourable framework conditions (regulatory framework on investments, for know-how and technology transfer and for electricity transmission). During the preparatory stage (2008–2009) meetings were held on 22 November 2008 in Paris, on 21 October 2008 in Seville and on 28 and 29 October 2008 in Berlin. Among the goals that were considered in spring 2009 in the framework of the EU's Mediterranean Solar Plan are:

- Expansion of renewable energy systems for electricity generation (wind, CSP, PV) and grid infrastructure with a perspective of exporting "green electricity" to Europe;
- Creation of an appropriate framework conditions to secure stable investments and a sustainable development;
- Development of the Master Plan Study and approval of first projects.

In February 2009, a German official[29] listed among the most urgent tasks the development of 1) projects (criteria, next steps); 2) master plan study (terms of reference, responsibilities, realization); 3) discussion about new elements of MSP (on efficiency, infrastructure, technology transfer); and 4) strategy paper (finalizing and distribution). A German technical expert distinguished two phases of the MSP.[30] The work on the *Master Plan Study* started in early 2009 to outline "concrete steps for the development of: a) solar thermal power plants: b) solar photovoltaic, c) other renewable energy installations, d) export of electricity to the EU along with local energy needs, e.g. for water desalination". One key goal is to develop a road map for the implementation of the Mediterranean Solar Plan.

As an outcome of the first ministerial meeting on sustainable development programmes on 25 June 2009 in Paris it was announced to organize: a) technical workshops on environment, transport, energy and sustainable urban development and b) an energy workshop about MSP with participants from 22 UfM member states, the EC and US representatives, plus multilateral and national financial institutions. Furthermore, MSP documents were released and it was announced that the KfW, EIB and AfD earmarked about 5 billion euros for renewable energy and energy efficiency projects for the next 5 years.[31] A conference of experts in November 2009 addressed the obstacles but also the business opportunities due to public-private partnerships.[32]

Based on the Strategy Paper an Action Plan will be set up to launch the first projects during 2010–2011, to improve the framework conditions and to secure and develop adapted financial mechanisms with the World Bank and the EIB. During the second deployment phase (2011–2020) the 20 GW target is to be reached as part of a master plan with a roadmap for implementation to be presented in 2011 that should develop a strategy including these elements:

- Site selection issues and local industrial capabilities and renewable energy market development in the countries of the Mediterranean region;
- Initiatives in the field of solar and other renewable energies for power generation and energy efficiency in the Mediterranean countries and potential synergy measures to make the best possible use

29 Ralf Christmann, Division Research and Development in the Field of Renewable Energies, BMU: *Union for the Mediterranean – Mediterranean Solar Plan*; at: <http://www.erec.org/fileadmin/erec_docs/Events_Documents/EUSEW_MSP_13_Feb_2009/MSP_Ralf_Christmann-panel_2.pdf>. He referred to these governmental tasks: a) keeping the momentum for achieving the goal; b) keeping continuity for the MSP development; c) enhancing active involvement; d) diversifying work and responsibilities; e) bringing transparency into the process and results; and f) ensuring broad backing and acceptance.

30 Karsten Hoyer-Klick, DLR: *Union for the Mediterranean – Mediterranean Solar Plan*; at: <http://www.eurec.be/files/Oldenburg,%2028th%20July%202008/07_Union%20for%20the%20Mediterranean.pdf>.

31 Ralf Christmann, BMU: "Mediterranean Solar Plan – Strategy, Governance and Progress", Paris, 25 June 2009; at: <http://www.ambitalia.org.uk/MSP_conference/Christmann_MSP.pdf>.

32 Manon Malhère: "Mediterranean Solar Plan - Project faces strategic and financial problems", in: *Europolitics*, 20 October 2009; at: <http://www.europolitics.info/sectorial-policies/project-faces-strategic-and-financial-problems-art251878-14.html>.

of existing efforts, notably regarding energy efficiency initiatives;
- Progress of legislative and regulatory reforms, institutional and administrative conditions, as well as other relevant infrastructure and electricity sector issues for a phased development of solar and other renewable technologies in the Southern Mediterranean countries;
- Suitable mechanisms for financing (including appropriate support and import-export schemes, concessional financing and carbon finance and other innovative financing schemes) along with the most cost-effective solutions to ensure active private sector involvement, taking into account results from existing or coming publications, such as the Commission's "Communication on financing low carbon technologies" and the FEMIP study on the economic conditions regarding the Mediterranean Solar Plan contracted by the EIB;
- Address the specific issue of transmission infrastructures to EU countries, taking stock of existing bilateral agreements and the ongoing involvement of transmission system operators, and proposing, in particular, specific electricity grid infrastructure projects that could be of common priority in the Euro-Mediterranean context for establishing an effective green electricity import-export framework and could be addressed in the framework of the *Trans-European Networks* (TEN) initiative;
- Relevant conditions for the improvement of energy efficiency in the most energy intensive sectors such as buildings, household appliances, industry and transport, including financial and economic aspects;
- Identify further needs for technical assistance and capacity-building in the fields of renewable energy production, energy efficiency and technology cooperation and transfer. Synergies with the *International Renewable Energy Agency* IRENA could be suitable for this purpose.

These activities on the governmental level provide a policy framework for activities of economic consortia, such as the DESERTEC Industrial Initiative (Dii), that aim to install thermal energy plants in the Sahara Desert for an estimated cost of €400 billion.

26.8.5.2 DESERTEC: From Vision to Reality

The DESERTEC concept gradually evolved during the past decade within the framework of the Club of Rome and the DESERTEC Foundation[33] stimulated by three research projects funded by the German Environment Ministry (BMU) on *Trans-Mediterranean Renewable Energy Cooperation* (TREC) that aim at:

> the perspective of a sustainable supply of electricity for Europe (EU), the Middle East (ME) and North Africa (NA) up to the year 2050. ... A close cooperation between EU and MENA for market introduction of renewable energy and interconnection of electricity grids by high-voltage direct-current transmission are keys for economic and physical survival of the whole region. ... The challenge of future electricity supply is to find a mix of available technologies and resources that is capable of satisfying not only the criterion of 'power on demand', but all the other criteria for sustainability too.[34]

The DESERTEC Foundation is to contribute to the realization of this concept and it works "for creating a global alliance to ensure security of energy supplies, to promote economic development, and to stabilize the world's climate". The *Desertec Industrial Initiative* (Dii) was launched on 13 July 2009 in Munich with the goal: "to analyse and develop the technical, economic, political, social and ecological framework for carbon-free power generation in the deserts of North Africa". Among its key goals are

> the drafting of concrete business plans and associated financing concepts, and the initiating of industrial preparations for building a large number of networked solar thermal power plants distributed throughout the MENA region. The aim is to produce sufficient power to meet around 15 per cent of Europe's electricity requirements and a substantial portion of the power needs of the producer countries. All of the Dii's activities will be aimed at developing viable investment plans within three years of its establishment. ... Besides the business opportunities for the companies, there are other economic, ecological and social potentials:
>
> - Greater energy security in the EU-MENA countries;
> - Growth and development opportunities for the MENA region as a result of substantial private investment;
> - Safeguarding the future water supply in the MENA countries by utilizing excess energy in seawater desalination plants;

33 On 26 April 2010, there was a leadership change in the DESERTEC Foundation; see at: <http://www. desertec.org/en/press/press-releases/100426-01-leadership-changes-within-the-desertec-foundation/>. Gerhard Knies, the chair of the Supervisory Board became Chairman of the Board of Trustees of the Foundation and was succeeded by Max Schön, an entrepreneur and chair of the German section of the Club of Rome. Ms. Katrin-Susanne Richter and the entrepreneur Thiemo Gropp became Directors of the DESERTEC Foundation.

34 See summary of the DESERTEC project; at: <http://www.desertec.org/en/concept/summary/>.

- Reducing carbon-dioxide emissions and thus making a significant contribution to achieving the climate change targets of the European Union and the German Federal Government.[35]

On 31 October 2009 the Desertec GmbH (limited liability company) was established that plans to cooperate with the MSP and the World Bank's *Clean Technology Fund* (CTF). [36]

Dii has already generated much interest in several MENA countries, including in Morocco, which plans to produce 2,000 megawatts (MW) per year of solar power by 2020; Jordan wants to produce 7 per cent of its energy requirements through renewable sources by 2015; Abu Dhabi 7 per cent by 2020, and Kuwait 5 per cent by 2020. Egypt has announced a goal of 20 per cent renewable power by 2020. Algeria is completing the world's first operational *integrated solar combined cycle* (ISCC) power station with a 150 MW plant at Hassi R'Mel. Egypt's solar thermal installation in Kuraymat that will be completed by the end of 2010 will have a generation capacity of 150 megawatts (MW), with 20 MW coming from the solar array. The project is expected to generate 852 GWh of electricity per year, with solar accounting for 4 per cent of the total. The solar components were supplied by Flagsol from Germany and all construction was undertaken in cooperation with Egyptian construction firm Orascom. With the CSP project Shams, the Abu Dhabi Future Energy Company will concentrate sun rays on a receiver filled with molten salt. Large solar projects are also underway in Saudi Arabia, Kuwait and Tunisia. [37] Besides the deserts of the USA and Mexico, of South America, Southern Africa and Australia, the MENA region offers the best technical potential for CSP (figure 26.4). To achieve the goal of a global 50 per cent reduction of GHG, or up to 80 per cent for most OECD countries by 2050 requires major political initiatives aiming at a 'Fourth Green Revolution' (chap. 95 by Oswald Spring/Brauch) with a major decarbonization and dematerialization of the economy.

In May 2010, both initiatives, the *Mediterranean Solar Plan* (MSP) of the UfM and the Dii of the private sector could become conceptual components of a far more ambitious *EU-MENA Survival Pact* that may link two essential commodities, food or 'virtual water' and sustainable solar energy or 'virtual sun' (Brauch 2002b).

26.8.6 Developing a EU-MENA Survival Pact

The concept of a 'survival pact' outlines an interregional perspective of sustainable co-development by linking these two commodities, where both partners either have a surplus or are in need. Both commodities are indispensable for human survival and for the economy. This proposal suggests an inter-regional framework for a strategy of sustainable co-development for the Mediterranean where the economic gap between North and South has widened. For no other contact region is the complementarity of both commodities as obvious. The growing demand for food (especially for cereals) in the South can be satisfied by importing food as 'virtual water'. In the North, the demand for energy can be satisfied by importing both hydrocarbons (oil and gas) and in the future also renewable sources of energy, e.g. electricity and hydrogen or the 'virtual sun', as part of a mutual sustainable development scheme.

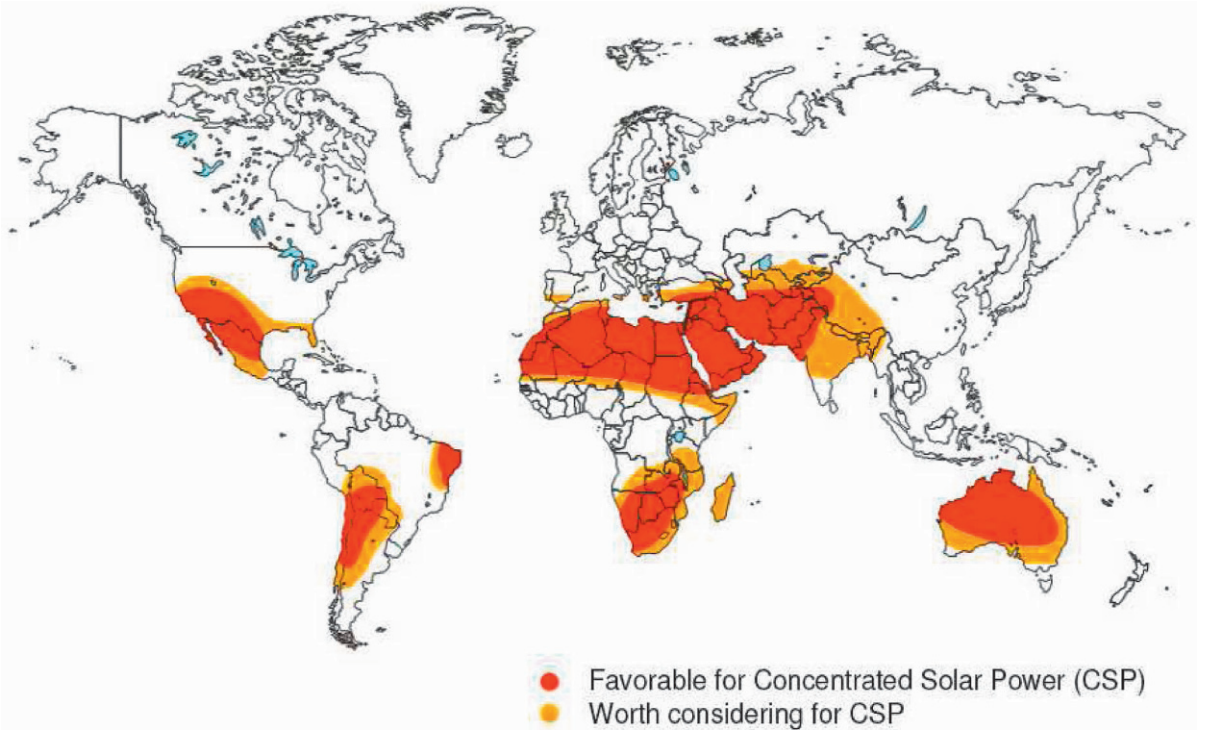
However, this perspective requires a fundamental change in political thinking by overcoming notions of food self-sufficiency (in terms of food security) in the

35 Press release – Munich, 13 July 2009: "12 companies plan establishment of a Desertec Industrial Initiative"; at: <http://www.desertec.org/fileadmin/downloads/press/09-07-13_PM_DII_english.pdf>; 30 October 2009: "Joint venture DII established and ready to take up work"; at: <http://www.desertec.org/en/press/press-releases/091030-01-formation-dii-gmbh/>.

36 The *Desertec Industrial Initiative* (Dii) "is a private-sector initiative" that seeks "all forms of collaboration with leading or complementary international political and institutional initiatives such as the *Mediterranean Solar Plan* (MSP) or the World Bank's *Clean Technology Fund* (CTF) that, like us, are devoted to developing the markets for large-scale sustainable energy production and transmission. See at: <http://www.dii-eumena.com/home/about-us.html>. In late April 2010, 17 companies from eight countries were among the shareholders of Dii: ABB, Abengoa Solar, Cevital, DESERTEC Foundation, Deutsche Bank, Enel Green Power, E.ON, HSH Nordbank, MAN Solar Millennium, Munich Re, M+W Group, NAREVA Holding, Red Eléctrica de España, RWE, Saint-Gobain Solar, SCHOTT Solar and Siemens, and 15 additional companies were associate members: 3M Deutschland; Bilfinger Berger, Commerzbank, Evonik Industries, First Solar, FLABEG, IBM Deutschland, Italgen, AEFER Isoliertechnik, Lahmeyer International, Morgan Stanley Bank AG, Nur Energie, OMV, Schoeller Renewables and TERNA ENERGY. See at: <http://www.dii-eumena.com/media/press-releases.html>.

37 Cam McGrath: "Oil-rich Gulf states look to the sun – Feature", in: *Earth Times*, 27 April 2010; at: <http://www.earthtimes.org/articles/show/320699,oil-rich-gulf-states-look-to-the-sun–feature.html>.

Figure 26.4: The best regions for *Concentrated Solar Power* (CSP). **Source**: Jonathan Walters, World Bank: "MENA Concentrated Solar Power", presentation for the Conference on the Mediterranean Solar Plan, Valencia, 11-12 May 2010; at: <http://www.mediterraneansolarplan-conference.es/uploads/documentos/documentos_onathan_Walters_World_Bank_9769228b.pdf>.



South and for energy supply security in the North. It necessitates a complex interregional interdependence between the agricultural and energy sectors of the EU and of MENA countries. The concept of a 'survival pact' requires a long-term strategy of political and economic cooperation on commodities that are crucial for human and economic survival. No such perspective is realistic without a level of mutual trust and confidence among its partners.

'Virtual sun' is the sun embedded in forms of renewable energy that can satisfy the energy demand (desalination of water) and can be exported to the North as electricity via long-distance cables (from Morocco to Spain and from Tunisia to Italy) and as hydrogen in existing gas pipelines. The MENA countries have a high potential for solar energy both as solar thermal (CSP) and photovoltaic. A major constraint in the North has been the thinking in terms of energy supply security since the oil shocks of the 1970's and 1980's that energy can be used as a weapon to 'strangulate' the economies of the North.

Solar electricity for solar home systems, solar village systems, or as part of hybrid energy systems can satisfy the rapidly growing electricity needs of the MENA countries by using their largest renewable source - the sun. It would thus extend the lifespan of available fossil energy reserves that have been projected to decline during the next 10 to 50 years.

The MEH-SEC Initiative suggested above could offer a political mechanism that involves besides the 43 countries of the UfM also relevant UN institutions (e.g. UNEP, UNDP, WMO). The proposal of a Euro-Mediterranean survival pact offers a long-term strategic perspective to cope with the multiple security implications in a proactive way by outlining a strategy of a long-term economic interdependence by making it impossible that either side could use energy or food as a weapon and by moving jointly towards a sustainable development path.

26.9 Conclusions

This chapter has compiled and summarized the best available scientific knowledge on the physical climate change impacts for the Mediterranean and the *Middle East and North Africa* (MENA) region; it reviewed the evidence on the possible societal impacts forcing people to move (push factors) or following the pull

factors of migration across the Mediterranean from North and Sub-Saharan Africa as well as from West and South Asia to Europe and discussed the high relevance of the WBGU's four conflict constellations for this environmental hotspot. Thus, the impacts of GEC and GCC in the Mediterranean and MENA regions may result in increased human, environmental (Chourou 2009), energy (Selim 2009) and climate (WBGU 2008; Brauch 2010; Issar 2010 and chap. 24; chap. 23 by Salem) as well as national and regional insecurity if business-as-usual policies prevail and proactive political strategies, policies and measures are not undertaken.

The water scarce but energy rich MENA region does not only control the largest oil and gas reserves, it has also the best conditions for the use of concentrated solar power, relying on solar thermal and wind power (Dii) but also on concentrated solar photovoltaic (Faiman 2009). The Mediterranean Solar Plan and the Desertec Industrial Initiative are indications of a political willingness by the 27 EU countries and a consortium of major industrial, energy consuming and renewable energy producing companies from the EU-MENA regions as well as financial institutions that have the economic potential to bring about a 'Fourth Green Revolution' during this century and thus to counter the possible consequences of the increased competition for access to and control of the hydrocarbon resources that may lead to future 'resource wars' (Klare 2001, 2001a) in the MENA region. Shifting from hydrocarbons to renewables in the countries of the sunbelt avoids the proliferation potential associated with the build-up of peaceful nuclear energy that is linked to the Iranian nuclear project.

The Mediterranean Solar Plan and the Dii are two bold schemes that may become catalysts for a major energy transformation in the EU-MENA region that must be embedded in a long-term oriented cooperative strategy for a sustainable peace between Europe and the Arab world based on mutual respect, cooperation relying on trust and common interests. If these complementary visions should gradually be implemented on the ground starting in 2011 they must be combined with determined and closely coordinated European and US efforts to resolve the Middle East conflict that has partly paralysed the Barcelona process since 1995 and that has also created obstacles for the UfM that could be the political framework for the realization of a trans-Mediterranean sustainable economic co-development. Both the MSP and the Dii may also become major 'partnership building projects' (Brauch 2000) linking Europe with the regions of North Africa and the Middle East.

This requires both mutual respect but also confidence and trust among the adherents of the three monotheist religions of Jews, Christians and Muslims. If they should succeed to create a few hundred thousands if not millions of new jobs and alternative livelihoods for the people in the EU-MENA region, especially for the qualified young generation, during this century then these visions – if they lead to new policies on the ground – may also reduce the pressure for forced migration that may be expected from the projected impacts of GEC and GCC.

Thus, the resolution of one of the most persistent conflicts of the past 60 years may be closely linked to efforts to move towards a 'Fourth Green Revolution', by implementing strategies, policies and measures aiming at transitions towards sustainable development (Grin/Rotmanns/Schot 2010) that aim at the longing of humankind for peaceful relations among states and for sustainable or progressive development (Issar 2010, also chap. 24), or for strategies of a sustainable peace (Brauch/Oswald Spring 2009) that conceptually combine both goals. However, for the realization of these bold plans and initiatives, a decoupling from the Middle East conflict is essential to avoid that setbacks continue to paralyse the Euro-Mediterranean cooperation.

27 Global Environmental Change and Conflict Potential in Central Asia

Jenniver Sehring and Ernst Giese

27.1 Introduction

The aim of this chapter is an assessment of the impact of *global environmental change* (GEC) on stability and security in Central Asia. Security thereby is not only understood as the non-appearance of interstate conflicts but also as the ability of states to manage economic and social crises and thereby to prevent violent conflicts and to guarantee human security as defined by the UNDP (WBGU 2007: 19–24) Therefore, in its conceptualization of the link between environment and security, this analysis follows the definition of security and conflicts of the WBGU.[1] The evolving research question is if and how global environmental change might increase security risks in the region – risks of violent conflicts between states, but also risks for the survival of the population leading to destabilization. Before this question is assessed, a review of the current situation regarding conflicts is appropriate.

The conflict potential in Central Asia is grounded in the internal situation of the states as well as in the difficult interstate relations. Internally, the conflict potential is often related to the general situation in the poor, authoritarian, and partly politically unstable states with weak governance structures, Islamic underground groups, and organized crime as well as to the relatively new borders that left considerable minorities of each country in neighbouring states. Here also the huge social differences play a role. Already during Soviet times the republics of Middle Asia as well as the Autonomous Region Xinjiang in China, had been the poorest regions in the respective states. Following independence, a small rich social class evolved which mainly stemmed from the former Soviet *nomenklatura* and controls the political and economic institutions. It maintains its influence through clientele networks. Patronage, nepotism, and corruption are widespread; not only in the political sphere but also in the socio-economic realm where they even determine access to basic resources such as education, health care, or agricultural inputs (Cummings 2002; Heathershaw/Toresjen 2005; Berg 2004). Cooperation between the states is – though announced in numerous agreements and declarations – still a difficult task. In those cases where they have been somewhat successful, as with the *Shanghai Cooperation Organization* (SCO), Russia or China are involved, but there is no successful 'purely Central Asian' cooperation (Seidelmann/Giese 2004; Allison 2004, 2007; Jackson 2007).

Since independence in 1991, several tensions with sometimes violent incidents between ethnic and political groups happened, especially in the following 'hot spots':

- the Fergana Valley, the most densely populated area in Central Asia, divided between Kyrgyzstan, Tajikistan, and Uzbekistan; social protests and ethnic tension erupted in the Eastern part (Namangan and Andizhan, Uzbekistan), Osh (Kyrgyzstan); it is also met by tensions along the new frontiers and by activities of militant Islamic groups.
- A conflict between poor Southern Kyrgyzstan and the Northern part of the country, which is richer and more secularized, together with a penetration of politics with persons connected to organized crime.
- Tajikistan, which experienced a civil war and still is characterized by fragile statehood and strong regional identities.
- The delta area of the Amu Darya where the interests of Uzbekistan and Turkmenistan on water distribution are in conflict (Tashaus, Turkmenistan and Khorezm, Uzbekistan)

1 This article is based on a more detailed background study of the two authors for the WBGU (Giese/Sehring 2006). We thank the WBGU for granting the copyright for the English version.

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Figure 27.1: Central Asia: Hydrographic and political overview. **Source:** The authors compilation.

- General instability in Northern Afghanistan in the border regions to Tajikistan, Uzbekistan, and Turkmenistan;
- Xinjiang, with the Kazakh and Kyrgyz autonomous districts in the upper Ili valley, the city of Kashi and the Western part of the Tarim basin as centres of the Uigurs and the capital Urumchi, which is dominated by Han Chinese (Giese/Sehring/Trouchine 2007).

Where violent incidents occurred, this mostly happened on a local level and was connected to access to key resources such as land and water and rooted in socio-economic disparities. It was hence not only a result of environmental degradation but also of political and economic factors. Will this situation be reinforced by environmental changes due to climate change? Will existing environmental crises such as water scarcity and soil degradation aggravate and lead to conflicts? Will poverty raise and threaten human security? The basis for the following analysis are the data of the 2007 report of the *Intergovernmental Panel on Climate Change* (IPCC 2007) and of own analyses of climate change in Central Asia (Giese/Mossig 2004; Giese/Mossig/Rybski/Bunde 2007).

27.2 General Geographical Conditions

For the purpose of this analysis, Central Asia comprises the area of the five former Soviet republics Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, and Kazakhstan as well as the Autonomous Region of Xinjiang in China (figure 27.1).[2] The region is characterized by mighty mountain ranges and huge basins without outlets. The ranges of Tien Shan, Pamir-Alai, Hindukush, Karakorum, Kunlun, and Altyn-Tagh are broadly above 4000 m and reach peaks up to 7000 m. The extreme difference in elevation is one reason for the frequent occurrence of mass movements (mudslides, landslides, etc) in certain areas of Central Asia, e.g. in the Fergana Valley or the Northern Tien Shan.

The Central Asian mountain complex is the biggest mass elevation world wide. This has two consequences that are climatologically relevant: First, the mainly east-west stretching ranges are a barrier to all south-north or north-south airstreams. It influences thereby precipitation patterns. Secondly, it impacts on

2 This definition is oriented at the former territory of Turkestan. In hydrographic or cultural and historical respect, other framings are possible, e.g. including Northern Afghanistan or Mongolia. See Machatschek (1921); Hambly (1966); Olzscha/Cleinow (1942); Stadelbauer (2004).

temperature (Blüthgen/Weischet 1980: 617; Haffner 1997: 307ff.): It is considered to be one of the main reasons (besides the location in the interior of the Asian continent) for the disproportionally high increase in air temperature in Central Asia.

The big arid inland drainage basins in Central Asia are the Aral Sea Basin, the Ili-Balkhash Basin, the Fergana Basin, the Issyk-kul Basin, Dzhungarian Basin, Turfan-Hami Basin, and Tarim Basin. All rivers from the mountain ranges – the biggest ones are the Amu Darya, Syr Darya, Ili and Tarim – drain in these basins, flowing into lakes without outlet or drying up before. All major rivers are transboundary crossing two or more states (Giese/Sehring/ Trouchine 2004; Kipping 2009; Rakel 2009; Wunderer 2009; Martius/ Froebrich/Nuppenau 2009).

Due to its location inside the Asian continent and its orographic structure, a highly continental climate prevails in the lowlands of the basins that are also extremely arid. Deserts and semi deserts are widespread, covering more than 50 per cent of the basin area. Consequently, only limited land is available for agriculture – in most countries of the region less than 10 per cent of the territory is arable land and even only 1.8 per cent in Xinjiang. More than 90 per cent of these areas are cultivated by irrigated agriculture, which is the prime water consumer.

Precipitation in the lowlands of Central Asia does not exceed annually 150–200 mm (in spring and summer). Precipitation increases – depending on exposure of the mountain range – with an elevation to 400 mm or even 600 mm per year. In the forelands of the mountains, which serve as water accumulator and water dispenser for rivers flowing into the arid basins, agriculture is therefore possible in the foothills and along the rivers.

Climate in Central Asia is not only arid, but also continental. It is not unusual that the annual variation of mean monthly temperature exceeds 25 °C (e.g. Almaty: -5.5 °C in January, +24 °C in July; Kazalinsk: -9.2 °C in January, +27.2 °C in July). Summers are very hot and winters very cold. In winter therefore is a strong need for energy, which cannot be met in parts of Kyrgyzstan and Tajikistan (Giese/Sehring 2007).

Scarcity of natural resources is a general characteristic in Central Asia. The shortage of arable land was already mentioned. Also water, while not scarce physically, appears to be short due to its extensive usage in agriculture, where demand exceeds available resources. One consequence is the well-known disaster of the drying up of the Aral Sea (Giese 1998; Micklin 2006; Sehring 2007, 2009). The scarcity of land and water is significant as agriculture – and especially irrigated agriculture – is an important economic sector, fundamental for the survival of a majority of the population. The following analysis focuses on the conflict potential arising from questions of resource access that might become influenced by the regional impacts of global climate change.

27.3 Impact of Global Environmental Change

27.3.1 Water

The scarcity of freshwater resources is the most pressing current as well as prospective environmental problem. As all major rivers in Central Asia are transboundary and water is a key resource in agriculture, this has enormous conflict potential on the national as well as on the international level. The share of irrigated cropland of the total area under cultivation is about 36 per cent in Northern Afghanistan, 75 per cent in Kyrgyzstan, 84 per cent in Tajikistan, 89 per cent in Uzbekistan, and 100 per cent in Turkmenistan (Ahmad/Wasiq 2004: 18; Bucknell/ Klytchnikova/ Lampietti/Lundell/Scatasta/Thurman 2003: 3).

Agriculture counts for more than 90 per cent of water use in Central Asia. A second usage is hydropower production, which is of increasing importance for the mountain states (Kyrgyzstan and Tajikistan). Since the 1960's, numerous reservoirs have been built in order to enhance the regulation of the rivers and produce hydro power. Examples are the Toktogul reservoir at the Naryn river in Kyrgyzstan, which allows the multi-year regulation of the Syr Darya, and the Nurek reservoir at the Vaksh, which is the main tributary to the Amu Darya. The working regime of hydro power production is opposite to that of the regulation for irrigation of water delivery (water discharge in winter when peak in energy needs vs. water discharge in summer when peak in irrigation water needs). While the downstream states Kazakhstan, Turkmenistan, and Uzbekistan need water especially for irrigated agriculture, the upstream states Kyrgyzstan and Tajikistan are interested in hydropower production (Giese/Sehring 2007).

The spatial distribution of water resources in Central Asia is highly unequal. The major part of renewable surface water is formed in the mountain regions of Tajikistan, Kyrgyzstan, and Afghanistan. In the Aral Sea basin, which covers most part of Central Asia, 43 per cent of annual discharge originates in Tajikistan,

Table 27.1: Water formation and usage in Central Asia. **Source:** Giese/Sehring (2007: 484).

State	Discharge formation			Usage	
	Amu Darya	Syr Darya	Total Aral Sea basin	Amu Darya	Syr Darya
Tajikistan	62,90	2,70	43,40	17,92	9,07
Kyrgyzstan	2,00	74,20	25,10	1,03	0,85
Afghanistan and Iran	27,20	–	18,60	?	–
Uzbekistan	6,00	16,60	9,60	41,76	51,76
Turkmenistan	1,90	-	1,20	39,29	-
Kazakhstan	–	6,50	2,10	–	38,32
Total	100	100	100	100	100,00

24 per cent in Kyrgyzstan, and approximately 19 per cent in Afghanistan. These states use only about 17 per cent of the water, while downstream Kazakhstan, Uzbekistan, and Turkmenistan use 83 per cent. These usage patterns are guaranteed in a quota system that was established in the 1980's by the Soviet Union and is still valid today. China is involved as an upstream state of the Ili (flowing into Kazakhstan) as well as a downstream state of the Tarim (whose main tributary is the Aksu from Kyrgyzstan).

Since the 1960's, the whole region is hit by an increasing scarcity of freshwater and degradation of the quality of drinking as well as irrigation water. The regions at the middle and lower reaches of the big streams are hit hardest: at the Amu Darya (Uzbekistan and Turkmenistan), Syr Darya (Kazakhstan), Ili (Kazakhstan), and Tarim (Xinjiang/PRC). The quantitative and qualitative water problems are mainly anthropogenic. As already mentioned, irrigated agriculture is the main water consumer. Since the 1950's, especially the water-intense cotton cultivation was massively extended. Today, the total irrigated area in the former Soviet parts of Central Asia exceeds 8 mio. ha. Water consumption increased from about 60,000 mio. m^3 in 1960 to almost 105,000 mio. m^3 in 1999. On the Chinese side, the government conducted a similar land reclamation policy in Xinjiang.

Water consumption did not only increase because of the expansion of the irrigated area, but also because of the low degree of efficiency in usage. Experts estimate that the usage coefficient is only about 40–60 per cent. The reasons are inadequate infrastructure (earthern instead of concrete-lined channels with high infiltration rate), open channels with high evaporation rate), mismanagement (outdated irrigation techniques with high water consumption and high evaporation rate on the fields), and salinization of fields due to decade-long cotton monoculture (need for additional irrigation in winter for desalinization).

While infrastructural and management reasons could be solved by technical improvements, also climate change plays a role and makes less water needs in the future unrealistic. According to time series analysis, global warming is stronger in Central Asia than on the global average. While on global average, mean annual temperature increased by 1.8 °C/100 years from 1970/72 to 2000, in Central Asia it increased by 3.1 °C to 4.8 °C/100 years (Giese/Mossig 2004: 33–35). The model calculations of the IPCC (2007) indicate an increase of mean annual temperature in Central Asia by 3.2 °C to 4.1 °C until the end of the 21st century (2.7 °C on average). A consequence is that evaporation rates further increase and hence even more water is needed.

A related long term problem of climate change is the melting of glaciers. Its consequence is the irretrievable loss of the freshwater resources stored in the ice of the glaciers. Since the 1970's, the melting processes became more intense due to the warming (Dikikh 2004: 27–28; Giese/Mossig 2004: 1–4).

Kuzmichenok (2003) developed several scenarios on the future development of the glaciers in the Kyrgyz part of the Tien Shan. Given an increase of summer temperatures by 5 °C/100 years and constant precipitation rates, he projects that by 2050 about 20 per cent of the glaciers, mainly smaller ones, will have disappeared and the total volume of glaciers will be reduced by 32 per cent. The results of Dikikh's (2004) calculations concerning the Kungey- and Terskey-Alatau are similar: Given summer temperature increases in the same pace as in the past 20 years (+1.5 to +2.0 °C), he forecasts a loss in volume of 38 per cent until 2025 for the Northern exposed glaciers and even 73 per cent for those exposed to the South.

In the short and middle term, discharge in the glacier-fed rivers will increase during the summer months. In the long term, however, discharge will decrease and partially the inflow of glacier water will stop completely. And for some rivers, the share of glacier water for the total discharge is immense - so e.g. up to 53 per cent in the rivers of the Terskey- and Kungey-Alatau of the Northern Tien Shan, which flow into the Issyk-kul basin. In summer, the share of glacier water can even reach 69–87 per cent (Dikikh 2004: 37). Micklin (2006: 564) estimates that the flow of the Amu Darya will reduce by 7–10 per cent in the next 50 years. These developments can have disastrous effects in those downstream areas that already today face shortages.

The increasing water scarcity already led to conflicts of interest concerning water usage between the states. The most important conflict constellations are:

- at the Syr Darya and his main tributary Naryn between Kyrgyzstan on the one side and Kazakhstan and Uzbekistan on the other side about water discharge from the Toktogul reservoir in Tajikistan;
- at the Vaksh, one of the main tributaries of the Amu Darya, between Tajikistan on the one side and Uzbekistan and Turkmenistan on the other side about the construction of the Rogun and several other dams;
- at the Amu Darya between Uzbekistan and Turkmenistan because of the Karakum canal, which diverts water from the Amu Darya into Turkmenistan, the usage of the Tuyamuyun reservoir, and the construction of the Golden Century reservoir in Turkmenistan;
- at the Ili between China and Kazakhstan about water usage in China
- at the Sary Dzhas/Aksu, main tributaries of the Tarim, between China and Kyrgyzstan about dam construction plans in Kyrgyzstan (Giese/Sehring/Trouchine 2004).

The question, in how far there is a threat that these conflicts of interests can lead to violent conflicts, has to be assessed differently for each case. It depends highly on the general relationship among the concerned states. As the relationship between Kazakhstan and Kyrgyzstan is quite close, it was possible to come to an agreement concerning the Chuy and Talas rivers, which flow from Kyrgyzstan to Kazakhstan (see: <www.talaschu.org>). Uzbekistan, on the other hand, has tense relations with almost all neighbouring states. Most conflict potential is definitely between Kyrgyzstan and Uzbekistan on the Syr Darya and between Uzbekistan and Tajikistan on the Amu Darya.

The potential of conflicts is hence not rooted in environmental degradation and climate change alone, but in its connection and interaction with economic and political tensions. This is also evident on the local level in rural regions. In all Central Asian countries (besides Kazakhstan) more than half of the population lives in rural areas, where often water and land is scarce compared to usage requests. Water shortage can destroy the harvest and sufficient and timely water supply is hence of crucial importance for the majority of the rural population that depends on subsistence agriculture. Local quarrels on water distribution time and again lead to affrays. Unauthorized water withdrawal is frequent and is not sanctioned by the state - partly because lack of implementation rules and knowledge of these by local courts and water agencies, partly because informal networks protect against sanctioning, partly because officials tolerate the withdrawal (Sehring 2009). Conflicts evolve when environmental degradation and scarcity of resources coincides with unequal access to land and water, demographic pressure, forced migration, economic crisis, or political marginalization.

Due to global environmental change and projected population growth (UN 2007), water shortage will increase in the long term and it therefore can be expected that current problems and conflicts will intensify. Violent conflicts seem to be more likely on the local than on the international level. However, local conflicts in border regions can easily get an international dimension.

The problem-solving capacity is weak as administrative structures in the water sector in all countries are characterized by hierarchical patterns, lack of horizontal coordination, sectoral fragmentation, overlapping competencies, competition among agencies for scarce financial allotments, lack of experience in policy formulation, movement of qualified labour, lack of transparency, accountability, and participation.

Concerning the transboundary water management at the Amu and Syr Darya, in 1992 the *Interstate Commission for Water Coordination* (ICWC) was established. Later it was subordinated to the *International Fund for Saving the Aral Sea* (IFAS). Its task is to control regulation, usage and protection of the water resources and to administer the water distribution among the states. However, decisions of the ICWC and IFAS respectively are often not adequately implemented. Reasons are a lack of competencies and legal base on the side of the ICWC, conflicting interests

and mutual mistrust of the states, and lack of capacities. Additionally, China and Afghanistan are not incorporated in its structure. Furthermore, freshwater disputes do not only involve the Central Asian republics, but also several competing regional powers, namely Russia, China, and Iran, which are involved as investors in dam construction projects (Giese/Sehring 2007). A necessary precondition for successful cooperation, however, is the political will of the elites and the overcoming of the mutual mistrust that characterizes current relations between the Central Asian states.

27.3.2 Sand and Dust Storms

A large part of the basins are covered by sand and salt (*solonchak*) deserts. These lowlands are due to atmospheric circulation and soil conditions especially predestined for the formation of sand and dust storms. The silted areas of dried-up lakes (Aral, Lop-nor) recently accomplished these areas. In the Turanian lowlands around the Aral Sea, such nourishing areas for dust and sand storms are capturing about 70 per cent of the total area (Zolotokrylin 1996: 48). This leads in certain regions of the lowland basins to the appearance of sand and dust storms in spring and early summer (April to June) and dusty winds in winter. Sand and dust storms do not occur area-wide, but are spatially concentrated. The following areas are especially affectted:

1. The eastern and north-eastern Aral Sea region (Kyzyl-Orda province in Kazakhstan);
2. the Southern Aral region (Karakelpakestan in Uzbekistan);
3. the foreland of the Kopet-dag (central Karakum, Turkmenistan);
4. in the Tarim basin the Northern and Southern border areas of the Taklamakan desert as well as the eastern border area, where the two sand deserts Taklamakan and Kuluk threaten to coalesce;
5. the Ebinur-region (Northern Xinjiang).

The reasons for the sand and dust storms in Central Asia are manifold. They are natural (atmospheric circulation, soil condition) as well as anthropogenic. Major factors are the existence of sufficiently big nourishing areas and the occurrence of strong winds. The last 30 to 40 years saw several changes that lead to the probability of a stronger occurrence of sand and dust storms in the future:

1. The climate in the arid lowlands of Central Asia is characterized by an increasing warming and aridization since the 1970's (see above). The consequences are on the one hand an intensification of circulation processes and on the other hand an intensification of evaporation processes, which leads to a further drying of the surface soil. Both promote the formation of sand storms.
2. Simultaneously to the temperature warming, there is a declining trend of annual precipitation in the central lowland basins in Central Asia.
3. Of major significance for the occurrence of sand and dust storms is also the deletion of desert vegetation and of the protective riparian and gallery forests along the rivers. It is partly a result of the land reclamation campaigns that were conducted in the 1950's on the Soviet as well as the Chinese side. It also affects desert shrubs that are important for the fixation of dunes and drifting sands. They are used as fuel by the population and are damaged by game bite. Their loss often leads to sand drifts. The increasing sand drifts since the 1950's affect arable land as well as settlements and infrastructure. An area especially hit by sanding are the middle and lower reaches of the Tarim river in Xinjiang (PRC). At the middle reach, the silted area increased from 917.6 km² in 1960 to 948.3 km² in 1998, this is 7.3 per cent (Song/Fan/Lei 2000: 381). Even stronger is said to be the sanding at the lower reaches. Between Korla and Lop-Nor the silted area is reported to have increased from 12 per cent to 52 per cent of the total area. The meteorological station Yuli at the lower Tarim recorded on average 42 days per year with sand storms in the 1960's, in the 1990's already 110 days per year were registered.
4. A strong impact on sand storms certainly also have the drying-up processes of the huge inland lakes such as the Aral Sea, the Lop-nor or the Kara-bogaz-bay at the Caspian Sea and the drying-up of delta regions of big rivers (Amu Darya, Syr Darya, Tarim, Ili). They led to an increase in nourishing areas for sand and dust storms. Around the Aral Sea the number of sand and dust storms increased from on average on 10 days per year until 1966 to 20 days and in some coastal regions of the Aral Sea even 50 days per year in the mid-1990's (Zolotokrylin 1996). This is especially significant due to the health risks of these storms. Of the Aral Sea alone, more than 54,000 km² of seabed were exposed. This exposed seabed consists of 75 per cent of salt-crust and 35 of sandy sediments

(Opp 2007: 97). The areas without vegetation are now a nourishing area for sand and dust storms. Satellite images show their expansion up to 500 km away from the Aral Sea (Orlovsky/Orlovsky 2001). Similar processes can be observed in other inland lakes and smaller salt pans. The former seabeds are now covered by sand and solonchak deserts, so that the sand storms are infiltrated by salt particles.

Concerning the general question on the conflict potential, sand and dust storms are significant for two reasons:

1. They are highly dangerous to health as they are interspersed with saline particles, so that the population of the affected regions suffers disproportionally highly from respiratory and lung diseases.
2. They cause processes of sanding and sand drifts, so that arable land (which is already scarce in Central Asia) gets lost, infrastructure and settlements are destroyed and droves killed.

Sand and dust storms hence affect human security and may sharpen conflicts on already scarce land resources.

27.3.3 Geo-hazards: Mass Movements

Geo-hazards such as mass movements (land slides, mud and boulder slides, avalanches, etc.) are frequent in Central Asia. Most affected are the mountain regions and the outskirts of the mountains at the Tienshan, especially the forelands of Kyrgyzskii and Zailiyskii Alatau as well as the Fergana valley. In these areas lives a considerable part of the population; also important cities such as Bishkek (800,000 inhabitants) and Almaty (1.5 mio inhabitants) are located there.

The Southern proximity of Almaty are among the most threatened regions worldwide (Schröder/Eidam 2007: 115). In 1921, Almaty was covered by a huge mud and boulder slide from the Zailiyskii Alatau. Similar, though not as strong, slides occurred in 1947, 1950, 1956, 1963, 1973, and 1977. In August 1977, a mud and boulder slide of 6 Mio. m^3 reached Almaty. Again and again mass movements bury villages or part of them, every year people have to be resettled. In 2003, the settlement Kashka-Suu in the Ala Archa valley South of Bishkek was completely destroyed by a mud slide.

Sudden mass movements are in general caused by a concurrence of several factors such as high precipitation and earth quakes. So do frequent land and mudslides in short time as in the Fergana valley only occur when larger masses of loose material in steep locations get oversaturated during snowmelt or during strong summer precipitation and then are shaken by earthquakes (Schröder/Eidam 2007: 115). Central Asia is among the areas of the world most hit by seismic activity and therefore also a region affected by geo-hazards. This is because two tectonic plates, the Indian and the Eurasian one, which drift with high speed (4 cm/year) and force against each other, cause earthquakes which then provoke land and slope slides. That earthquakes provoke mass movements is proven by the fact that the strong mass movements in the Fergana valley mostly occur along tectonic rupture zones (Roessner/Wetzel/Kaufmann/Kornus/Lehner/Reinartz/Mueller 2000; Wetzel/Roessner/Sarnagoev 2000).

The major reason for the instability of slopes is often water. The factor that finally initiates land and mud slides are mainly heavy rainfalls as well as the snowmelt in spring and early summer. They lead to increased soil saturation and undercutting by groundwater. The risen frequency of land slides and avalanches in recent time is related to global warming, due to which heavy rainfalls have increased and snowmelt processes got more intense. But there is also another effect of climate change that fosters especially avalanches: Due to the temperature increase in Central Asia since the 1970's (Giese/Mossig 2004; Giese/Mossig/Rybski/ Bunde 2007), the surface of permafrost soil in altitudes above 3000 metre has melted (Schröder/Eidam 2007: 117). As a result, much of the before frozen material lost its cohesion. Therefore big avalanches are also observed in valleys that were not at risk before, steep hillsides considered save until recently are now perceived as avalanche formation zones (Schröder/Eidam 2007: 118). Given the continuing global warming it can be anticipated that periglacial permafrost soil will further thaw and the occurrence of avalanches will increase.

While since the 1960's protection dams against mass movements have been built, these are not sufficient to protect all settlements at risk, especially not in the 'new' areas of avalanches. The described geo-hazards do not only threaten the human security of the affected population. As was described, it is especially the Fergana valley that is faced with an increase in mass movements (figure 27.2). And this is a region that already is considered to dispose over a high conflict potential with tensions on access to land and water resources (which already incidentally led to violence), dense population, border disputes, Islamic underground movements, and drug trafficking. This is one reason why it is already addressed by many con-

Figure 27.2: Impact of climate change on environmental risks in the Fergana valley, Uzbekistan. **Source:** Viktor Novikov/Philippe Rakacewicz (UNEP/GRID/Arenal 2005); at: <http://maps.grida.no/go/graphic/climate_change_and_natural_disaster_impacts_in_the_ferghana_valley>. Permission has been granted by the copyright holders.

flict prevention programmes (Heathershaw/Torjesen 2005). Natural hazards can destabilize this region easily. Additionally, as the Fergana valley is shared by Kyrgyzstan, Tajikistan, and Uzbekistan, local conflicts quickly get an international dimension.

27.3.4 Salinization

Salinization of land plots is one of the most serious bottlenecks in agricultural production. It dramatically increased during the last decades. In Kyrgyzstan at

least 12 per cent, in Tajikistan 16 per cent, in Kazakhstan 33 per cent, in Uzbekistan 50 per cent, and in Turkmenistan 96 per cent of the irrigated area are affected by salinization (Bucknall/Klytchnikova/Lampietti/Lundell/Scatasta/Thurman 2003: 9). It is also a problem in Xinjiang, where along the Tarim 35–41 per cent of the land plots are salinized (Giese/Mamatkanov/Wang 2005: 28). As a result, irrigated areas have to be abandoned and new land has to be reclaimed.

Reasons for salinization are mainly the irrigation system and irrigation practices. They are often not adapted to the natural conditions (especially to the soil which is often loamy soil with low hydraulic permeability). Furthermore, the high water amounts used for irrigation of rice and cotton are not met by enough capacities of drainage systems, which are sometimes completely missing (Giese 1998: 70ff.; Betke 1998: 139–141; Giese/Mamatkanov/Wang 2005: 28f.). Other reasons are the enormous use of fertilizers that became necessary due to the decade-long monoculture (cotton and rice), which leached out the soils, and the re-usage of irrigation water that is already enriched with residuals of fertilizers, pesticides, and herbicides.

Beside these economic and technical reasons there are also climatic factors. Sand and dust storms transport the salts from the dried-up sea beds and deposit them partly on the fields. Partly the particles in the winds are absorbed by rains and on this way also reach the soils. The salt concentration in the precipitation in the Aral Sea area has risen sixfold alone from 1968/69 to 1979/80 (Murzaev 1991: 28). According to Razakov (Giese 1998: 69), in the oases of the lower Amu Darya each year 240 kg dry and 180 kg liquid salts per ha precipitate. A big part of these salts are sulphates and chlorides that are especially harmful for plant growth. If the frequency and intensity of salt and dust storms increase with global change, increased salinization can be expected leading to the loss of arable land. Arable land is already scarce. If land availability further decreases, it might lead to instability especially in poor and densely populated rural regions such as the Fergana valley. Here conflicts about land access questions already occurred in the early 1990's and are interrelated with political instability. But also in other regions the conflict potential is high.

27.4 General Assessment of Conflict Potential due to Global Change

While oil and gas resources in the region are economically important, for a majority of the population living on subsistence agriculture, water and land are key resources. Both are not only scarce compared to demand, but also distributed spatially unevenly. And these are the two resources that are most affected by global environmental change: water as well as land resources will get scarcer due to increasing evaporation, salinization as well as damage by sand and dust storms.

This situation already led to tensions on the local as well as the interstate level in the past. Where violent incidents occurred, this mostly happened on a local level and was connected to access to key resources such as land and water and rooted in socio-economic disparities. It was hence not only a result of environmental degradation but also of political and economic factors. With soil degradation and climate change, the productivity of arable land decreases while water demand simultaneously increases, hence both resources become relatively scarcer. The negative socio-economic consequences of the environmental change hit primarily the poor parts of the population. Rural population commonly is excluded from the economic development in the capitals and depends on subsistence production. Access to sufficient and qualitative satisfactory water and land is therefore crucial and the lack of access a security risk.

Until now environmental degradation was not a direct cause for violent conflicts in Central Asia. However, it interacts with existing social, economic, and political tensions. On the local level, violent incidents occur when degradation goes along with lack of access to or unjust distribution of land and water, population density, forced migration, refugee movements, economic crises, or ethnic tensions. The safety hazard is hence not solely environmental degradation enforced by global climate change, but its interaction with societal and socio-economic deficiencies. The security implications of the disastrous environmental situation in Central Asia are addressed by numerous programmes of international and non-governmental organizations. Since 2002 the Fergana valley is one of the main foci of the *Environment and Security Initiative (EnvSec)* of UNDP, UNEP, OSCE and NATO (Cheterian 2009).

The internal stability of the Central Asian states was unsettled in the last years by civil war (Tajikistan), Islamic militants (Uzbekistan), organized crime (Kyr-

gyzstan), and civil unrest (Uzbekistan, Kyrgyzstan). All political systems, even the initially more democratic Kyrgyzstan and Kazakhstan, can be classified as authoritarian regimes, with Turkmenistan and Uzbekistan as most repressive states. They are characterized by increasing social inequality, strong subnational identities, and neo-patrimonial ruling patterns. All these features prevent political responsiveness to the needs and demands of the population. This comes along with the fact that those regions that are especially affected by (future) environmental degradation are also politically and economically marginalized such as the Fergana valley in Uzbekistan, the Aral Sea area in Kazakhstan and Uzbekistan and Xinjiang in PRC. Their problems have no priority for the political leadership. Governments give priority to economic development rather than to ecological considerations. This can lead to unrest, particularly when problems are instrumenttalized. This assessment is also made by UNDP (2003a: 3): "Environmentally triggered or heightened tensions arise at sub-state level and in already marginalized and remote areas."

The capacities of the national agencies to deal with the environmental problems and their consequences are rather weak – concerning the development of adequate policies as well as the implementation of international agreements and national reform programmes. On the regional level, since the end of the Soviet Union the states in rhetoric strive to establish cooperative structures. In practice, most efforts failed due to mutual mistrust and prevalence of national interests. However, the transboundary character of many environmental problems requires international cooperation, especially in water management. The failure of joint management on this level might have a worsening effect on existing problems and can lead to further conflicts. Due to the general unstable situation in Central Asia, the lack of good governance on the national level, and of cooperation on the regional level it is unlikely that the capacity for environmental problem-solving and adaptation to climate change will increase in the near future.

27.5 Conclusion

This analysis has shown that global climate change has serious impacts on the environment in Central Asia. It affects the availability of land and water resources and tends to increase the occurrence of sand and dust storms as well as of land and mud slides. While land and water resources might not be financially as significant as gas and oil resources, they are crucial for agriculture, which is the major sector in the region and for the survival of the rural population which is dependent of subsistence agriculture. A further degradation and shortage of resources might increase the conflict potential as questions of resource access are closely related to social and economic disparities and can easily be politically instrumentalized. The weak governance structures in the concerned states and the lack of public participation limit the adaptive capacities and the development of adequate strategies.

It should therefore be obvious that any effort to mitigate the impact of global environmental change in Central Asia and reduce the conflict potential has to built on a two-fold strategy: technical assistance in environmental issues as well as support for governance reforms to enhance the adaptive capacity of the concerned societies.

28 Impact of Environmental Change on Stability and Conflict Potentials in China

Thomas Heberer and Anja D. Senz

28.1 Introduction

During the last decades China has faced serious environmental degradations due to extensive economic development. In particular China's large emissions of greenhouse gases have raised international concerns about the environmental situation in China. The country faces a large amount of international criticisms due to its poor environmental performance and is perceived as one of the most polluted countries in the world. The 2008 Environmental Performance Index Report of Yale University, which evaluates indicators like people's health, air and water pollution, ranks China as 104 of 149 countries. According to the World Bank, the majority of the world's most polluted cities are located in China (Klein 2004: 21).

Without doubt, China has serious environmental problems (Economy 2006). While China spends 1 per cent of its GDP on environmental preservation, pollution and environmental degradation annually amount to 8 to 13 per cent of GDP (Dupont 2001: 52).[1] Hence, environmental costs are as high as annual economic growth. The deteriorated environmental situation causes many domestic socio-political problems (Jun 2000). According to official data, 510,000 conflicts on environmental pollution occurred in China in 2005, of which 70 per cent occurred in the countryside, because rural areas suffer especially under heavy environmental degradation (Yan 2005: 184). A rapid loss of arable farm land, declining soil quality, air and water pollution, water scarcity and droughts especially in northern China, but also a rapidly decreasing groundwater level in the North and a large acid rain belt in the South are negatively affecting the people's livelihood and human security[2] in general. The already high rate of domestic migration may even more be aggravated by the effects of climate change. If the projected sea level rise impacts on the prosperous East coast up to 90 million people could be forced to resettle. According to some estimates climate change could reduce China's economic capacities by 20 per cent until 2050 and be related to new resource conflicts (Heberer/Senz 2007b).

Environmental challenges are therefore sensitive national political issues and taken seriously by the Chinese central government, as the growing amount of protests and conflicts caused by environmental degradation and climate change could challenge political stability. With rising expenditure for environmental protection[3] and the adoption of a policy framework including modern environmental laws, the central government demonstrates its emphasis on this issue (OECD 2007; Yan 2005; Abigail 1998). But in many ways China still lacks effective institutions to implement policies and laws. Therefore central policies often do not have the expected effects at the local level.

This chapter explores the relationship between environmental challenges and regime stability. We argue that the central government tries to preserve regime stability by enhancing system legitimacy. An important basis of system legitimacy is the demonstration of administrative performance, but in an institutionally fragmented administrative structure often such policies cannot effectively be implemented. Therefore, even if environmental issues are taken seriously by the

1 See, e.g. *Shanghai Daily*, 6 June 2006; at: <www.chinadaily.com.cn/China/2006-06/06/content_609350.htm> (12 June 2006).

2 Human security refers to a holistic approach of security in the context of sustainability, food security, health, employment, education, poverty reduction, etc. and does not limit security to violent conflicts among states (Mushakoji 2001).

3 Expenditures for environmental protection have recently considerably increased. In 2008, they reached 100 billion yuan (News Office of the State Council 2006).

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central government, these measures may not convincingly be implemented at the local level. Hence, with regard to environmental policies and administrative performance it has been difficult for the Chinese system to cope with environmental challenges. Inadequate capacities of political and socio-economic system and at the institutional level may provoke further domestic conflicts and could lead to political instability in the long run.

28.2 Argument, Theoretical Approach and Database

The Chinese political system has been characterized as a fragmented authoritarianism, because the party state is not a homogeneous entity but a complex structure of different interrelated actors operating at different administrative levels (Lieberthal 1992: 1). However, from a theoretical perspective authoritarian regimes are fragile, mainly because of weak legitimacy and over-dependence on coercion (Nathan 2003: 6). But research shows that the legitimacy of the Chinese party state is not as weak as the theory suggests (Heberer/Schubert 2008).

Using Fritz Scharpf's concept of legitimacy, the authors distinguish analytically between input and output legitimacy. Output legitimacy refers to effective policies that serve general public interests and meet the criteria of distributive justice. In this regard, states produce effective outcomes like in the environmental field by "achieving the goals that citizens collectively care about" (Scharpf 1997: 19). Therefore, output legitimacy is concerned with common interests and the degree to which a state is able to implement policies responding to the needs of its citizens. Input legitimacy means integration of citizens by political participation and is strongly related to the idea that problems are solved cooperatively by a contribution of all affected actors. Obviously the Chinese party state lacks an input-oriented legitimacy with free elections and a transparent democratic political process. The input has certainly increased for instance due to responsibility contracts for local officials, the internet and the media, environmental NGOs, local parliaments, etc. Concurrently, in generating legitimacy the Chinese party state relies primarily on what is called output legitimacy. Accordingly, this chapter links legitimacy primarily to the output of the state and to a policy that is strongly oriented at finding solutions for environmental problems. In this regard, efforts of the party state to ensure stability by enhancing output legitimacy are based on achieving minimum standards of environmental protection. However, administrative constraints make it difficult to meet these standards.

In this chapter the term stability is closely related to the political system. Political systems interact with their environment, they influence and are also influenced by the context. Processes of change or crises in the system's environment can cause dynamics and may even induce major disturbance that could spawn socio-political instabilities. Stabilization means that in the case of such disturbances or 'malfunctions' a system is capable of returning to a state of balance. Stability may be defined both structurally and functionally in relation to the system, i.e. as political performance. Efficiency, output legitimacy, and order may be classified as factors for generating stability. Influenced by Parson's system theory and Gabriel Almond, Wolfgang Merkel defined a functional, action-oriented political concept of stability. He sees one of the requirements for stability in that the "inner construction of the multi-stranded interrelationships between structures and actors [must] be laid out in such a way that both are able to solve the tasks required by the environment (economy, society, international political arena)" (Merkel 1999: 57–58). If stability is understood as a "process of dynamic equilibrium", in which a system is to be situated, for Merkel it is primarily a matter of the system's adaptability and of determining the conditions which would allow or impede such adaptive flexibility (Merkel 1999: 58). Accordingly, the concept of stability is not tied to perpetuation and persistence, but rather to change: there is no stability without adaptation. Thus, stability may be understood as an adaptive process rather than a static situation.

As an effect of the economic reforms since the late 1970's the Chinese system has undergone rapid changes that affected not only economic but also political as well as social and cultural issues. During this rapid development socio-political stability has always been crucial to Chinese leaders. According to the central government reform policies are to serve the stability of the system and gaining legitimacy is seen as a way to reinforce stability.

Currently, the political leadership pursues a two-fold strategy to generate legitimacy. On the one hand output legitimacy shall be gained through enhanced administrative efficiency and responsiveness to local demands. Top-down pressure on local authorities via financial means, career promotion and institutional constraints are major tools to achieve this objective.

On the other hand the party state tries to win the support of the population for central policies.

Chinese surveys illustrate that large sections of the population expect that the state tackles environmental problems and improves their environment and ecology (Wong 2003). Thus, the authoritarian system does not only try to convince the people of certain policies but to integrate the people by input institutions like local hearings, opinion polls, space for NGO activities and local offices where complaints and petitions can be submitted. Here the impression is conveyed to the population that the people can influence decisions and in this way input legitimacy can be strengthened to a certain degree. However, far more important is the fact that with these input institutions information can be gained on the performance of local administrations and local officials can also be monitored with the support of the population. Such information is useful to improve administrative performance and thus serves output legitimacy. It is precisely this two-sided approach in serving output legitimacy which can be used to explain the relative stability of the state in contemporary China.

To assess the output legitimacy of the central state this chapter will first briefly discuss the relationship between environmental degradation and the risk of socio-political instability (28.3). Then China's environmental policies, and in particular its modes of governance on the central-local relationship and the steering capacity of the central state are examined and efforts of the central state and problems with the implementation of environmental policies are addressed (28.4). Finally, the public awareness and environmental protests are analysed as mechanisms that are employed by the central state to put pressure on the local administration (28.5). On environmental policies different interests between the central leadership in Beijing and the local governments can be observed. It is argued that the central government is interested to ensure stability and an effective implementation of policies, while local governments are more concerned with economic growth (28.6). Moreover, due to certain institutional incentives local officials often conceive environmental protection as a contradiction to economic success (Heberer/Senz 2008). Besides this, the fragmented political system offers sufficient institutional space for different actors to express their own concerns. Finally the policy output regarding environmental policies and the output legitimacy of the Chinese party state are assessed (28.7).

This chapter relies on findings of two research projects on "Environmental administration and the environmental implementation gap in China" that were conducted in six counties and cities in the Northwest (Shihezi/Xinjiang) Northeast (Yingkou/Liaoning), East (Shouguang/Shandong), Southeast (Xiamen/Fujian and Deqing/Zhejiang) and South China (Nanfeng/Jiangxi) between 2007 and 2009. The first project focused on urban areas, the second on rural areas. In-depth interviews with environmental experts, administrative personnel of local bureaus concerned with environmental issues, grassroots officials in townships and villages, environmental NGOs, journalists, and ordinary citizens in China have been conducted. Further, a large amount of Chinese material has been analysed. This includes academic books and articles as well as local newspapers and official documents.

28.3 Environmental Degradation and Risks of Socio-political Instability

In Chinese history the downfall of dynasties has often been triggered by natural disasters. The emperor, so the popular interpretation, had lost the mandate of heaven (Gernet 1988). In the light of this tradition, environmental degradation and an increasing amount of natural disasters as a result of climate change could currently also challenge the legitimacy of the Chinese government. Therefore, an awareness of the Chinese government for a fast and effective crisis management as well as the respective demand of the population is likely.

But social challenges could turn into threats for socio-political instability if environmentally-induced disturbance of relevant parts of the society erupts in large protests.[4] Here not only the sheer size of protests might be a relevant fact. Even more important could be the reason for these protests. If such protests are no singular events triggered by a certain cause, but based on a popular assumption of severe general governmental failures, the Chinese authoritarian regime would face a challenge with the potential of destabilizing the country and questioning the authority of the regime. Thus, the environmental crisis might turn into a challenge to stability, if followed by the population's

4 As relevant parts of the society the authors consider social groups that are capable to articulate their interests and gain recognition due to the sheer size or their access to the public arena. Those groups in China could be the rural population (peasants), migrants, the urban elite and the emerging middle class.

principal loss of confidence in the modes of governance (crisis of legitimacy) or the diminishing ability of the government or the leading elite to maintain power (either by repression or financial compensation for environmental damage).

Another potential threat to stability is the malfunction of state institutions, caused by the absolute amount of environmentally provoked challenges, which bind financial, technical and administrative resources of the system and drastically reduce the political scope of action. Thus, an interconnection between stability and environmental issues in China could occur if pollution, natural disasters or other effects of climate change would cause a massive curtailing of basic needs for relevant parts of the population. Access to potable water, clean edibles or health care might not be guaranteed in the future and could lead to conflicts between different sections of society. Several areas of the systems' tension can be identified with regard to environmental degradation, climate change and human security (Heberer/Senz 2007b):

a.) *Socio-political disparities and poverty*: Environmental degradation could intensify current income disparities as well as poverty. In particular, the livelihood of the rural population is endangered by massive environmental degradation. If in the future more peasants depend on social welfare this will further bind financial resources.
b.) *Health:* Prior to the reforms launched in 1978, the entire population had access to at least basic health care. Currently, large sections of the rural population are underserved with health care. Given an increase of diseases caused by pollution and a higher demand for health care in cases of natural disasters caused by climate change, this could become a major challenge for China. Again, this could bind financial resources that cannot be invested elsewhere.
c.) *Ethnic and religious factors*: China is a multiethnic state, but many ethnic minorities are not well integrated into the Chinese state. In addition, the areas of ethnic minorities are in particular exposed to an exploration of resources that cause massive environmental damage. Further environmental challenges could aggravate the situation in the ethnic areas and result in ethnic conflicts (Heberer 2001).

Socio-political stability will depend in particular on the ability of the government to control and channel resources and to handle environmentally-induced conflicts efficiently. Stability in terms of system' equilibrium will therefore depend on the existence of a balanced relationship between steering capacities of the state, its social acceptance and the available (material) resources. In particular assuring the access to resources is an important base for China's further economic development, and both – economic development and growth – are needed to assure the working abilities of the political system (Heberer/Senz 2007a; Ding 2002).

Finally, in case of China's instability even regional conflicts might occur, which could be caused by the rivalry for resources, cross-border migration, pollution affecting neighbouring countries or the regional spread of infectious diseases. In general, environmentally-induced conflicts will only turn into threats to stability and regional security if the willingness and ability of the Chinese government to act cooperatively and conflict managing is not convincing anymore for other actors involved.

28.4 China's Environmental Policies

In 1972, prior to the economic reforms, China already faced major ecological problems. This fact alerted the government to care more about environmental issues. In the following years China established institutions for environmental protection, integrated an environmental agenda into its five-year plans and even into its constitution (Bechert 1995: 22). Laws to protect the environment have been enacted and international standards for environmental measurements have been implemented. Since 2006 the expenditure for environmental protection are officially included in the central level budget (News Office of the State Council 2006). In 1998, China established a central authority for environmental protection, the State Environmental Protection Administration (SEPA) which in 2008 has been upgraded to a ministry. In 2008 the Chinese government also launched a 600 billion US$ programme for climate and environmental protection. Hence, compared with other developing countries China started its environmental policies quite early and has relatively well established environmental institutions.

In addition, the Chinese government treats the concept of sustainable development favourably and supports water and wind energy as well as other renewable energies. China aims to increase the use of solar, wind and hydro power from currently 8 per cent of its total energy supply to 15 per cent by 2020. Furthermore, the government plans to include an

evaluation of environmental degradation into the calculation of its GDP (green GDP) (Lincoln 2004: 7/8).

In the international field, China has signed all major environmental agreements (Montreal Protocol, UN Framework Convention on Climate Change, UN Convention on Biological Diversity, and the UN Convention to Combat Desertification). Beijing supports the United Nations and the creation of a UN environmental organization. But China has so far opposed, like the US during the Bush Administration, any binding limitations of its CO_2 emissions. Its political leadership recognizes the common global responsibility for the climate, but stresses the particular responsibility of 'developed countries'. Therefore, China has ratified the Kyoto Protocol, but as a 'developing country' it did not sign any binding obligations (Lewis 2007/08).

As our own research in several Chinese regions between 2007 and 2009 indicates, especially in the big cities, the pressure of the central government to protect the environment has been increasing and the attitude of local governments towards environmental issues is changing. The implementation of environmental regulations is closely controlled and published in the internet.

In recent years the central government has allocated large financial resources for building waste water sewage plants, waste incinerating plants, energy and water saving, the technical retrofitting of plants and for enhancement of renewable energies (biogas, solar energy, wind power, etc.). All counties and cities are entitled to apply for funding. In the rural areas the gigantic nation-wide programme "Constructing new villages" shall provide a new infrastructure in rural areas: afforestation programmes, waste disposal in villages, concreting of rural roads, piped water and modern lavatories for each rural household, establishment of biogas facilities where the necessary conditions are existing, etc. are part of this programme. It is also considered to improve environmental and living conditions in rural areas. For the various packages the central state, the provinces, the prefectures, cities, and counties have to share funding. In more prosperous areas like in the Zhejiang province in 2009 this programme was rather advanced, whereas in poorer areas like in the Jiangxi province it was estimated that ten to fifteen years were needed to implement it.

Certainly, this very progress should not hide the fact that the environmental situation across China remains precarious. Yet, this progress also illustrates that the will of the central state to tackle environmental problems has increased. It may be hoped that these effects will be sustainable, the more as many local governments conceive environmental protection merely as a policy enforced from above and are often disregarding local peculiarities.

28.5 Chinese Administrative Capacity Between Local Leeway and Steering by the Central State

To understand environmental policies of the party state, it is necessary to understand that the party state does not have a centralist but a fragmented structure (Lieberthal 1992). Accordingly, China is not controlled by a small cluster of politicians at the highest echelons of the party state. Today a lot of different actors with diverse concerns are involved in policy formulation and decision-making. While the ministry of commerce i.e. tries to foster economic development, the ministry for the environment wants to ensure that environmental laws are observed. Those different and sometimes contradicting preferences can not only be found at the centre but in particular at the lower levels of the government. Provinces, cities, counties, townships and even villages claim local characteristics and convey different concerns and standards. The Party and state are therefore split into many different actors with different aims or priorities with the result that orders cannot anymore be issued top down like in the Mao era. This means that policy implementation often has to be coordinated and negotiated among many actors at different levels within the party-state's structure, with contingent results.

Accordingly, China's political system is characterized by both a horizontal and a vertical fragmentation of power and the involvement of a multitude of actors with various self-interests. Structures of that kind complicate a countrywide implementation of policies, laws, and minimal standards or frequently thwart national endeavours in the sphere of environmental protection. In this respect China is facing major institutional challenges.Thus, the further fate of the political system will depend on the successful coping with those challenges to find solutions for the most urgent (environmental) problems. Nevertheless, in offering space for a locally bounded test of approaches to solve particular problems this fragmented system certainly has specific advantages, as it is flexible enough to enable institutional learning, importing ideas and concepts, and implement certain problem solutions which have proved successful in other regions or countries (Heberer 2008). If the central state would

insist that all localities across China had to implement a unique environmental policy this would on the one hand negatively affect local economic development, when e.g. local enterprises were forced to close and accordingly unemployment would rise, on the other hand evoke strong local opposition or even instability.

The policy of liberalization since the 1980's has significantly widened the room of provinces and municipalities to manoeuvre and bargain. The consequence of the process of decentralization is that local authorities frequently pursue policies diverging from those of the centre and do not follow directives of the higher echelons. Under conditions of an authoritarian system this reinforces selfish and arbitrary political decision-making of local authorities and causes problems to the effective implementation of environmental policies.

So, decentralization and devolution (i.e. the transfer of decision-making power to lower levels) has spawned a double identity of local governments. Whereas in the Mao era they had to a large extent been merely agents of the central state today they are also local economic principals and thus advocates of local interests. Consequently, they enjoy a wider room in implementing, non- or partly implementing policies of the centre and concentrate upon the protection and promotion of local social and economic interests (Ting 2006).

Part of this fragmented system is a so called implementation gap (Chan/Wong/Cheung/Lo 1995), which means a discrepancy between decisions made in Beijing and the realization at the local levels. This implementation gap can be well observed in the field of environmental policies: Even though the Centre passes and enacts laws and regulations, many cities and counties violate the laws under the pretext of local economic development. In general decentralization has transferred decision-making capacities to the local level permitting them to accomplish their own 'local experiments'. Therefore some counties for instance, follow orders from above, while others ignore them or even develop their own 'local models'.

What are the main reasons that local authorities do not or only in a limited way implement environmental laws or policies of the centre? Several reasons can be identified according to the field research of the authors:

a.) *institutional deficits*: Decentralization reinforced the power of local authorities thus spawning a fragmentation of state power. There are no institutional means (e.g. legal remedies) to sanction deviance in a satisfying way;

b.) *one-sided policy preferences*: The Centre strongly emphasizes two issues: first, economic growth and second, preserving stability. All other issues are of secondary relevance. They only gain priority if a policy field becomes more prominent by virtue of domestic economic and social pressure or by international pressure. Accordingly, local officials know that in the case of environmental damages or mining accidents they have little to fear as long as no major social unrests appear. Minor protests can easily be suppressed, because the media are not permitted to raise open concerns or criticisms. Moreover, in assessing the performance of local officials only the two issues mentioned above (economic growth and preserving stability) are crucial. All developments that affect those issues negatively are directly sanctioned by the centre;

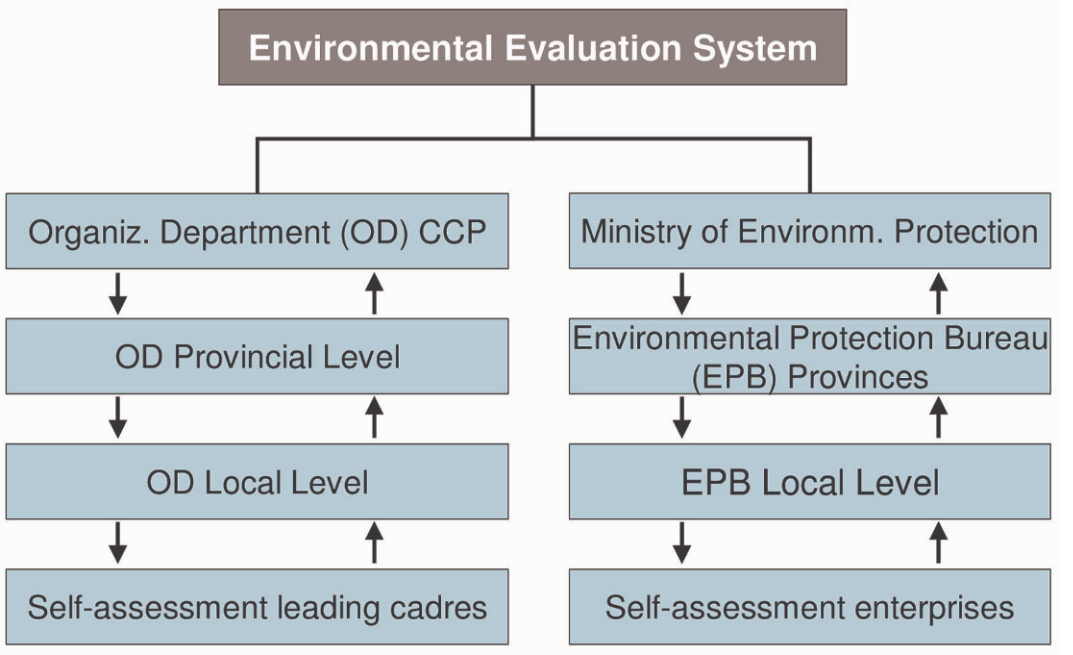
c.) *lack of financial resources* for implementing environmental policies;

d.) *local-level clientelism, i.e. local networks*: mighty coalitions of local officials with entrepreneurs or certain social groups directly or indirectly participate in an issue (e.g. in an enterprise contaminating environment, unsafe mines) and oppose the implementation of central policies in the name of 'local stability' or 'economic development'. According to their perspective closing enterprises could result in an increasing unemployment rate and accordingly cause social unrest. Moreover, the local state would lose tax income, entrepreneurs their profits – and officials their sinecures and additional incomes;

e.) *corruption and local-level state capture*, i.e. influencing local policies, rules and regulations in the interest of local enterprises and entrepreneurs;

f.) *incorrect reports* to higher authorities or officials which do not reflect the real situation, i.e. double realities in 'reporting'. Local officials report 'politically correct' to higher authorities, but those reports do not describe correctly the current situation; thus, the higher authorities are not informed about the real situation in a given locality. Zhao Shukai displayed how cadres at the district, county, township and village level form coalitions if cadres from higher echelons (the Centre or the province) arrive for inspections. Top officials arriving in a region are observed and every aspect they are interested in to evaluate will be rearranged in order to make sure that the real situation is covered (Zhao 2006: 25). A good example is the extreme pollution of Lake Taihu in South China. Shortly before the pollution was publicly

Figure 28.1: Environmental evaluation system in China. **Source:** The authors' survey of 2007.



announced the city of Yixing, the main polluter of Lake Taihu, had been chosen as a "model for environmental protection" – obviously without knowing the actual local situation.

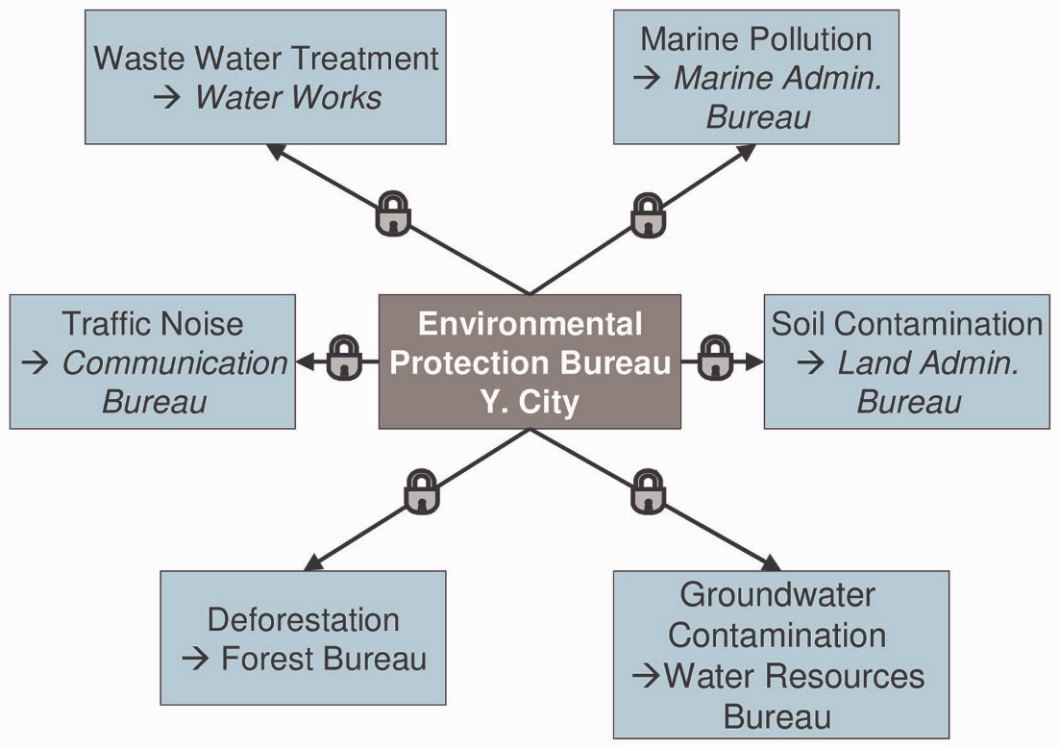
A lack of understanding of the Chinese implementation gap in the Western literature often leads to the notion that the central state is responsible for all grievances and deficits in China. Even if the central level issues general policies, it is overcharged with controlling the implementation of such policies in the 2,862 counties. Therefore some 'hard' policies are issued – such as economic development, stability, increase of local level income and birth control – and their adherence is checked rigorously. 'Soft issues', currently for instance environmental protection, efforts are made to control central regulations, but institutional and legal instruments are too weak to guarantee their implementation. In this regard political fragmentation and implementation gaps in several policy fields of minor relevance are accepted by the government as part of a process of pluralization.

However, the central government tries to improve governance. In recent years a cadres 'responsibility system' and an evaluation system for cadres' and enterprises at the local level have been established. Contracts of higher administrative levels with local officials determine the most relevant tasks of policy implementation at the local level. It is argued that this has enhanced environmental governance (Lo/Tang 2007). Officially, the organizational departments of the Communist Party have been entrusted to monitor the performance of cadres and the implementation of the contract tasks. Regarding environmental issues the local *Environmental Protection Bureaus* (EPB) should concurrently monitor the environmental performance of enterprises on a yearly basis. Our own investigations in China in 2007 revealed, conversely, that currently a genuine evaluation process does not exist, because the responsible departments are understaffed and therefore the evaluation in many locations is primarily based on self-statements of the offices or officials concerned (figure 28.1). Furthermore, there are 'hard' contracts for issues related to economic growth and social stability and 'soft' contracts for environmental issues. The former are strongly related to an official's advancement and reward and have to be implemented under any circumstances, the latter should be implemented and are not related to promotion and remuneration. Therefore the incentives to implement environmental issues are rather weak.

Three structural problems at least aggravate an effective implementation of environmental policies:

1. *Coordination problems*: At the local level environmental tasks are highly fragmented. Different offices are responsible for different issue areas (figure 28.2). The core problem is that those fields are not linked to each other and that no clear-cut (positive) coordination exists. The various offices

Figure 28.2: Problems of Environmental Governance in China: Fragmentation. **Source:** The authors' survey of 2007.

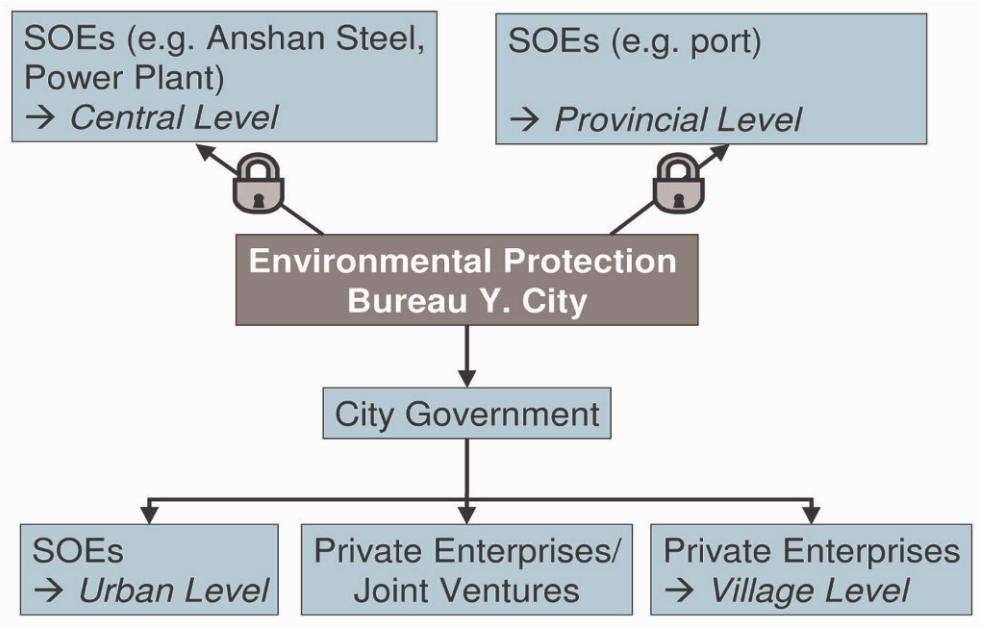


are not well informed on each other's activities. Due to the lack of a clear-cut division of labour, overlapping responsibilities, and an asymmetric information structure, the coordination of environmental policies among the various authorities are seriously impaired. The various offices are simply not interested in any cooperation because they conceive themselves to be 'local kingdoms' competing with each other for funding, income, prestige and power.

2. *Territoriality*: Regarding environmental responsibilities strong boundaries exist between administrative entities, i.e. counties, municipalities, prefectures or cities discharge waste water in rivers so that downstream areas are negatively affected. Cooperation beyond territorial borders is virtually non-existent and no respective regulating body exists. Due to this multiplicity of territorial structures in China administration and problem solution is much more complicated than in other countries.
3. *Hierarchization of Ownership Structures*. Complex ownership structures make the territorial administrative structure even more complicated. Enterprises can be located in a city but administered by higher levels, i.e. the central or provincial level. Hence, local governments and the *Environmental Protection Bureaus* (EPBs) do not have access to those enterprises, i.e. *State Owned Enterprises* (SOEs). In this highly fragmented and hierarchical structure a monitoring of major environmental polluters is often simply not possible (figure 28.3).

This example from Y. city in Northeast China illustrates this problem: Here, a branch of the state-owned Anshan Steel Company was the biggest polluter in town. As this enterprise is under the administration of the State Council and therefore much higher in the hierarchy than the government of Y. city, let alone the local EPB, this bureau is not permitted to monitor or supervise this enterprise. The second largest polluter is the local sea port. It is administered by the provincial government and the EPB has no access to the port area. The enterprises under the local government as well as the joint ventures and private businesses are protected by the local government, as they are the biggest source of tax income and employment. In order to enrich the local peasants the Y. government even protects the polluting village enterprises against inspections by the local EPB. As the EPB has a lower standing in the local hierarchy, its power and monitoring capacity is limited to very narrow domains.

Figure 28.3: Problems of Environmental Governance: Hierarchy. **Source:** The authors' survey of 2007.



28.6 Environmental Awareness and Environmental Protests

Our field research has revealed that generally speaking the environmental awareness has increased. The media are concerned with ecological issues almost on a daily basis. Furthermore, in recent years Chinese surveys have proven that particularly young, well-educated and urban professionals increasingly give priority to environmental protection. The internet, meanwhile one of the most salient sources of information in urban space, contributes to elucidate environmental damages, its consequences and alternatives. Particularly NGOs as well as an increasing number of environmental organizations among students display more general interest in ecological issues. Already in 2006 such organizations existed at 176 universities in 26 provinces (Stalley/Yang 2006: 335).

Meanwhile urban inhabitants increasingly perceive ecological problems as severe. Chinese surveys reveal that urban citizens expect greater government efforts in tackling environmental issues. Yet, only a minority, particularly younger and better educated people living in the better-off parts of the country, are aware of the negative impact of their own behaviour and know how to contribute to improving environmental conditions. Therefore, since the late 1990's the Chinese government is fostering education programmes concerning environmental protection and sustainable development in educational institutions. But an understanding and insight in the regional and global dimensions of environmental problems is still widely lacking.

Despite some improvements even Chinese surveys reveal that the environmental awareness among both the Chinese population and the authorities is not yet well developed. According to Chinese sociologists in 2008 merely 1.8 per cent of the respondents (out of 7,135 people surveyed) held the opinion that environmental pollution is belonging to the most severe problems for China. While in this regard the urban-rural variety was small there were interesting regional differences: 17.0 per cent in the Eastern part of China were convinced that environmental damage was a serious problem, compared with 9.1 per cent in Central China and only 8.1 per cent in the poorer Western part of the country (Li/Li 2009: 25). Likewise surveys by social scientists illustrate that the environmental awareness among students and university graduates has grown. Stalley and Yang have argued that many students perceive environment protection as a central task and that the awareness of Chinese university students does not fall behind that of students in other countries. The majority of the respondents were even of the opinion that environmental problems would mitigate in the years to come (53.4 per cent), while

merely 21.0 per cent expected a further deterioration (Stalley/Yang 2006).

City and county governments are forced by higher echelons to increasingly attach greater weight to environmental protection. The norms and targets of the centre and the provinces became much stricter, particularly in the more developed regions. But the cities often relocate environmentally polluting industries and channel off waste water into rural areas. Therefore protests among the rural population is currently on the rise (in the year 2005 already 70 per cent of all cases). More and more information on the consequences of environmental damage and pollution (e.g. via the internet, the media, and environmental NGOs) are likely to increase environmental protests in the near future in both urban and rural areas, particularly where local governments disregard environment protection.

Usually, peaceful protests are not very advantageous and laws are so far hardly formally enforceable. Therefore, the rural population often turns to specific forms of protest. In May 2007, for instance, a larger group of peasants from Anhui province kneeled before the State Environment Protection Office in Peking in order to achieve an investigation into the massive environmental pollution in their hometown. More than ten years the peasants had patiently submitted their concern to various offices. Several times prefecture and province governments had dispatched investigation teams to their hometown without any result (Wang 2009: 90).

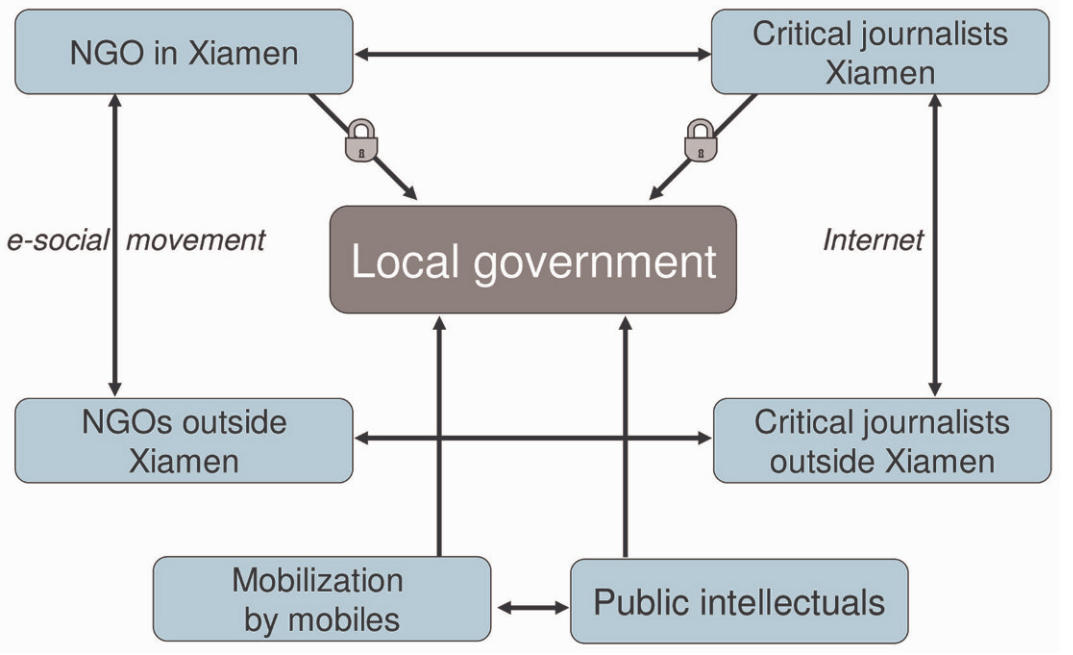
So far there are only few opportunities to take legal action. Although meanwhile in some provinces environment courts and an environment police force does exist, the majority of provinces have not yet established such institutions. Moreover, as a rule higher courts refuse to accept lawsuits of individuals or NGOs by pointing out that they were already overburdened. This conflicts with the national environment law which explicitly stipulates lawsuits by individuals or group of citizens. Chinese surveys display, however, that the argument of higher courts is pleaded. Even months after establishing environmental chambers, the environment courts for instance in Kunming (Yunnan Province) or Wuxi (Jiangxi Province) had not yet received a single lawsuit. The reason is that individual citizens or NGOs are reluctant to turn to the law as they are afraid of reprisals by local authorities or enterprises or because they have to spend large amounts of money for lawyers and court fees (Wang 2009: 90/91).

Another problem is that due to institutional weaknesses no checks and balances and no efficient monitoring system for environmental protection exists. Furthermore, the local *Environmental Protection Bureaus* (EPBs), parliaments, media, and the legal system do not play a noteworthy role.

Meanwhile, several international NGOs are operating and a small environmental movement is developing that can be understood as a basis for the development of Chinese environmental NGOs, too. But local NGOs in most cities are weak and depend on local authorities. Often such NGOs are even intimidated or attacked by local authorities, which are pursuing goals contrary to environmental protection and standards. As long as this small environmental movement does not challenge the party state but rather turns against local violations of policies and laws, the central state is willing to support it. Yet, in the case that it commences to challenge the authorities or even the political system the central state will suppress such activities very rapidly. Under these conditions, NGOs and the environmental movement emerge only in large cities or regions with enormous acute ecological crises and remain fragmented and locally orientated. While NGOs are often hampered by the local state, the central state needs environmental organizations, because he lacks both information on local problems and the ability to enforce environmental policies by institutional means. If environmental activists do not confront the party state and challenge its authority but denounce local violations, the central state tolerates and makes use of them in order to put pressure on local administrations. Such pressure is to improve local administrative performance and foster output legitimacy of the party state.

An interesting case of new forms of protests of citizens was the public opposition against the settlement of the PX factory in the Eastern coastal city of Xiamen. PX stands for para-xylene, which is said to cause cancer. In May 2007, the city government had announced the construction of this factory. This event immediately caused protests by scientists and ordinary citizens. At first well-known intellectuals criticized the project and provided information on it via the internet. In the internet the project was heavily discussed; citizens then informed each other by using their mobiles (SMS) and invited to protest demonstrations. For many weeks tens of thousands of people demonstrated peacefully. Local NGOs refrained from attending but spread information and critiques via the internet throughout the country. Even local journalists provided information to outside reporters. This inter-

Figure 28.4: New forms of protest: The PX factory case in Xiamen. **Source:** Authors' own survey 2007.



action of intellectuals, critical journalists, NGO networks and citizens as well as the public protests finally forced the local government to renounce the project.

28.7 Conclusion

Undoubtedly, an ambivalent situation exists in China. On the one hand international and domestic pressure grows to cope with environmental issues and to implement stricter environmental policies by the state. The central state is interested to implement better environmental policies in order to reinforce legitimacy and secure stability. On the other hand there is still a gap in implementing central environment policies at the local level. A rather low level of environmental awareness prevails in local authorities and within the population. Local authorities often give preference to economic development and economic growth and they avoid the closing down of enterprises which could increase unemployment and therefore negatively affect social stability. Ultimately the central state is responsible as both economic growth and preserving socio-political stability gain top priority in national politics thus often assigning the environment a subordinate role.

Yet, with a rising environmental awareness among Chinese citizens the central state will have to change its policies. Environmental and climate protection are likely to become the third priority in national politics. The upgrading of the *State Environmental Protection Agency* (SEPA) to a ministry, a stricter enforcement of environmental regulations and the establishment of a broad variety of environmental funding programmes illustrate that the significance of environmental issues is rising. It also seems that the central state uses local requests for stricter environment protection, e.g. from NGOs, as a mechanism to put pressure on local authorities.

By strengthening environmental policies, the party state also attempts to reinforce its output legitimacy and, in doing so, to preserve socio-political stability. An interest in maintaining stability presupposes a collective benefit for the actors involved. Both interests and benefits are ensured on different levels: a) on the part of the citizens by improving environment and ecology; b) on the part of the state by ensuring environmental protection, guaranteeing environmental standards, and installing tools for monitoring local authorities and policy implementation (e.g. through evaluations, cadres' responsibility systems, etc.). The current institutional change in environmental governance is not occurring as a bottom-up process triggered by a civil society but as a top-down process driven by the authoritarian state.

By a policy of fostering, monitoring and improving the environment and ecology, the party state attempts to generate output legitimacy at the local level. "Administrative capacity", the party daily *Renmin Ribao* [People's Daily] wrote in March 2005, "is a central

component of the Party's leadership capacity [*zhizheng nengli*]." It went on to claim that measures to strengthen this capacity would need to focus on the aspect of a "serving government" [*fuwuxing zhengfu*], so that the people will be pleased with the government even on environmental issues. Good governance including the improvement of the environment, good public services as well as continual stability even under difficult circumstances would also need to be ensured (Xu 2005).

To sum up, the environmental policy output of the central government has noticeably increased. It has also intensified its pressure on local governments and pays more attention to environmental issues. Furthermore, local environmental protests are not always and automatically oppressed but used to enforce better local environmental protection. The central state even contributes to strengthening the awareness of the people by disseminating information and knowledge on environmental issues through the media and the educational system. The media report on environmental issues and problems on a daily basis. In newspapers, television and broadcast there are special programmes where people can complain and in each city or county environmental 'hotlines' (*green 110*) are available. Moreover, particularly the internet contributes to enhancing and spreading information on environmental problems and issues. And knowledge is a salient factor to enhancing the environmental awareness of the population.

But due to institutional constraints, e.g. the minor role of the legal system, media control and especially the implementation gap between central policies, laws, decisions and their local implementation have the effect that the level of environmental output legitimacy is still low. And in the case that environmental policies should negatively impact upon those domains which bring most legitimacy to the central and local state (like GDP growth, employment, and social stability) this impact would negatively affect the general output legitimacy of the party state.

Undoubtedly, the implementation gap increasingly challenges the accountability of local authorities and compromises the legitimacy of both the local and the central state. Additionally, stability is affected where local authorities disregard environmental issues, albeit the Chinese case proves that stability at the local level could erode without having a direct impact upon the central government. Presumably the rising awareness of the urban middle classes might evoke social pressure that could spawn the state to endorse that environmental protection also becomes a top priority of Chinese politics.

Part IV Threats, Challenges, Vulnerabilities and Risks for Urban Centres in Hazards and Disasters

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29 The Vulnerability of Cities to Disasters and Climate Change: A Conceptual Framework

Mark Pelling

29.1 Introduction

This chapter offers a conceptual overview to help unpack human vulnerability to natural disaster and climate change in the city. Vulnerability and its components are interpreted as applications of wider debates on social justice that emphasize the human dimension of security – the meeting of basic needs and human rights (Anand/Gasper 2007). But vulnerability is more than this; at its core is the interaction of social and environmental systems so that human security has to be seen within a socio-ecological lens. This positioning is felt most clearly on the ground where projects aimed at reducing vulnerability overlap comprehensively with those for sustainable development (UNDP 2004).

Human vulnerability to both hydro-meteorological and geophysical hazards has generic and hazard specific attributes and can lay latent or unrecognized until manifest through a disaster. One of the primary – but still challenging – aims of vulnerability research, recently extended by the climate change community, is to identify and act to reduce vulnerability before it is revealed through disaster loss. Human vulnerability can be disaggregated into constituent elements including social vulnerability (health, livelihoods, and social well-being) as explored in part IV of this volume, and physical vulnerability (buildings and critical infrastructure), and is the product of social governance processes acting across scales and through time.

This chapter starts by asking what a city is and what we seek to protect within cities when we study vulnerability (29.2), and it then examines six elements shaping human vulnerability to climate change in cities (29.3).

29.2 Competing Visions of Urban Risk

What do we mean by urban vulnerability? Who asks this question has a great influence on the answer. This is because different actors with varying stakes in the city differ on the primary purpose and driving forces behind urbanization and what a successful or sustainable city might look like. Five conceptualizations of the city are compared in table 29.1. Each vision leads to the identification of a specific set of vulnerable objects. This in turn leads to the identification of key strategies for managing vulnerability in the city. The dominant literature base with which each vision is associated is also noted.

The predominant conceptualization of the city is as a motor for economic growth. Economic development is assumed to trickle down to reach the poor, so that the poor as well as the rich rely upon the safety of physical assets, critical infrastructure and financial or business systems. Academic work has tended to come from business management or insurance sectors and to provide technical rather than socially critical input (Castillo 2004). Some work has explored the vulnerability of cities as nodes in globalized networks and flows of capital (Vale/Campanella 2005). Connection to global flows can provide resilience to global capital, while at the same time magnifying the vulnerability of places as they are exposed to contagion effects from other networked places and the potential flight of global capital (Klein 2007).

A similarly top-down, comprehensive view is taken by those who see them as integrated systems of consumption and production. Here cities are often presented as organisms consuming raw materials from the hinterland and producing wealth and waste. Such systems rest on the safety of critical life support systems – transport networks, communications, potable water, sanitation, and drainage (Pelling 2003a). When these systems are damaged by disaster local direct losses can magnify quickly as the movement of people, goods, and information around and through the city is disrupted. The earthquake that hit the port city of Kobe, Japan in 1995 cut trade routes from Japan

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Table 29.1: Diversity in the conceptualization of urban vulnerability. **Source:** The author.

Vision of the city	Vulnerable objects	Pathways for managing vulnerability	Literature
An engine for economic growth	Physical assets and economic infrastructure	Insurance, business continuity planning	Macroeconomics and business continuity
An organism or integrated system linking consumption and production	Critical/life-support infrastructure	Mega-projects connecting urban and rural environmental systems	Political-ecology, systems theory
A source of livelihoods	The urban poor, households, livelihood tools	Extending and meeting entitlements to basic needs	Livelihoods analysis
A stock of accumulated assets	Housing and critical/life-support infrastructure	Safe construction and land-use planning	Engineering and urban planning
A political and cultural arena	Political freedoms, cultural and intellectual vitality	Inclusive politics and the protection of human rights	Discourse analysis

with repercussions across Southeast Asia (UNCRD 1995).

Cities can also be seen as an aggregation of multiple components. The most common use of this perspective is to see cities as a collection of individuals all seeking to secure and hoping to improve their livelihood status. Most at risk in this conceptualization are the urban poor – the homeless, those living in shelters without legal tenure or renting. Safety in this vision of the city is built through the extension of individuals' entitlements to basic needs, through which livelihoods can be built and protected in the face of disaster risk. Livelihoods analysis, initially applied to rural vulnerability analysis has proven a successful tool for analysing the production of vulnerability and resilience particularly amongst the poor (Moser 1998).

Cities are also an outcome of the historical aggregation of physical assets – even relatively young cities are given form and have their physical vulnerability shaped by land-use and building standards. Risk is most graphic in those cities where the majority of the urban population lives or works in buildings that are not disaster resistant. A review of health service infrastructure in Latin America and the Caribbean found that around half of all hospitals are sited in high-risk areas. Perhaps not surprisingly, this report also found that over the 1980's and 1990's, 100 hospitals and 650 health centres have been destroyed in disasters (Conchesco 2003).

A final vision of the city sees it as a place of political, cultural, and intellectual interaction – as a stage or theatre where different beliefs or sets of values come into contact. Disasters can damage or destroy cultural assets, including architecturally significant buildings, urban landscapes, and artworks housed in urban centres. During the '*Jahrhundertflut*' (most intense flood in a century) of August 2002 that affected the Czech Republic, Germany and Hungary, the world heritage towns of esky Krumlov and Prague were damaged and galleries of international importance in Dresden and Prague were flooded. Disaster response can threaten cultural, political, and intellectual freedom. The two most effective ways of managing risk are *autocratic command and control* (which limits freedoms) and *inclusive governance* (which opens political freedoms). The former is the most common response from liberal and authoritarian governments alike (Pelling/Dill 2006). A notable exception was the response to the Mexico City earthquake in 1985 when strong civil society composed of new allegiances between workers and liberal intellectuals forced open and maintained new political space which transformed the reconstruction process and post-disaster political life in the city (Pelling 2003).

Part of the challenge of understanding urban risk is to explore the ways in which these varied and sometimes conflicting visions of the city lead to competing discursive and material constructions of vulnerability and policy for its reduction. As table 29.1 shows, a holistic view is made difficult because of the segmented division of policy in urban governance with each vision being promoted by particular policy sectors and actors, each under the control of different professions and administrative structures (Warmsler 2006) and at times built on incompatible theoretical foundations. Horizontal diversity, produced by policy sectors, is compounded by vertical diversity, produced by different levels of governance. Neighbourhood committees sit within local governments and these within municipalities that in turn liase with national line ministries.

Similar connections across scale from the local to the global can be found in civil society and the private sector.

Scale can also generate conflict. Ways of measuring vulnerability and subsequent policy interventions differ by scale. For example, city level vulnerability assessment and management may cause (planned or unplanned) damage to the assets and livelihoods used by local actors at risk so that local vulnerability is increased while city level vulnerability is reduced (Adger/Arnell/Tompkins 2005). Thus, for any one way of seeing the city or of constructing its vulnerability there are multiple stakeholders whose ways of measuring and acting on vulnerability are dictated by the sector and scale of their responsibilities. Individual policy actors may be engaged in activity at multiple scales but nonetheless policy tends to be enacted at specific scaler levels, this is especially so in cities with multiple levels of government.

The study of urban vulnerability is not the first time a research agenda has been challenged by diversity and scale. Work on sustainable urbanization in the 1990's was faced with the same task when trying to bring together the environmental, social, and economic elements of sustainable development with local and global agendas of change (Drakakis-Smith 1996). In their urban environmental transition model, McGranahan, Jacobi, Songsore, Surjadi and Kjellén (2001) showed how development gains, rather than reducing net environmental risk, tend to push hazard from one place or time to another. Sanitation systems can protect the urban poor from environmental health concerns, but without treatment sewerage can generate pollution for downstream residents and ecosystems. At a larger scale, urban industrialization and high carbon consumption systems provide one route for safety form environmental and social hazards but are the world's largest contributor of greenhouse gas emissions generating risk for the future and disproportionately for those people with least ability to cope – often the economically poor and politically marginalized.

Two observations from the sustainable urbanization agenda have particular resonance for research on vulnerability and resilience in cities. The first is that local actions can make profound contributions to the lives of the most vulnerable (Pugh 1996). Scaling-up or reproducing innovations from local or neighbourhood level to city-wide programmes requires support from local or municipal government. The centrality of local or municipal government in managing risk in the city is a starting point for the second observation, that urban governance should be the focus for research and policy aiming to understand and manage risk (Satterthwaite 1998).

Recognizing that governance is central to any enquiry on vulnerability and disaster risk in the city is important analytically because it can be used for the study of generic as well as hazard specific vulnerability. Hazard specific vulnerability assesses vulnerability in relation to a known hazard type – a past event or future scenario. Generic vulnerability assessment focuses on the vulnerability of human systems without any specific hazard type defined, and is particularly useful in urban contexts where hazards are varied, multiple and overlapping, and in an era of climate change where future hazards increasingly depart from historic records in their distribution, severity, and frequency. Building adaptation into urban governance requires responsive and flexible decision-making models.

Governance is also central to understanding the interaction of disaster risks in the city. As McGrenahan, Jacobi, Songsore, Surjadi and Kjellén (2001) have shown us, disaster risk is neither static nor isolated. Table 29.2 presents urban disaster risk as a continuum from everyday to small and large disasters. This includes technological and natural hazards and the potential for compound natural-technological events where one hazard triggers another. Everyday disasters are felt at the individual level and are caused by environmental health hazards, including inadequate sanitation or access to potable water or dangerous road use; they are the largest cause of premature mortality and injury in the city. Small and large disasters are caused by natural and technological hazards and differ in their scale of impact. The distinction is arbitrary but follows that used by the *Centre for Research on the Epidemiology of Disasters, Emergency Events Database* (EMDAT: <http://www.em-dat.net/>) allowing analysis of larger events. Very few countries or cities undertake systematic collection of small or large disaster data. This is a major challenge to comparative or historical analysis and has played a part in the lack of support given to mitigating small disasters, which are rendered invisible to city authorities and humanitarians through this lack of data.

Everyday hazards are typically studied and managed apart from small and large disasters, but each kind of disaster risk and associated vulnerability interact with each other. The ratchet effect of vulnerability describes the erosion of capacity following exposure to hazard (Chambers 1989). This can be seen where those individuals or households already weakened by

Table 29.2: The continuum of urban disaster risk.

	Everyday disaster	Small disaster	Large disaster
Frequency of exposure	Everyday or continuous	Frequent, can be seasonal	Infrequent
Scale of impact	Individuals	Less than 10 killed or 100 injured, no call for external assistance, no state of emergency	10 or more killed, 100 or more injured, external assistance required or a state of emergency
Impact on all premature death and serious injury	Main cause of premature death and serious injury in aggregate	Under-reported but considered to be significant	Can be catastrophic in particular places and times
Hazard types	Environmental health hazards including air pollution and traffic accidents	Localized natural or technological hazards	Major natural or technological hazards
Established, formal risk managers	Public health and critical infrastructure providers	Local emergency and recovery agencies	Local and external emergency, recovery and reconstruction agencies

disease or injury (perhaps forced to live in more hazardous conditions as household incomes are reduced) are less able to withstand the impacts of small or large disasters. Disasters that destroy environmental health infrastructure or local primary health clinics will have a long-term impact on local and city-wide vulnerability to everyday disaster. Food security and urban drought have the potential to cross from one classification to another, moving from being recognized as everyday to small and large disasters. There is little research on vulnerability to either type of urban disaster in the literature, creating a gap in knowledge that becomes more urgent under climate change and the continuing failure of cities to meet the basic needs and entitlements of the poor to sufficient nutrition and clear drinking water.

29.3 Urban Poverty and Vulnerability to Disasters and Climate Change

This section focuses on six overlapping aspects of vulnerability. Each aspect is relevant to understanding vulnerability to natural disasters and acts as a foundation for exploring vulnerability to extreme events associated with climate change (table 29.3). Climate change is felt in cities through increasing variability and extremes in temperature, precipitation, wind, and through sea-level rise. Cities magnify some hazards such as extreme temperatures through the heat island effect or the consequences of sea-level rise and flooding in cities affected by subsidence. Because urban residents and economies are connected into global financial and trade systems they are also exposed to climate change related shocks being felt across the globe. The 2008 global food crisis demonstrates this interconnectivity with a combination of changes in local planting regimes, increasing global demand, the failure of key regional harvests, and instability in the global financial systems resulting in price rises and increased hunger and malnutrition for the poorest. Locally, this fed back into the political system through violent protests, for example in Cameroon, Egypt, Haiti, Indonesia, Mexico, Morocco, Pakistan, Senegal, and Yemen (FAO 2008a). The following discussion equates climate change risk with extreme events and interprets larger systemic crises as global root causes for human vulnerability.

There is some tension between the application of terms within the disaster risk and climate change community (ISDR 2006). Within the disasters community mitigation describes interventions aimed at reducing local hazard. While a similar definition is used in climate change, the global orientation of the discourse has meant mitigation has come to be applied to reducing climate risk through controlling greenhouse gas emissions. Local actions to reduce subsequent hazard are described as adaptations. So climate change adaptation includes mitigation and vulnerability reduction efforts as conceived by the disasters community. Climate adaptation has come to replace coping as the term of choice in international development discourse. Where they are used together coping has come to signify the application of short-term and tried and tested responses to threat or loss, adaptation refers to more fundamental systems changes and suggests a novel departure from established routines of living with risk. In the following discussion ability

Table 29.3: Six aspects of human vulnerability to climate change. **Source:** Based on Satterthwaite, Huq, Pelling, Reid and Lankao (2008).

Exposure	Hazard mitigation	Early warning	Resistance	Resilience	Adaptation
Who lives and works in places most exposed to hazard?	Who lives or works in places where hazards are least contained?	Who lives or works in places where there is least capacity to avoid impacts before they arrive?	Who is least able to bare the physical impacts of hazard?	Who is least able to cope with the impacts and losses caused by a disaster?	Who is least able to change in order to reduce risk through exposure, mitigation, early warning, resistance or resilience?

to respond to threat and loss are included within an overall vulnerability framework. This reflects dominant conceptualizations of vulnerability which see it as an outcome of interactions between exposure to hazard, sensitivity to loss, and capacity to cope with/adapt to threat or loss. In this respect while individual formulations may differ in favoured terminology, the climate change and disaster risk communities agree.

The separation of the six aspects of vulnerability in the following discussion is heuristic. On the ground there are many policies or spontaneous actions that impact on multiple aspects simultaneously or through trade-offs where reduction of vulnerability in one area may generate vulnerability elsewhere, to another hazard type or for another actor. For example, investing in household retrofitting to protect a dwelling from strong winds may increase the resistance of the building in the long-term, but in the short-term, the household will have fewer resources to adapt to shocks from other hazard sources, for example a food price increase associated with global markets and climatic extremes.

29.3.1 Exposure

Exposure to urban hazards including those associated with climate change is a function of the location of residence or work. In theory this should be an outcome of land-use planning, but with more than 50 per cent of the population of many urban settlements living outside the formal sector, scope for planning is severely limited. Within already constructed settlements controlling exposure requires expensive retrofitting of buildings, or urban redevelopment and rehousing schemes to move people to less exposed locations. Unless undertaken with great care relocation can easily disrupt social and economic networks that sustain low-income households (UN-HABITAT 2007).

In cities that are expanding rapidly there is an opportunity to plan hazard exposure out of the city. However, there are few cases where this is being done. More often expansion of small and medium sized settlements or in the fringes of larger cities is unplanned or does not take hazard into account. The result is that urban expansion continues to bring new sources of hazard into the city as hill slopes, floodplains, and coastal wetlands are developed, exposing more not fewer people to risk.

Rapid urban growth can also expose the less poor living in the formal sector. This is especially so where the pace of expansion exceeds the ability of local governments to regulate construction, or where the demand for housing is given political priority over vulnerability management. In the UK, many have warned that extensive contemporary public housing development on the floodplain of the Thames is generating future hazard exposure and vulnerability (Lavery/Donovan 2005).

29.3.1.1 Hazard Mitigation

Exposure to hazard is mitigated by physical infrastructure. There is no shortage of technical ability and know-how including engineered drains, dams, river defences, sea walls and slope stabilization, however, the uncertainty imposed by climate change means that existing infrastructure and planning guidelines may not be able to cope with growing extremes in weather events (World Federation of Engineering Organizations 1999). Even without the uncertainty of climate change dominant political and economic concerns mean that many infrastructure projects were not built to disaster resistant standards leading to human exposure. This is an important element of urban risk showing that mitigation is not simply a technical exercise but a political one as well. A review of World Bank lending during the period 1984–2005 found that of 197 completed mitigation projects, 26 per cent showed flaws in design, and half had been damaged by a subsequent event (World Bank 2006b).

Mitigation can protect the exposed from direct hazard impacts and can also aim to limit indirect and systemic losses. Where disaster losses are contained by mitigation this can also help prevent or limit indirect losses caused by knock-on consequences of disruption of critical infrastructure and systemic losses when the urban economy is distorted following disaster shocks or the demand for goods during reconstruction. The wider impacts of climate change – for example on global commodity process – are beyond the scope of local or urban mitigation but show how international mitigation for climate change affects local vulnerability.

Successful urban mitigation brings together top-down and bottom-up strategies, large-scale civil engineering works with local adjustments such as hazard mapping and collective action to contain hazards through the construction of dams, drains, and revetments (UN-HABITAT 2007). A good example of this is the Naga City programme in the Philippines, which has integrated disaster risk reduction into urban planning, through the formation of disaster management standards and training of urban professionals and local stakeholders, and also established governance mechanisms to bring together neighbourhood level and city level planning (see: Asian Urban Disaster Mitigation Programme; at: <http://www.adpc.net/AUDMP/Phi.html>).

29.3.1.2 Early Warning and Evacuation

When a hazard exceeds mitigation capacity, early warning and evacuation can still prevent human loss. Experience from recent disasters, even from high-income countries (such as the US during Hurricane Katrina) emphasizes the challenges in extending early warning and evacuation to the urban poor (IFRC 2006).

Most state controlled early warning systems are oriented towards national security. This works well for large hazards – such as tropical storms, sea-surges, and for major urban areas which are important for the national economy and political stability. Less well covered are small and medium urban centres that have to rely on relaying national level warnings or develop stand alone early warning systems that can translate national alerts for local conditions. Thus, one challenge that prevents early warning from getting to those at risk is a lack of fit between national and local information needs. There has been much investment in city level early warning systems for geophysical hazards, for example through the *Earthquakes and Megacities Initiative* (<http://www.emi-megacities.org/>), but less work on developing systems that are locally relevant for hydro-meteorological hazards.

Where local early warning exists this has been shown to add value to national early warning. During Hurricane Mitch, the La Masica municipality, Honduras was protected by a community-based early warning system that proved more resilient than high-tech alternatives (IFRC 2005). Neighbourhood early warning systems are particularly useful not only in providing resilience through overlapping capacity and local control but because through this greater awareness of hazard and trust in warning is generated. Maintaining local early warning and hazard monitoring services for infrequent hazards is challenging because of limited finances and competing local priorities.

In short, the greatest challenge is not to increase the technical capacity of national early warning systems but to devise ways of translating available scientific information into forms that are useful for local populations at risk. This requires more investment in local early warning systems but also in innovative information dissemination strategies, such as the use of mobile phone networks to broadcast warnings (see chap. 93 Villagrán).

29.3.1.3 Resistance

Resistance describes openness to impact (and is referred to as susceptibility in the climate change literature). Both resistance and resilience share similar root causes and on the ground are often difficult to distinguish. This also means that interventions aimed at reducing susceptibility and a lack of resistance can also build capacity for resilience.

In people, resistance is shaped by physical and psychological health and indicated by age, gender, physical ability, and psychological state (Wisner/Blaikie/Cannon/Davis 2004). Higher impacts are associated with the very young or old, being a woman, disabled or injured. Women may suffer high losses (Enarson/Morrow 1998). Women and orphans can also lose out during reconstruction as assets are transferred away, often to male relatives (UN-HABITAT 2004). But demographic characteristics shaping resistance are not linear or necessarily cumulative, for example age can bring experience or social respect and so added individual security.

In property, resistance is indicated by design quality and standards of maintenance. Most cities have detailed design standards, which need to keep pace with the changing hazard profile of climate change. The main challenge is a failure to implement these standards (UNDP 2004). In the formal sector this weak-

ness is linked to cost-cutting, corruption, and the high demand for dwellings in rapidly expanding cities. Losses to the Marmara earthquake, Turkey in 1999 were predominantly felt by aspiring middle-income families who had purchased recently built flats constructed without applying basic construction guidelines. This disaster has led to a revision in regulation as well as planning laws in Turkey (Özerdem/Jacoby 2006; see chap. 38 by Gencer; 37 Tekeli Yeşil).

Most of the urban poor live in informal housing or in rental accommodation in the formal sector. Both housing sectors have very low resistance to natural hazard shock. Short term financial needs mean that few dwellings built in the informal sector consider natural hazard standards. As settlements mature and incomes grow there is scope for retrofitting, but this is more expensive than building safe dwellings. Those living in rental accommodation often have little knowledge of the standards used in construction. For the urban poor, lack of maintenance by landlords (both state and private sector) of basic services and high density living can generate its own health risks aggravating risk associated with the building's poor resilience to climate shocks (Pelling 2003).

Livelihoods can also be analysed in terms of resistance. For the urban more than the rural poor, the dwelling is a key productive asset. High levels of commodification in the urban economy make repairing and replacing the dwelling more challenging so that livelihoods can be disrupted should a dwelling be damaged or lost following a climate shock.

The most vulnerable are those who experience a triple burden of inadequate housing, human and livelihood frailty. As hazards associated with climate change become more frequent and severe the number of exposed people and places without sufficient resistance to withstand impacts will increase.

29.3.1.4 Resilience

Resilience describes the capacity of an individual, social group or physical structure to cope with and survive the impacts of a climate shock or stress. For poor households, a low level of assets relative to loss makes coping difficult as these are destroyed or sacrificed for survival. The range of coping strategies employed by households is described in figure 29.1.

Coping is presented as unfolding in a series of steps, with the potential for a return to pre-disaster livelihoods and social life. However, as external stresses, including disaster impacts, make resources scarcer the household finds it harder to return and over time can descend closer to economic and social collapse. The further down the coping staircase a household descends, the harder it is to recoup losses and emerge from coping to getting by and improving welfare.

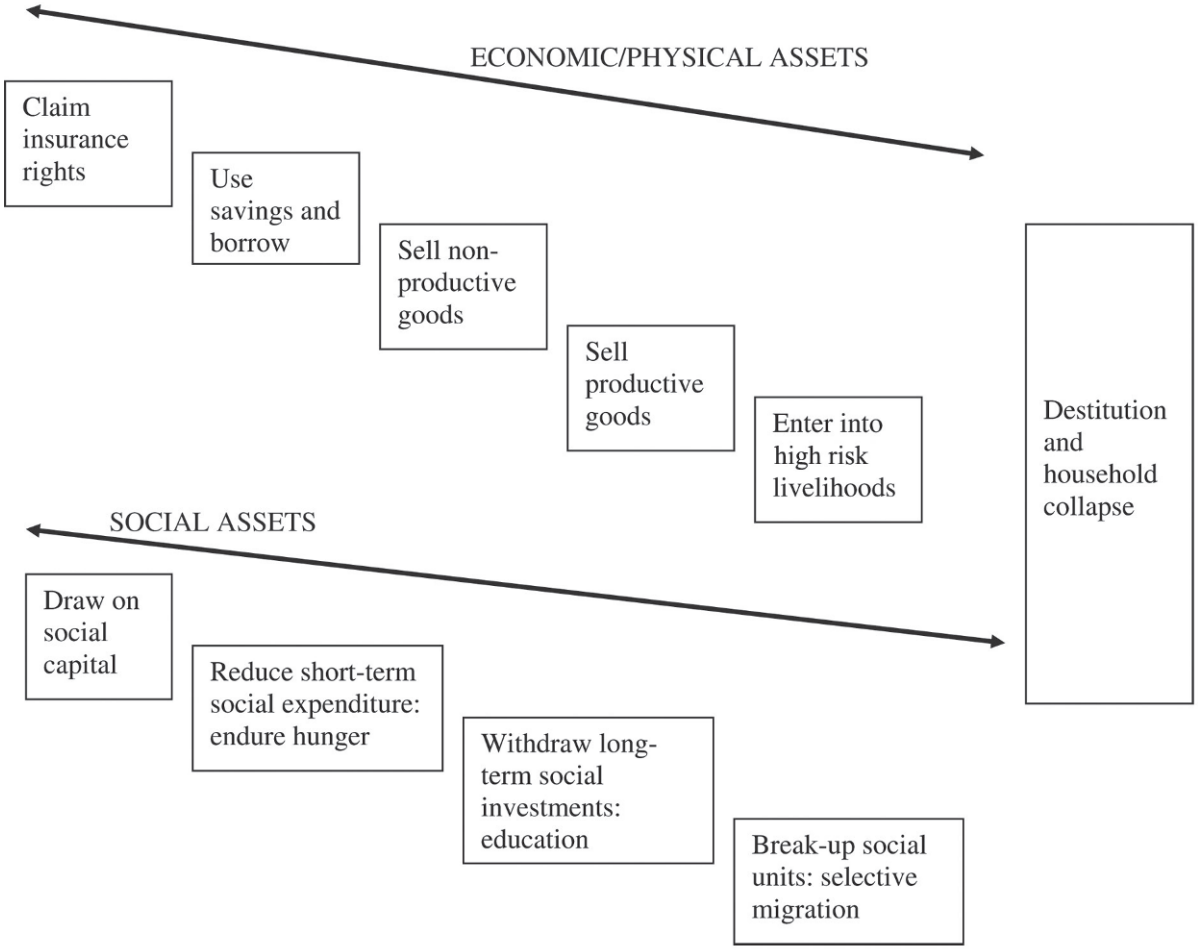
Economic and physical assets can be protected when losses are covered by insurance. For the poor this is seldom an option forcing households to cope by expending savings (which can act as an informal insurance mechanism), selling non-productive and productive goods. A last resort before destitution may be for household members to enter into exploitative livelihoods, the poor are vulnerable to engaging in work that jeopardizes their human rights and is dangerous with long hours of labour providing minimal return, and illegal or socially unacceptable activities including child labour and the sex industry.

Social assets can be protected if they are embedded in strong ties of social capital. Social capital is strengthened when used so those communities and individuals with stocks of social capital may build resilience when coping is successful. Where social capital is weak this can also impact directly on livelihood recovery. Following Hurricane Mitch widespread looting, on top of disaster losses, has been used to explain the slow rate of formal labour market re-entry, especially for women in Nicaragua and Honduras (Delany/Shrader 2000).

Where households suffer economic impact and have limited social capital three coping mechanisms have been identified. The order presented in figure 29.1 shows a continuum of severity rather than a chronology of deployment. Final choices are an outcome of household cultural context and households can jump from one element to any other and in both directions as indicated by the double headed arrows. The temporary withdrawing of children from school is common during times of stress, this cuts costs and provides scope for children to contribute to the household economy. Over the short-term reducing expenditure on food or medicine can help preserve the household economy even if it undermines social assets. Finally, before the household collapse children may be sent to live with relatives. This is socially acceptable and common in the English-speaking Caribbean, for example.

- Figure 29.1 identifies the primacy of economic resources and of social capital in determining whether a household will cope with the impacts of disaster shocks. Interventions by the state and civil society actors can support poor households at risk of slipping down the coping slope and build resil-

Figure 29.1: The coping slope: coping and erosion of household sustainability. **Source:** The author.



ience into the city through social policy. Key interventions and target populations include:

- Land and property tenure documentation before disaster and after disaster for widows and orphans to prevent loss of physical assets. This should be applied to the informal as well as formal sector.
- Extending insurance mechanisms to the urban poor through micro-insurance schemes.
- Supporting local social capital building through community development programming.
- Make health care and education zero cost for the urban poor to maximize access post-disaster.
- Provide flexible education to allow students to integrate work and study.
- Provide short-term and low or zero interest loans to slow down the drift into debt and the selling of assets.

Support for those whose households do collapse is a core component of reducing urban vulnerability. In contrast to rural disasters the majority do not gravitate towards shelters and refugee camps but are redistributed across the city, perhaps moving to different neighbourhoods or migrating to different settlements (Shelter Centre 1982). This is a dislocating experience serving to erode further the social and economic capital stocks of the most vulnerable. The homeless and those with marginal livelihoods are at risk from even minor subsequent shocks.

29.3.1.5 Adaptation

Adaptation in response to any aspect of vulnerability can target material or institutional change (Pelling/High 2005). The former includes using better building standards the latter changes in decision-making structures and governance. Adaptation can also be hazard specific or generic, responding to background stresses and opportunities of life in the city that in turn shape household assets and capacity for climate change hazard risk management.

Adaptation requires information to identify a potential future hazard or cause of vulnerability, information to identify an alternative mode of working or living that can reduce vulnerability, and the social/political will and resources to make a change. Proactive adaptation where hazards are infrequent but large is difficult. Will to change is often lacking even if scientific evidence of the threat exists. Here the best chance for adaptation is immediately following disaster events. To have the best chance of taking this opportunity, local actors need to be organized before disaster.

Proactive adaptation is preferable to post event adaptation. Work comparing prevention with humanitarian response shows the former is cheaper as well as saving human loss (DFID 2005). Given the lack of experience with building adaptation into urban planning, a good place to start is with disaster risk reduction activities (Sperling/Szekely 2005; Schipper/Pelling 2006). This includes an array of practical measures that enhance each stage of vulnerability identified in table 29.3. UN-HABITAT (2007) has documented examples of local, proactive risk reduction including:

- Participatory disaster risk assessment;
- Micro-finance and micro-insurance;
- Local early warning;
- Local mitigation including raising dwellings, clearing drains, slope stabilization, building bridges and walkways.

Local government led initiatives include:

- Land tenure regularization and upgrading of settlements;
- Relocation of settlements at high risk;
- Land-use planning to inform new construction;
- Updating and implementing building codes for disaster resistant housing and places of work;
- Protecting critical infrastructure; and
- Improving early warning systems.

City governments, line ministries, and civil society organizations can help provide an institutional environment that supports adaptation by the vulnerable – an agenda for progressive change in governance which is itself an adaptation, and perhaps the most fundamental one. The starting point for providing a supporting environment is legislation that recognizes the basic needs and human rights of the urban poor. Perhaps most important here is a right to secure housing and to safe places of work. Granting the poor rights of tenure to land can stimulate local actions to invest in upgrading the dwelling and can also help local government and civil society actors invest in social infrastructure to support mitigation and resilience and reduce hazard exposure.

City government can also directly invest resources to enable adaptive action through providing skills for the most vulnerable, including women, those with the most precarious livelihoods, and socially isolated groups such as recent migrants. Following the Gujarat earthquake in India a variety of projects helped to train local craftsmen in earthquake resistant building technique and then employ them in reconstruction programmes providing human and financial resources for the local economy. SEWA (2001) combined this with an emphasis on female employment and community led planning.

29.4 Conclusion

The aim of this chapter has been to outline the predominant forces shaping human vulnerability, particularly of the urban poor, to natural disasters and to use this as an entry point for exploring vulnerability to climate change. Discussions of vulnerability are necessarily political with different visions of the city leading to particular priorities for protection and potentially to competing interests and approaches for vulnerability reduction. From the perspective of the urban poor, climate change associated hazards are just one of a range of threats faced everyday and through small and large disaster events. This calls for an integrated meta-theoretical frame, and one that retains a focus on power asymmetries in driving the social distribution of vulnerability. Political economy can provide this level of analysis but is less good at revealing the mechanisms and networks through which information – and power – flows in shaping risk. For this reason it is argued that political economy needs to be nuanced with approaches from systems and complexity theory (Pelling 2003c).

This chapter presented a framework for unpacking the different aspects of vulnerability around the themes of exposure, mitigation, early warning and evacuation, resilience, resistance and adaptation, aspects that overlap on the ground but open different opportunities for policy intervention. Most important is the role of adaptation, which can operate across each of the former themes but yet is usefully separated to enable focused conceptual debate.

Across this analysis of urban vulnerability and adaptation the most important determinant of risk has

been governance and within this the role of local or municipal government acting to coordinate between sectors, scales, and areas of professional responsibility. In many cities, realizing the potential for local government to reduce risk is one of the biggest challenges in confronting urban vulnerability. It is likely that in searching for what makes urban systems better able to adapt to the uncertainties of climate change – including indirect economic as well as direct impacts through extreme events – adaptive management within inclusive governance will be key.

Adaptive management is not yet understood well, but can draw on research into social learning (Pelling/High/Dearing/Smith 2008) that identifies the need for clear communication, horizontal decision-making, flexibility in setting and meeting goals, and the need to build personal and professional trust so that information can move quickly across administrative systems. There is a danger that the high levels of trust found in adaptive management systems can lead to closed social circuits, and undermine equity and efficiency. It is because of this that adaptive management needs to be set alongside inclusive governance. Inclusiveness has been shown to enhance human and systems safety when support for local actors has been networked through civil society associations, and there is much support for this from the international community. Still, unless municipal government is put at the heart of vulnerability reduction, policy and analyses to understand the causes for urban disaster risk under climate change will be incomplete.

30 Vulnerability to Natural Hazards: Case Study on Landslide Risks in La Paz

Fabien Nathan

30.1 Introduction[1, 2]

Before the 1980's the study of risks and disasters was mainly focused on the features of hazards and on post-disaster reactions. Natural disasters were seen as the only result of natural forces: geophysical, hydro-meteorological or biological hazards. Pre-disaster intervention was reduced to engineering techniques (construction of dikes, contention walls, etc.); risk management was reduced to disaster management: emergency warnings, search and rescue operations with command and control schemes. This has dramatically changed since more than 25 years, partly triggered by a shift in the dominant paradigm. This chapter will briefly examine how this happened.

Historically, there were early attempts in human ecology by the Chicago School, since the end of the 19th century, to examine the relationships between man and nature, and the interaction between society and environmental hazards (Dewey 1938; MacIver 1931; Mileti 1999). Another starting point of social sciences' studies of disasters can be traced back to the study of Samuel Prince (1920) that raised pertinent theoretical questions about crises and social change but that have not been taken up until World War II. Then most researches focused on the psychological study of stress situations and behaviour in times of crisis and disasters, mainly war. These studies were generally driven by a Western vision, led by U.S. agencies (Lepointe 1984). It continued during the 1950's with the cold war. This situation of the field changed in the 1960's with the establishment of the Disaster Research Center[3] founded in 1963 by E.L. Quarantelly, Russell L. Dynes, and J. Eugene Haas (Dynes/Haas/Quarantelli 1967). They laid the foundation for the sociological study of disasters (Oyola-Yemaiel/Wilson 2006). At the same time, Gilbert White founded the human geography study of hazards and hazards management (White/Haas 1975; Burton/Kates/White 1993, 1977), and in 1976 he established the Natural Hazards Research and Application Information Center at the University of Boulder, Colorado.[4] These centres, researchers and studies initiated the multiplication of the hazard and disaster research in the world and its progressive widening. But behind these multiple approaches, Oliver-Smith (1986a) noted the creation of an "academic research consensus" dominated by sociology and geography, dividing into two branches: behaviourist and environmental. The first one puts the emphasis on individual and collective behaviour in disaster situations and the second one considers disasters as extremes of the geophysical process, minimizing the role of social factors.

For a long time, hazard and disaster studies have thus remained caught into a technicist paradigm with a post-disaster focus, attributing natural causes to natural disasters and considering disasters more than risks. But since the mid 1970's, this view was questioned, firstly by researchers working in the South who began to rethink the dominant explanations, putting the emphasis on the role of the social context in disasters, and criticizing the prevailing views on dis-

1 This chapter is based on the author's PhD research on *The Social Regulation of Disaster Risks. Study in the Western Peripheral Neighbourhoods of the City of La Paz, Bolivia*, under the supervision of Prof. Milbert that was defended in September 2009 at the IHEID, Geneva. More information at: <http://www.nccr-north-south.unibe.ch/Person/person.asp?contextID=&Context=NCCR&refTitle=the%20NCCR%20North-South&ID=709> and <http://www.afes-press.de/html/download_nathan.html> (papers available for download). Some results are available in Nathan (2008, 2009, 2009a, 2009b), the latter on the link between vulnerability and security.

2 For a complete attempt to understand the genesis, structure and logic of the field of global risk management, see Nathan (2004).

3 See for details at: <http://www.udel.edu/DRC>.

4 See for details at: <http://www.colorado.edu/hazards>.

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aster management. At the same time in the 1970's and 1980's, the world took progressive awareness of the devastating effects of multiplying disasters, and the necessity of a different response. Indeed, these years were marked by a dramatic raise of big disasters, such as the 1970 cyclone and tidal wave in Bangladesh (with 300,000 deaths), the 1976 Tangshan earthquake (China, with 290,000 deaths), the Armero eruption in 1985 (Colombia, with 25,000 deaths), and the great famines affecting the Sahel region in the 1970's and 1980's that had a big impact on public opinion and researchers (Meillassoux 1973), etc. The governments were spending increasing amounts of money to finance an emergency state that was becoming almost permanent. This explains the growing recognition that emergency assistance is not enough.

The creation of the *United Nations Disaster Relief Organization* (UNDRO) in 1971 that was replaced in 1992 by the *Department of Humanitarian Affairs* (DHA) to coordinate help and to promote also the study, prevention and pre-disaster planning is part of this change. The real paradigm shift was theorized among others by Cuny (1983), Hewitt (1983b), Watts (1983) and Oliver-Smith (1986). They put the emphasis on risks and discovered what is now considered as axiomatic in risk studies: vulnerability is the key to understand disasters, and there is no such thing as "natural disasters" (O'Keefe/Westgate/Wisner 1976).

This was followed by the *La Red* group[5] in the 1990's, emphasizing the concepts of *socio-natural disasters* (Fernandez 1996), *popular mitigation* (Maskrey 1993), risk management, etc. The famous book *At Risk* (Blaikie/Cannon/Davis/Wisner 1994) also brought some of the main theoretical insights and remains a major reference. Consequently, the field of questions, domains and disciplines concerned by the study of hazards, risks and disasters became enormous. Risk analysis now counts with thousands of publications in all directions, from history (Dourlens/Galland/Theys/Vidal-Naquet 1991) to econometrics (Mechler 2003), post-modern sociology (Beck 1992), conflict theory (Stallings 1988), political ecology (Bohle/Fünfgeld 2007), urban vulnerability analysis (Pelling 2003) etc. In turn, some major moves in the international world occurred in the 1990's, like the creation of the *United Nations International Decade for Natural Disaster Reduction* (IDNDR), ancestor of the current *International Strategy for Disaster Reduction* (UN/ISDR).[6] This gave birth to the Yokohama conference and Strategy[7] in 1994 that was updated in Kobe in 2005.[8]

The shift towards the study of what is happening *before* the occurrence of disasters is now widely recognized and understood through the rapid rise and triumph of the concept of vulnerability (Varley 1994; Bankoff/Frerks/Hilhorst 2004; Birkmann 2006; Cannon 2006; Villagrán de León 2006; Bererra/Peltier 2009). It is now so widely employed in many different fields that confusion sometimes arises around this notion. Security and international studies should better integrate these concepts and try to establish more bridges with risk and disaster studies (Nathan 2009). It has been noticed that one still lacks a robust theory of vulnerability (Kasperson/Kasperson 2001). It is essential to define these concepts, their usefulness and how they may be applied to better understand risks and disasters.

Therefore, this chapter explores the central concept of vulnerability (Nathan 2009a), as this is the absolute key to the understanding of risks, and ultimately why disasters happen. It will be done through a brief analysis of the literature but also how to best apply vulnerability analysis to a concrete case study on landslides in the city of La Paz, Bolivia. The chapter will first present what is vulnerability, how it can best be defined (30.2), what are the most useful existing frameworks for analysis (30.3), and how they can be combined and one of them applied to the case study (30.4). A new and simple method will be offered to analyse vulnerability at the household level.

30.2 Definitions and Conceptual Precision

30.2.1 Vulnerability as a Component of Risk

Vulnerability has emerged from a notion of everyday language to a more elaborated scientific concept. There are so many uses of vulnerability (Brutschin 2002) that it is very difficult to formulate a synthesis. Each author, institution or report has proposed its own, usually adapted to a specific context: research in hazards, climate change, food security, social sciences, psychology, health, etc. But generally it is possible to distinguish two types of definitions and their variants:

5 See for details at: <http://www.desenredando.org>.
6 See for details at: <http://www.unisdr.org>.
7 See for details at: <http://www.unisdr.org/eng/about_isdr/bd-yokohama-strat-eng.htm>.
8 See for details at: <http://www.unisdr.org/eng/hfa/hfa.htm>.

- *vulnerability as susceptibility*: a set of conditions, that raise the susceptibility of a community to the impact of a damaging phenomenon.
- *vulnerability as capacity*: the manner in which an exposed unit can anticipate, cope with and recover from hazard impacts.

Following Chambers' (1983) three categories of vulnerability, Hans-Georg Bohle (2001) has theorized this distinction as respectively *external* and *internal vulnerability*. The first one is representing the 'exposure', whereas the internal side represents 'coping', each side having its own theories to apply to. Many definitions combine both aspects, defining vulnerability as a compound that aggregates *negative* aspects (potentiality of having damages, incapacity to anticipate, resist, or cope) and *positive* aspects (capacity to cope, resist, recover). One of the most used in hazards and disaster research has been developed by Blaikie and colleagues:

> By 'vulnerability' we mean the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society (Blaikie/Cannon/Davis/Wisner 1994: 9).

Or even more clearly,

> vulnerability is a measure of a person or group's exposure to the effects of a natural hazard, including the degree to which they can recover from the impact of that event (Blaikie/Cannon/Davis/Wisner 1994: 57).

Cannon, Twigg and Rowell (2003) has summed up both approaches of vulnerability and capacity:

> The first conceives of them being the two ends of a spectrum, so that people who have a high degree of vulnerability are low in capacity (and vice versa). (...) The second perceives them as two distinct (or only partly inter-related) sets of factors (Cannon/Twigg/Rowell 2003: 4).

This chapter stresses the positive aspects in vulnerability definitions in order to avoid confusion: vulnerability is by essence negative, or we need to radically change its meaning. Vulnerability would then be both a susceptibility to undergo damages by specific hazards, and an *in*capacity to anticipate, cope, resist, or recover. On the contrary, capacities are not part of vulnerability but to reduce it, thus contributing to its opposite, resistance and resilience.

There is also a tendency to use vulnerability independently from the context, like 'vulnerable people' in general. It is emphasized that vulnerability in the absolute does not exist. It is both context-dependent and subject-dependent: *one* is vulnerable *to something*, in a given place and at a given time. There is a 'stake', i.e. someone or something is threatened, and there is a 'threat', i.e. a hazard, like a storm, an earthquake, etc. For instance, the people living in the Pacific coast in December 2004 were vulnerable to tsunamis, which created the conditions of the possibility of this disaster. They were at risk of a disaster triggered by a tsunami hazard.

One can define risk as a probability of undergoing damages by one or several hazards, and a disaster as a 'realized' risk, i.e. a social disruption provoked by the impact(s) of one or several hazards exceeding the capacities to cope by the affected society/people. Risk is a virtual and latent potentiality, and disaster is more concrete, observable, a sensible phenomenon, although it is also a question of appreciation (Perry/Quarantelli 2005).

The hazard alone is not able to 'convert' a risk into a disaster. For example, a heavy rain or an earthquake is not necessarily disastrous or a damage-generator. There must be specific conditions of vulnerability: the presence of populations, animals, ecosystems or valued objects (stakes) in hazardous areas (D'Ercole 1994); and some properties which render the damages possible: a certain fragility and incapacity to resist, face or cope. That is what the concept is covering. Vulnerability is thus a component of risk, the latter being the encounter of a hazard with vulnerable stakes. Risk as a probability of damages is closely related to hazards occurrence and severity, but at least as significantly to numerous other components: the *vulnerability* of the exposed unit, its *capacity* to anticipate, resist (*resistance* or *robustness*, see Van der Leeuw 2001), face the adverse consequences of the impact (*coping*, see Smit/Wandel 2006; Gallopin 2006), and adapt to come back to a functionally acceptable state (*resilience*, see Janssen/Ostrom 2006; Holling 1973; for a new framework on social resilience, see Obrist/Pfeiffer/Henley 2010). Many formalizations have been attempted, usually with poor results. It begun with R = H + V (Blaikie/Cannon/Davis/Wisner (1994, 2004) where R means risk, H hazard and V vulnerability) and was rapidly replaced by R = V x H in order to show the *combination* between hazards and vulnerabilities that shape risk (UN/ISDR 2002, 2004). As some scholars have argued that societies also have capacities to lessen risk, the variable C for coping appeared, as in UN/ISDR

(2002 :24): R = H x V/C. Others (ZEF 2002: 11) have tried V = H - C (coping).

What can be said is that risk is a function of hazard, vulnerability, resistance and resilience, the first two being multipliers of risk, and the last ones divisors: R = f (H, V / Resistance, Resilience). Between a hazard and its social translation into a disaster, there is thus a society at risk, more or less vulnerable, capable, resistant, or resilient. It is sometimes argued that capacities are part of resilience or resistance, and that resilience and resistance are the inverse of vulnerability: V = f(1/Rtce+Rlce). These conceptions and formalizations are defining risk as a state. It is now known that risk is an ongoing process shaped by all its components, and should be analysed synchronically but also diachronically (Oliver-Smith 1999). This is the same for vulnerability.

30.2.2 Definition

To sum up, vulnerability can be described on the one side as a *propensity to undergo damages*, i.e. a state of fragility that raises the susceptibility of the stake to suffer the impact of a damaging phenomenon. On the other side, vulnerability is the incapacity to anticipate, cope with, resist to, adapt to, and recover from hazards. Vulnerable units are either non-resistant, i.e. incapable of withstanding the shock (without adapting); and/or non-resilient, i.e. incapable of absorbing the shock and adapting back to a (functionally) acceptable state.

At the global level, the rise of the number and severity of disasters is more important than the increase of the hazards themselves (UN/ISDR 2004). This means that the vulnerability of the human societies has risen, i.e. they are more disaster-prone; their arrangements and organization favour the transformation of hazards into disasters. This shows the extreme importance of a good understanding of vulnerability. If all the pre-disaster conditions not directly related to the hazards can now be analysed through vulnerability, one could object that the concept is too broad, encompasses everything, and would therefore be unusable for analytical purposes. This is not so: even though it is very broad, complex and dynamic, it can be sliced to render the analysis possible, before reconstructing the entire puzzle in a more dynamic and relational way. For that purpose some frameworks are suggested to analyse vulnerability.

30.3 The Frameworks

This section reviews five of the most useful frameworks proposed in the literature to analyse vulnerability. Generally there are two types of approaches on vulnerability. In the debates they are often opposed or seen as contradictory. Some people work with a concept of vulnerability that is precise and varies according to the context, in particular the hazard related to it. Vulnerability to floods is different from vulnerability to droughts or earthquakes. Others prefer a more general concept, applicable to all hazards, sometimes called *baseline vulnerability*. It deals with general fragility factors that do not depend on the hazard and act as a general context: if they are present, the person or household is vulnerable, in general. Both approaches generally do not match very well with each other.

It seems in reality that the real division resides in the relationship to the hazard(s). Seen in that way the two approaches are complementary. On the one hand, the 'single-hazard-related vulnerability approaches' describe a vulnerability that is different according to the hazard. The protective measures, exposure factors or fragilities in relation to a hurricane are distinct to those related to a landslide. The 'single-type-of-hazards-related analyses', in turn describe vulnerability to one broad type of hazards, comprising several hazards of that type: vulnerability to natural hazards, or industrial, etc. These types of approaches ('single-hazard-related' or 'single-type-of-hazard-related' vulnerability assessments) comprise the classical analyses of vulnerability and those of the literature on risk management.

On the other hand, the 'multi-types-of-hazards-related vulnerability analyses', without necessarily conceptualizing it that way, analyse vulnerability to multiple types of hazards at the same time: natural hazards, social hazards (poverty, survival, violence...), etc., trying to understand the strategies and aspirations of the individuals, households and communities in their struggle for life. One finds here the literature focused on livelihoods, households, poverty reduction, access to assets, human security, etc.

It seems that both approaches are complementary, and that they can be applied simultaneously: first, consider the specific vulnerabilities according to the hazards, and then replace them in the general context of the social strategies of the actors in the face of adversity.

Below the main frameworks of qualitative vulnerability assessment will be reviewed. Table 30.1. gives an

Table 30.1: Overview of the main frameworks to analyse vulnerability. **Source:** The author.

Framework	Scale-analysed unit	Relationship to hazard(s)	Advantages	Limits
1. Analytical slicing	Works at all scales, but mostly used as general holistic analysis	Related to one or one type of hazards	Serves as a remainder of all broad dimensions that should be taken into account	Not relational nor dynamic; too linear; redundancies inevitable; does not provide any interpretation
2. Five components	Household centred, but includes upper levels	Related to multiple types of hazards	Comprehensive and articulate; relational between dimensions and scales; reflects people's priority on livelihoods; intermediary between pure analysis and proposal of interpretation	Does not relate enough with exposure factors; difficult to scale up
3. Vulnerability and capacity assesments (VCAs)	mainly community level	more related to one or one type of hazards	Insists on capacities and resilience factors; people- and practical-oriented, but serves also for research	Too simplistic; too much separated from the upper levels; too separated from power and governance analysis; lack of historical dimension; purely analytical
4. Livelihood	household level	related to multiple types of hazards (natural, social, etc.)	people- and practical-oriented; emphasis on the assets people have or need	vulnerability mixed with hazards and considered as a 'context', not a dynamic process; simplistic action theory (agency considered but not structure); too economically-driven; lack of power and governance analysis; lack of historical dimension; impossible to scale-up
5. Pressure and Release	general, holistic	Related to one or one type of hazards	causal, dynamic, obliges to trace back the root causes and have an interdisciplinary, holistic understanding	Categories too vague; does not help to explain the links between them; lack of methodology to apply it.

overview of their scales, advantages and limits, and table 30.2. analyses their commonalities and differences.

Below the frameworks will be examined one by one.

30.3.1 Assessing Vulnerability through Analytical Slicing

The first model for the analysis of vulnerability to natural hazards is a decomposition in analytical parts (Nathan 2009). It is a inspired by Bohle (2001) and Wilches-Chaux (1993).Vulnerability has two sides in interaction: the exposure (a), and a series of insufficient capacities (b):

a.) Exposure refers to the following features:

1. *physical exposure*: presence and density of the people, habitat, networks, ecosystems, goods and services in risk zones, defining potential losses or damages, both human and non-human (stakes).
2. *socio-ecological exposure*: human-induced ecosystemic perturbations aggravating the natural

Table 30.2: Commonalities and differences among five frameworks. **Source:** The author.

Scale	Scope	Contradictions and possible combinations	What is still lacking
• 1 and 5 are general • 2, 3 and 4 are mainly household-oriented • 2 and 5 allow cross-scale analysis • 1, 3 and 4 are single-scale	• 1, 3 and 5 are purely analytical and theoretically neutral tools that need to be nourished by interpretational content. • 2 and 4 propose a middle-range interpretation • 2, 3 and 4 give methodological hints to help application; 1 and 5 not.	• 1, 2, 3 and 5 are basically compatible: within the broad 5. • may enter all dimensions of 1 that include both vulnerabilities and capacities, and can be eventually regrouped into the five categories of framework 2 to provide a beginning of interpretation, at a general level. • Some parts of framework 4 may enter into the analysis (e.g. capitals as capacities) but the underlying theory of action is not really compatible with 2 and difficult to upscale to 5.	All frameworks fail to present a more advanced combination between the analysis (what dimensions need to be taken into account) and interpretation (how to explain the construction and current existence of vulnerability in a given setting).

hazard (deforestation, land degradation, street pavement, some engineering practices, climate change, etc.).

b.) Insufficient capacities to prevent, prepare for, face and cope with hazards and disasters

1. *physical weakness*: insufficient capacity of an individual or an asset to resist or recover from a hazard's impact.
2. *juridical-legal*: inadequate state of the legislative and judiciary regulations to prevent, mitigate, prepare for, face and recover from disasters.
3. *institutional*: inadequate state of the institutional disposals, at all levels, to prevent, mitigate, prepare for, face and recover from disasters.
4. *technical*: technical factors impeding to prevent, prepare for, face and cope with hazards and disasters such as: inadequate knowledge and/or use of risk management techniques.
5. *political*: political factors impeding to prevent, prepare for, face and cope with hazards and disasters.
6. *socio-economic*: social and economical elements which raise the susceptibility of undergoing disasters and lower the capacities of self-protection, such as: socio-spatial segregation, inequalities of wealth and of access to the security disposals, misery, anomia and social disorganization, poor social position and social isolation of exposed people, existence of higher social hazards undergone by people, etc.
7. *psychological and cultural*: psychological and cultural factors impeding to prevent, prepare for, face and cope with hazards and disasters such as: inadequate security paradigm or risk perceptions; cultural anomia or weakness; attachment to risk zones or risky behaviour, non-willingness or incapacity to protect oneself.

The overall vulnerability (Wilches-Chaux 1993) of someone, a community or a society is a mix of some or all of these dimensions. Almost all of these vulnerabilities include an informational dimension: lack of information, bad information, misinterpretations, etc. (White/Kates/Burton 2001). They are also generally both collective and individual, so the model can be applied at all levels (societal analysis as well as household-centred or individual analysis). This is a neutral, purely analytical framework that serves to remind about the main dimensions that should be taken into account in synchronic vulnerability analysis. However, it does not help to draw connections between the categories or study of the genesis of vulnerability.

30.3.2 Terry Cannon's Five Components of Vulnerability

A more articulate classification of vulnerability components has been elaborated by Terry Cannon (2006). It reflects people's priority on livelihoods and constitutes an intermediary level between pure analysis and interpretation, as it gives a vision of the importance for the household of broader structures such as social protection, the governance system, and the like.

- *Livelihood and its resilience*: assets and income earning activities;
- *Base-line status*: initial well-being: health (physical and mental), nutrition;
- *Self-protection*: quality of house construction and location;
- *Social Protection*: adequacy of building controls; large-scale measures;
- *Governance*: power system, rights, status of civil society.

The degree to which a household is vulnerable depends on its livelihoods (assets and income earning activities), initial well-being (health and nutrition), self-protection (quality of house construction and location), the social protection provided by society, and its governance structures (power system, rights, etc.). This analysis takes into account different social dimensions and levels of analysis: the individual vs. the household level and its relation to broader social structures. It is more relational and very informative. But the application is mainly a household-centred one and it remains difficult to upscale.

30.3.3 Vulnerability and Capacity Assessment Models

The second dimension of vulnerability is a series of insufficient capacities. It is generally not a binary matter of presence or absence of a capacity, but more of a degree in which people are *not capable enough* to resist or recover properly. Therefore the analysis should not be purely pathogenic, but seriously consider the capacities, abilities to cope, i.e. the elements lowering the vulnerability and contributing to *resistance* and *resilience*. It is increasingly recognized that risk analysis must encompass an analysis of vulnerability and capacity.

Field workers, unsatisfied with usual mitigation methods, proposed a tool called *vulnerability and capacity assessment* (VCA), but its application by social scientists is still in its infancy. They consider vulnerability as being predictive and applicable, as for example Cannon, Twigg and Rowell (2003: 4): "Vulnerability should involve a predictive quality: it is supposedly a way of conceptualizing what may happen to an identifiable population under conditions of particular risks and hazards. Precisely because it should be predictive, [vulnerability assessment] should be capable of directing development aid institutions." The first comprehensive attempt to propose a VCA, by Anderson and Woodrow (1989: 12), proposed a matrix of vulnerabilities and capacities with three categories:

- *Physical and material*: "What productive resources, skills and hazards exist? ...What made the people affected by disaster physically vulnerable: was it their economic activities ..., geographic location ... or poverty/lack of resources?"
- *social and organizational*: "What are the relations and organizations among people. ... What [was] the social structure (...) before the disaster and how well did it serve the people when disaster struck? ... What impact do disasters have on social organization?"
- *motivational and attitudinal*: "How does the community view its ability to create change. What are people's beliefs and motivations, and how disasters affect them?"

This matrix is both a conceptual tool and a tool to guide practical assessments in communities. For Cannon, Twigg and Rowell (2003: 10), it should be completed by five factors: "disaggregation by gender, disaggregation by other differences (e.g. economic status), changes over time, interaction between categories, and different scales or levels of application (e,g, village or national levels)." Strangely enough, they oppose vulnerability to needs:

"Vulnerabilities refer to the *long-term factors* which affect the ability of a community to respond to events or which make it susceptible to calamities. Needs, as used in disaster context, refer to immediate requirements for survival or recovery from a calamity" (Anderson/Woodrow 1989: 10).

Other attempts are being developed to create practical tools for community leaders or NGOs to assess vulnerabilities and capacities[9] that are useful mostly for practitioners. These types of VCA have the advantage of being very practical, operational, by insisting on skills and capacities of the exposed or affected people that are usually underestimated or misunderstood by risk managers. It also insists on the social and cultural aspects, as the OXFAM methodology does: "vulnerability is quite explicitly seen as a social phenomenon that is related to level of exposure to risk ..., in combination with a range of factors ...

9 See for example the Community based Vulnerability and Capacity Assessment (VCA) in Central America <http://www.proventionconsortium.org/?pageid=32&projectid=9> or Guidelines for vulnerability and capacity assessment (VCA), IFRC at: <http://www.ifrc.org/what/disasters/dp/planning/vcaguidelines.asp>.

that affect people's ability to cope with their exposure" (Cannon/Twigg/Rowell 2003: 36). On the other hand, it is very simplistic and too much separated from the upper levels. It is also very separated from the power and governance analysis. To sum up, it is more a practical tool than a framework for researchers.

30.3.4 Livelihood Approaches

30.3.4.1 Sustainable Livelihood

A whole area in disaster research is developing around (*sustainable) livelihoods* (SL), considering "vulnerabilities, of all kinds, as part of the context in which livelihoods are shaped" (Twigg 2001: 8). This approach is well known (De Haan/Zoomers 2005; Carney/Drinkwater/ Rusinow/Neefjes/Wanmali/Singh 1999) and close to human security-based approaches and Amartya Sen's concepts of capabilities and entitlements (Sen 1999). It originated in a work done by Chambers and Conway (1992: 1) who defined it as follows:

> a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term.

The aim of the model is both analytical and normative: "The SL approach seeks to understand the many factors influencing people's choice of livelihood strategy and then to reinforce the positive aspects ... and mitigate the constraints" (Twigg 2001: 12).

This framework may be summarized in the following manner (Solesbury 2003): a *vulnerability context*, in relation to some *transforming social structures and processes*, and a series of *livelihood assets* (equivalent to capacities, both material and social) determine some *livelihood strategies*, to end up with *livelihood outcomes* (food security, income, reduced vulnerability, etc.). Categories of vulnerability are *trends* (large-scale social, economical, technological and political), *shocks* (health, natural, economic, conflict, crop) and *seasonality*. Capacities are resumed in *five capitals*: a) *human* (skills, knowledge, health), b) *social* (relations), c) *natural* (resources), d) *physical* (infrastructures to support livelihoods), and e) *financial*. "Transforming structures and processes" are institutions that, from a sociological perspective, determine the livelihoods, the possible strategies, etc.

The five capitals remind the reader of Pierre Bourdieu's (1983; 2002) four capitals, but in a quite modified version; another underlying theory is institutionalism, as the analysis of the role of "transforming social structures and processes" on livelihoods is a simplified institutional socio-economy. The discussion on capitals (Bebbington 1999; Moser 1998) has resulted in thousands of publications, especially on social capital (Wisner 2002a). The capitals are viewed as assets people need to make a living and cope with adversity (Glavovic/Scheyvens/Overton 2002). One of the main concepts in this discussion is access, remarkably paved by Penchansky and Thomas (1981), although still little followed.

This kind of explanation is nothing more than an attempt to explain actor's strategies around livelihoods, something that sociology has tried for more than a century. But this has the advantage of proposing an alternative view on disasters and security, considering "the significance of hazards and their impact ... in the vulnerability/livelihoods equation" (Twigg 2001: 16). Indeed, "vulnerable people and victims of disasters, without using theory, will always place the disaster in the context of their daily struggle to earn a living and feed their families. They can also articulate these issues clearly, if they are given a chance" (Twigg 2001: 16).

The framework is nevertheless limited by several elements: vulnerability is somehow mixed with hazards ('trends, shocks, seasonality') and considered as a 'context', not as a dynamic process linked to the household; the action theory proposed is very simplistic (agency is considered but not structure); it is also too economically-driven and lacks a power and governance analysis, and a historical dimension. Finally, it is impossible to scale-up.

30.3.4.2 The Access Model

Blaikie, Cannon, Davis and Wisner (1994: 48) have developed a model of disaster risk centred around the household level and livelihoods: the *access model*, which is quite similar to the SL model and obviously served as a basis for it. Access refers to "the ability ... to use resources which are directly required to secure a livelihood." [10]

As access to resources is essential to maintain livelihoods, less access means an increased vulnerability. In short, an individual or a production unit have spe-

10 It is close to Amartya Sen's *entitlements theory* developed in his studies of famines (Sen 1984).

cific resources and assets, material and immaterial, determining a specific access level and further economic opportunities and decisions that are also influenced by structures of domination. These decisions lead to livelihoods, a household budget, and further choices, which in turn lead to an outcome: changes in the access profile.

In the second edition of *At risk* (Blaikie/Cannon/Davis/Wisner 2004), the authors take into account the critiques made to them in almost a decade (e.g. Haghebaert 2001) as well as theoretical developments in order to present a more sophisticated model. It now comprises the different temporal dimensions that lead to the 'unfolding' of the disaster, among them the time of the hazards, of the household activities, strategies and opportunities, the seasonality, the temporal development of the political, class and domination structures, the times of the emergency phase and coping strategies, etc. This reflects the historical dimension of vulnerability, hazards and disasters, and to take into account the transformations of the household analysed but also of what is external to it in a dynamic way.

However, the framework seems difficult to apply and the authors do not really propose a methodology for that. Another constraint is that even if it takes the social structures into account, the model remains mainly economic. Even if an interesting discussion on needs is proposed to analyse coping, it remains difficult to understand with this model all non-economic determinants of household vulnerability, and how the structures of domination really operate at the household level. The authors' 'Pressure and Release' framework, complementary to the access one, insists more on these structural aspects.

30.3.5 Pressure and Release Model

This famous and widely reproduced *pressure and release* (PAR) model is based on the idea that "... an explanation of [a] disaster requires us to trace a progression that connects the impact of a hazard on people through a series of levels of social factors that generate vulnerability" (Blaikie/Cannon/Davis/Wisner 1994: 22). It is the only framework of disaster risk and vulnerability that clearly distinguishes between the different causal levels. It is also one of the most ambitious ones, allowing a real social science analysis.

In the framework, the disaster is crunched between the hazards on the one side, and the "progression of vulnerability" on the other. Vulnerability starts from "root causes", a "set of well-established, widespread processes within a society and the world economy, [which] reflect the distribution of power." These political and economical ideologies and systems translate into activities and processes called "dynamic pressures," which are "macro forces" (e.g. urbanization, debt repayment schedules, etc.) and incapacities (a series of lacks). These pressures, in turn, create the "unsafe conditions" which express the vulnerability to hazards of a specific population (exposure of buildings, specific groups, livelihoods; lack of local institutions; endemic diseases, etc.). In short, "the unsafe location is linked [to] a series of dynamic pressures that can be traced back to root causes" (Blaikie/Cannon/Davis/Wisner 1994: 23).[11]

The great merit of this framework is to recognize that the deepest causal factors "may ultimately be quite remote from the disaster event itself" (Blaikie/Cannon/Davis/Wisner 1994: 22), therefore operating a breech with common sense and allowing to construct a scientific object, with a "chain of explanation." It also reminds researchers, that risk and vulnerability are processes that develop through time, thus necessitating to make synchronic as well as diachronic analyses to trace its genesis.

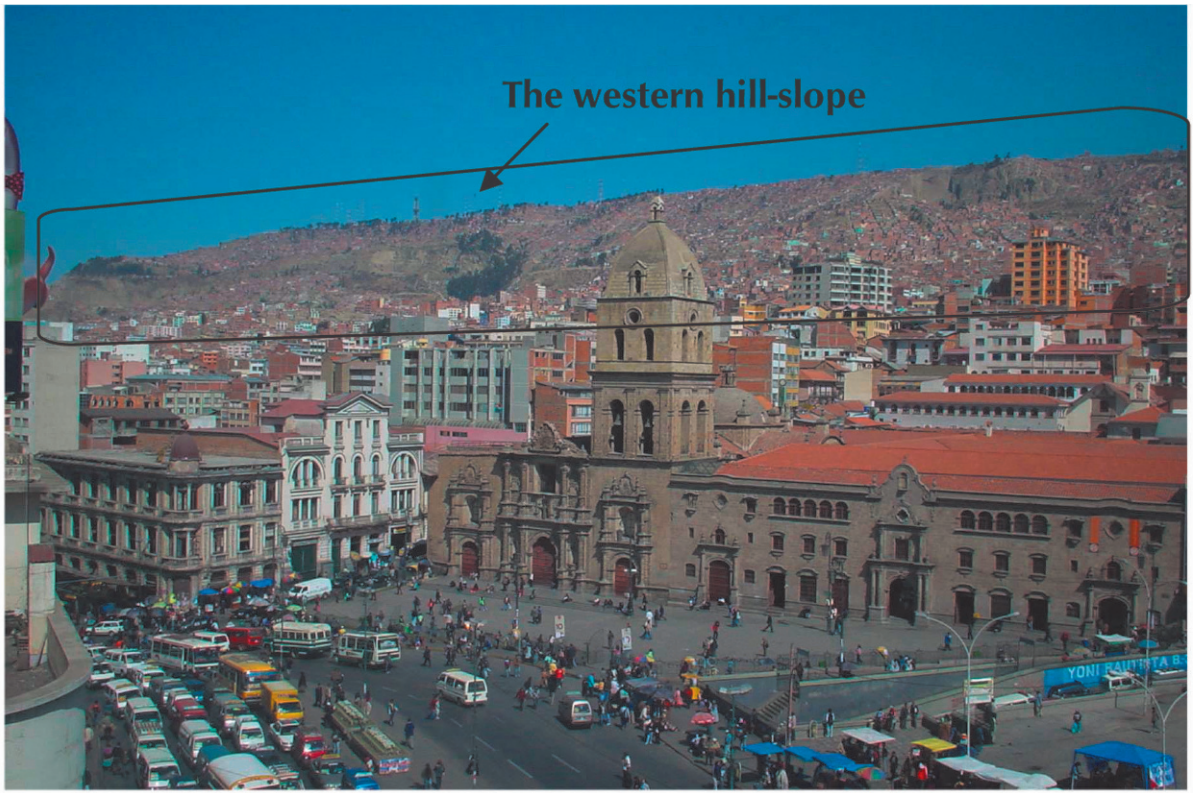
Only with such a 'grand' analysis is it possible to identify and correct the determinants of disaster risk which lead to human insecurity. The authors postulate that it is possible to inverse the progression of vulnerability by addressing root causes, reducing pressures and achieving safe conditions.

30.4 Application to the Case of Landslides in La Paz

The city of La Paz (figure 30.1), Bolivia, is situated in the Andean Mountains, between 2,800 and 4,000 meters high. More than 500,000 people live in the hill slopes surrounding the city centre, many of them in poverty and precarious conditions.

11 The 'Pressure-State-Response' Framework of OECD (2003) is probably inspired by this framework, driven by the need to show in a simple manner human-environment interactions. It is not really focused on disaster issues but more on the ecological services and consequences of human actions on it, and ultimately on society. The human actions exert a pressure on the natural environment which reacts to these pressures by qualitative and quantitative changes. In the face of that situation, human societies elaborate societal responses (mitigation, protection, etc.).

Figure 30.1: The western hill slope viewed from the city centre. **Source:** Photo of the author.



Many of the people live in slopes of more than 50 per cent and are highly exposed to hazards like landslides, mudslides, land/debris fall, and the collapse of their house because of the instability of the soils due to many subterranean rivers. The neighbourhoods are densely populated and composed of adobe houses (made of mud) or red brick houses built without expert advise and generally by the owner himself (figures 30.2, 30.3 and 30.4)

The fact that thousands of poor people are relegated into the peripheral zones of the city at risk is a well-known phenomenon in many cities of the South. What is more place-specific is the history of risk and the progression of vulnerability in La Paz. It all started by the choice of the location of the city by the Spanish colonizers, but the risk really became massive since the 1970's and 1980's, when the migrants from the countryside were pushed into the cities, in Bolivia and elsewhere, and in particular towards the city of La Paz. This has occurred mainly because of the growing difficulty to make a living in the countryside, and after 1985 the brutal neoliberal adjustment expelled thousands of workers out of their jobs, worsened the living conditions, and pushed people into the informal urban economy. Yet the peculiar topography of the city leaves very few habitable spaces that were rapidly taken by those who could afford it. Thus, the poor migrants had no choice but to buy or invade the remaining lands, those most unstable: the hill slopes. Risk was the price to pay for them to be able to live in the city. At the same time, the authorities were incapable or unwilling to plan and control these massive population movements, and let the greediest speculate with lands. Until now there are very few restrictions of control of the market of urban landownership in La Paz, and everybody knows that the norms of land use remain largely unenforced. The people in unplanned and unrecognized neighbourhoods would progressively gain the legalization of the neighbourhoods, with increasing consolidation (more public services) and enhancements. However, the problem of the exposition of considerable amounts of people to natural or socio-natural hazards remains difficult to solve, resulting in frequent small to medium-scale disasters (from minor damages to more than 30 deaths in a row). There are also a myriad of other factors that contribute to vulnerability, be them physical, legal, institutional, technical, political, socio-economic, psychological and cultural, at all scales: individual, house-

Figure 30.2: Some exposed houses in La Paz, western hill slope. **Source:** Photo of the author.

Figure 30.3: Views of some exposed neighbourhoods in La Paz, western hill slope. **Source:** Photo of the author.

hold, community, municipality, etc. That is why it is a good example to test the frameworks and see how they can be used and combined.

Combining the 'analytical slicing' with the 'Pressure and Release' framework provides a general idea of the vulnerability of the city of La Paz and its inhab-

Figure 30.4: Views of some exposed neighbourhoods in La Paz, western hill slope. **Source:** Photo of the author.

itants to landslides hazards (table 30.3). An additional dimension may be added between the dynamic pressures and the root causes, if we stick to the definition of the latter as the root processes that deal with the distribution of power within a society. Indeed, there may be an intermediary level of analysis, like migration, socio-spatial segregation or misery that is causal to the dynamic pressures but not really constituting the root processes of the political economy. We also choose to leave the 'root causes' as well as some of the causes as question marks, because although it is fascinating to do, analysing that goes beyond the scope of this chapter and deals with the Bolivian society's overall political economy. The reader will notice some redundancies, like 'misery' or 'migration' as causes appearing several times, which is normal: misery can be one of the cause of a physical incapacity to cope (e.g. poor health) as well as a lack of worry for disaster risks, because of the law of adaptation of the expectations to chances Bourdieu had revealed (Bourdieu 1992). Migration from the countryside can also be one of the causes of a lack of knowledge of the hazards in urban setting, as well as of an inappropriate construction technique, imported from another context where these abilities are well adapted.

The table offers a causal progression of vulnerability from the right to the left, for each type of vulnerability - those who pertain to the exposure and those who constitute the insufficient capacities to prevent, prepare for, face and cope with hazards and disasters.

Each line represents a type of vulnerability; the columns represent the progression of this vulnerability to landslides in La Paz, from the existing unsafe conditions to their root causes, going through the dynamic social pressures that lead to the existing vulnerability. It is important to understand that vulnerability is a complex compound of mainly socio-economic and organizational aspects that derive from social causes quite remote from the disaster but that is leading to an increased and effective vulnerability. These vulnerability types and their causes are related to each other and must be analysed in a dynamic way. Some causes that ultimately contribute to vulnerability to landslides in La Paz, as shown in table 30.3, are misery, lack of resources, socio-spatial segregation, migration, scientism and technicism, absence of care by powers for certain social sectors, etc. They are the causes of the pressures that lead to exposure and the incapacity to prevent disasters or cope with them. In turn, explaining their root causes would require another type of political economy analysis.

As the results of the application of the above framework are very general, it is important to combine it with other methods which allow understanding the process of the construction of risk and vulnerability closer from the people exposed, at the

Table 30.3: Some dynamic factors of vulnerability to landslides in La Paz, Bolivia. **Source:** Compiled by the author.

Progression of Vulnerability —— Types of Vulnerability	Unsafe Conditions	Dynamic Pressures	Causes	Root Causes
		Exposure		
Physical Exposure	Presence of houses, people and goods in landslides areas	Settlement in hazardous zones	Socio-spatial segregation	?
Socio-ecological Exposure	Perturbed ecosystems in La Paz	Deforestation; Inadequate water management and waste management; Destabilizing of soils	Migration; Lack of technical knowledge; Lack of ecological management	?
Insufficient capacities to prevent, prepare for, face and cope with hazards and disasters				
Physical	Physical incapacity to resist or cope with impacts	Diseases; Impossibility to cure oneself; Bad quality of housing	Misery ; Cultural mistrust	?
Juridical legal	Inadequate legal system for prevention and mitigation	Non-application of norms for land use planning; Absence of compliance and control mechanisms	Disorganization; Lack of human and financial resources for effective application	?
Institutional	Lack of an overall and coherent organizational risk management system in the city of La Paz	Confusion, lack of coordination between risk management organization; Lack of overall prevention strategy	Scientism; Technicism; Lack of resources	?
Technical	Bad use of risk management techniques: construction without contention walls and with bad foundations, lack of drainage of water, weakening and destabilization of soils for construction, bad state of canalizations for water management	Lack of ecological management; Lack of technical knowledge; Autoconstruction	Migration; Lack of resources of individuals and organizations	?
Political	Lack of integral risk management policies in La Paz	Weakness of political powers and instability; clientelism, lack of long-term vision	?	?
Socio-economical	Misery: very low income which hardly allows a minimal alimentation; malnutrition of children; extreme isolation: lack of social capital and solidarity; impossibility to sell the house and have access to credit. unemployment and informal economy; job instability	Economic crisis; Unequal structure of landownership; Vertical structure of power; Differences of power among neighbourhoods	?	?
Psychological and cultural	Underestimation of risk; Lack of preoccupation of risk and disasters; Wrong beliefs: that the soil is stable for example; Resignation	Existence of more important social hazards: unemployment, livelihoods, violence; lack of education in risk and risk management; lack of trust in existing institutions and organizations; massive unemployment	Misery; Absence of care by powers; lack of resources for education; high tolerance to risk; Migration	?

household level. In his field study the author used among others a methodology that is partially inspired by the livelihood framework, partially by Terry Cannon's classification, but above all adapted to the specific research needs. It will be shared here because it may be applied to other contexts, although it may be developed much further. The author used an interview guide that was used for the heads (male, female or both together) of the households at risk, working only with people highly exposed (quasi independent variable) in order to understand their perceptions, their trajectory, their vulnerability and capacity to cope, and the way they manage risks in their daily living (dependent variables). This allows to see how the big structures that may act as causes or root causes in table 30.1. (e.g. the state of landownership, neoliberal policies that led to a microeconomic crisis, etc.) are transformed, lived, experienced or embedded at the individual/household level. For example, it shows how people are somehow forced to settle in risk zones, why, how they cope, what is their current grade of vulnerability, what are their household strategies, their social position, etc. The interview guide tries to inform eleven elements: a general self-presentation of the family, its trajectory, conditions of habitat, how they perceive the neighbourhood and what are its main problems, the economy of the household, its health, its relationships with friends and relatives, the relations with organizations, risk perception, past emergencies and risk management in their daily living. If conducted properly, this offers the researcher a general picture of the household, not only of its perceptions but also some objective elements of its situation. The qualitative analysis and interpretation of each category gives rich ethnographic data, and this allows to conclude with a general interpretation of the interview, including the following information: understanding of the reasons of exposure-taking and the trajectory that led to it; general situation of the household and social position, the habitat, some elements of exposure, the perception of risk and lay risk management, the cultural, social and economic capitals available, and if relevant the governance issues related to the neighbourhood (this should also be gathered by other means, like participant observation and interviews with key informants). This permits conclusions on the state of the household's self-protection and social protection that contribute to vulnerability or resilience, and thus qualify and understand closely the people's vulnerability in the field.

One example of analysis and interpretation of an interview we realized is the following (skipping the analysis of the 11 categories above-mentioned):

A and B[12] live in a tiny adobe house, on a rocky headland eroded from below and above the precipice. Their young children are wearing second-hand clothes and do not seem to be in good health. One of them is coughing. The room where the parents and their four children use to sleep is minusculous, humid, and only comprises two small beds. The ground is made of clay and the ceiling is made of distended cloth.

A and B form a family of migrants from the Altiplano who came to settle in La Paz since a decade because of the difficulty to live in the countryside. They live in a house that was donated by the father of A, who had bought there a long time ago in prevision for the future of his children, when the hill slope was still empty land. Their material conditions are very harsh, living in misery without being able to satisfy their vital needs (food, health, basic services, housing). Their exposure to landslides is very high, living in an adobe house sensible to humidity, victims of water infiltrations and having cracks in the walls, without real rainwater drainage nor sanitation, just above the precipice on an eroded rock, etc. Their cultural capital is very weak (primary school, strong peasant accent in Spanish) and their social capital reduced to the minimum (meetings of the neighbourhood's organization, few relations with neighbours). In other terms, they cannot count on anyone to help, moreover their position within the neighbourhood seems weak (symbolic capital very low), and they do not feel legitimate to seize the existing institutions. Their economic capital and their income are largely insufficient because of A's lack of a regular and secure job, the fact that he gets very low income when he manages to get paid, and the absence of protection and respect for labour legislation.

In contrast, their perception of the hazard, of the exposure, of risk and of the solutions is extremely precise, conscious and developed, though without having the means to cope, which contributes to their despair. They know that their house will, sooner or later, fall, but they are incapable of moving, reinforce or protect the house, or obtain protective measures from the authorities or from the neighbourhood leaders. The few measures of self-protection they take during the rainy season are insignificant when compared to the magnitude of the problem.

12 A stands for the name of the husband and B of his wife.

Figure 30.5: Some exposed houses in La Paz, western hill slope. **Source**: Photo of the author.

Their social protection is almost non-existent: they are not well taken into account by the community leaders or by the authorities; they have no health protection, pension or social benefits; the precariousness at work is absolute, etc. The children are victims of that state, without possibility to get treatment when ill, and with few possibilities of social promotion. The family's vulnerability, as much to the natural as to the socio-economical hazards, is thus maximal.

30.5 Conclusion

The chapter focused on the notion of vulnerability in order to clarify its meaning, its uses and the models for qualitative analysis. It was replaced in the history of the discipline and this showed that although it is now widely used, the paradigm shift that accompanied its appearance and proliferation is recent, and science still lacks a more developed theory and methodology for vulnerability analysis. The author reviewed the compatibility and differences among major frameworks and concluded that there are two framework types and that there is a compatibility among many of them. But the real challenge is their application in concrete case studies. Almost no methodological insight is provided to achieve a practical application, apart from the VCA analyses that were designed from the start for practitioners. In moving towards this direction, the author proposed two ways of applying the frameworks in a creative manner to the case of landslide risks in the city of La Paz, Bolivia. The first was deliberately at a general scale, i.e. at the level of the city or society. It focuses primarily on vulnerabilities more than on capacities. The second is a personal simplistic but practical way of evaluating qualitatively the vulnerability and assets or capacities of exposed households based on semi-directive interviews and life stories with family leaders. The author used it in his PhD research (Nathan 2009b) and it provided interesting results: not only rich ethnographic data, but also a possibility to understand people's vulnerability close to them. Policy recommendations may arise, especially from the latter methodology. In the case of La Paz as in many other cases, understanding the exposed people's priorities and situation is essential for an integral risk management (Cannon 2008, Gaillard 2008, Nathan 2008), as any purely top-down proposal would fail. For example, risk for many people is just a supplementary price to pay for the people to be able to live within the city,

Figure 30.6: : Some exposed houses in La Paz, western hill slope. **Source**: Photo of the author.

benefit from a minimum of public services, and be relatively close to points of the city where informal employment is exercised. One solution could be a kind of people-centred resettlement of the most exposed people at the neighbourhood level, working with social organizations that are very strong in Bolivia, in conditions that put the beneficiaries' priorities and livelihoods at the centre. This could be accompanied by mitigation measures for those who remain exposed, like forestation schemes, waste management, water management, capacity building, community early warning, etc. A synergy between local authorities, the central government and the people could arise around such a project.[13]

13 A feasibility study of the pilot-project has been conducted. For more information, please contact the author at: <nathan.Ffbien@gmail.com>.

31 Revealing the Impact of Small Disasters to the Economic and Social Development

Mabel C. Marulanda, Omar D. Cardona and Alex H. Barbat

31.1 Introduction

The effects of natural hazard events of small or moderate size are not considered by many people as 'disasters', although they share the same origins and causes of large and extensive effects. The impact of these events cannot be underestimated, because in general terms, they typify the disaster risk problem of a city, region or country. This chapter does not debate risk regarding to extreme events with a long return period, but insular, real and daily risk that multiple communities are exposed to in rural areas and in small and large cities. The most of these disasters are the result of socio-ecological processes associated with environmental deterioration and are associated with persistent small hazard events such as landslides, avalanches, flooding, storms, and also lower scale earthquakes and volcanic eruptions.

The analysis of small disasters illustrates how frequent small disasters, usually as a result of climate variability, increase difficulties for local development and entail a serious problem for the development of a country as a whole. These disasters, contrary to the extreme and extraordinary events, are very often not visible at the national level and their effects are not relevant from a macro-economic point of view. Small disasters usually affect the livelihoods of poor people in rural areas and small municipalities, perpetuating their level of poverty and human insecurity as factors of social vulnerability. In urban centres small and moderate disasters occur in those city zones that historically had the greatest degree of vulnerability.

At present, climate change impacts cause worry to several scientists and some politicians. Particularly the effects related to risk and human insecurity are increasing (UNFCCC 2007; UNDP 1994). However, the risk is growing not only from hazards due to climate variability that are exacerbated by climate change. There are also other risk factors that must be seen with the same thoroughness as the 'vulnerability' conditions and the need of 'adaptive capacity' to the action of the natural hazard events (IPCC 2007; Manuel-Navarrete/Gómez/Gallopin 2007). These are risk factors that have not been perceived well enough due to the lack of systematized information. For this reason, this chapter presents data that illustrate the increase of 'small disasters' or 'invisible disasters'. They are a result of climate variability and the vulnerability increasing from an economic, social, and environmental perspective. These figures illustrate, from a new perspective, that climate change implies a serious problem for disaster risk not only related to the potential of future extreme events but also small and frequent disasters that destroy the livelihoods of the poorest and deepen their incapacity of adaptation, perpetuating their vulnerability and poverty.

From the beginning of 1990's, some researchers in Latin America posed the hypothesis that the effects of small and moderate events, accumulated over time, could be equivalent and even bigger than the impact of big disasters. This hypothesis can be verified through analyses of the losses and damage reported in the DesInventar; database developed by the *Social Network for Disaster Prevention in Latin America* (La RED) and used in this research to evaluate the impact of small disasters This database has been useful to evaluate the number of events, the effects in terms of deaths, injuries, crops and housing destruction, the economic costs, and their comparison to the impact of extreme disasters.

The chapter presents the results of the evaluation of the proneness of Colombia to small scale and chronic disasters, and the type of impact they have for local development, and the country from an aggregated perspective. This analysis detected the spatial variability and dispersion of vulnerability and risk in the country as a result of events that rarely enter the international or even national disaster databases, but which pose an accumulative development problem for

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local areas and, given their overall probable impacts, for the country as a whole.

The empirical work made in Colombia to reveal the impact of small disasters in the country is treated in three sections. In the first, the database of small disasters used is described to identify the strengths and weaknesses of the available data and how that information was prepared for this research (31.2). In the second, a conceptual framework regarding the impact of small disasters is presented to characterize the risk associated to this type of disasters (31.3). In addition, in this section, a quantification of their effects and their economic costs are presented to illustrate their relevance due to their accumulated impact and recurrence. The third section presents the conclusions of the study (31.4). They are not only concerning the specific case of Colombia but also other developing countries. Accordingly, new risk concepts have been issued (ISDR 2009): The concept of 'intensive risk' to refer to the concentrated risk manifesting infrequently in specific locations, and the concept of 'extensive risk' to refer to the diffuse risk manifesting frequently over wide territories.

31.2 The DesInventar Disaster Database

DesInventar[1] offers simultaneously a database to elaborate a historical inventory of disasters and a methodology for their analysis. It consists of a software that allows to gather, systematize, organize, and consult information recorded in the system both from a spatial and temporal point of view, and an information capture and analysis methodology that especially emphasizes these aspects:

- *DesInventar* analyses disasters as a set of adverse impacts on lives, goods, infrastructure, and social relations caused by the interaction of socio-environmental and anthropogenic phenomena in given vulnerability conditions. It includes from those disasters very few effects (i.e. destruction of a house or five affected people because of crop loss caused by a frost) until those with large effects (such as the Quindío earthquake in Colombia, 1999).
- Disasters materialize in communities and their environment. The scale of resolution of the observation of disasters affect the vision and understanding of them, therefore they should associate with various spatial scales, both to perceive small and 'invisible' disasters as an expression of daily risk construction, and to decompose those disasters that affect large areas with multiple and different effects that are singular for each affected community.
- Information that record the exposition, vulnerabilities, and risks conditions at all scales must be constructed as variables and indicators that should be as much as possible homogeneous both in terms of effects and in trigger effects. There should be a common language aiming at a compromise between rigorous definitions and the comparability of data at a continental scale.
- The resolution of the inventory offers information for the municipality or territorial level comparable with other countries. A local or regional inventory with a more detailed resolution can be made. This information is also gathered with a lower resolution (e.g. for a department or country).

DesInventar Colombia has been initiated, and maintained, refined and updated as a part of the Project *DesInventar* of La RED by the *Observatorio Sismológico del Sur Occidente* (OSSO) since 1994. It records information from 1914 to 2002, with a total of 23,386 entries. The information used and analysed in this chapter covers a 32-year period (1971–2002) and are based on 19,202 entries. In the databse *DesInventar*/Colombia, as in other existent disaster databases, the information compiled does not pretend to shape the universe of disasters that historically have occurred. In the best case, it is a wide sample of disasters, limited by the characteristics of the information and its sources, permanently subjected to debugs and complements and, therefore, it is not free of errors.

With regard to the sources three significant aspects can be distinguished in the case of Colombia:

a.) Until 1995, the principal source of database were newspaper archives, with an emphasis on national newspapers (*El Tiempo* and *El Espectador*) and, in some cases regional papers (*La Patria of Manizales*, *El Colombiano of Medellín* and *Cali's*). Irrespective of the quality of the information there is a bias in gathering information that privileges

1 Detailed information on the conception, methodology and use of *DesInventar* is at: <www.desinventar.org>, especially on the methodology and the user manual. The work by LA RED-OSSO for UNDP-ISDR on: "Comparative analysis of disaster database EmDat-DesInventar" of January 2003 may also be consulted at: <www.desenredando.org>.

Antioquía, the coffee-growing zone, the Valle del Cauca and Bogotá/Cundinamarca, compared with other regions of the country. For other regions only cases are recorded that were reported in national newspapers ignoring the regional press. This implies that the quality of the recorded information on the regions is unequal.

b.) Since 1995, the main source has been provided by *Disaster Prevention and Attention Directorate of Interior Ministry* (DPAD), and has been complemented with information from the media. As the DPAD does not register 'all events' but only those which require national support, this information coverage is probably more significant for small and medium municipalities and for those departments with few resources (Costa Atlántica, Caquetá, Meta, Arauca, Casanare and Santanderes) than for big cities and the rest of the country, although press information contribute to reduce that slant.

c.) Information on national territories (e.g. Orinoquía and Amazonia with few inhabitants and very far from the national centre) is practically inexistent for this period.

d.) Due to the origin of information and representatives of sources, information on regional capitals and intermediate cities (bigger than 100,000 inhabitants in the census of 1993) is more complete than for the remaining municipalities).

In summary, weaknesses and problems with the data have been recognized and to some extent corrected or compensated for, as to be discussed on the next section. On the other hand, different factors must be considered for an appropriate analysis:

a.) It is important to have available strong or robust variables such as: type of the event that caused a disaster; date of occurrence and geographical location of the event. There are other less robust variables but useful for an analysis like number of dead people, number of destroyed and affected houses, and number of casualties and affected people as it results from the comparison with other databases, such as EmDat/DesInventar (La RED/OSSO 2003), that provide data on. The affected crop hectares can be also aggregated.

b.) In quantitative terms these less robust variables may present different problems (additional or generic 'prejudgment' of newspaper information) that require a permanent assessment of data and their analysis:

- The data from journalists often do not come from proven sources (and often contrast this information with other official sources of fire brigades, the red cross, civil defence, and 'technical and scientific' such as by Ingeominas (Colombian Institute of Geosciences and Mines) that produced studies or from other newspaper archives).
- Official sources that 'inflate' data due to certain political interests (e.g. the 'lathe operation' of the government (1994–1998) at the Atlantic Coast), are difficult to correct but may be compared with other non official sources.
- Errors in data compilations.

c.) Furthermore, not all entries contain the same information due to the type of damages (e.g. if there is no damage to houses but to bridges), or no quantification of them (a 'lot of damaged houses'), probably if the original information only includes certain variables and not others (e.g. logically, damaged houses must have a corresponding number of casualties or affected people, although they do not belong to anybody and nobody lives there, and it does not always appear).

d.) Particularly the affected people often include high numbers that in 99 per cent of cases refer to the inclusion of the affected population that stayed one or two hours, or one or two days without supply of basic services (e.g. two million people lacked electricity in Bogotá).

e.) From a spatial perspective, as the information is organized by municipalities, three problems may occur: a) some records are taken at regional level and municipality is not defined; b) some records are taken at a lower municipal level (commune, road); and c) some municipal divisions change and it is not possible to know which records correspond to which municipality.

31.2.1 Preparation of the Database

Information was compiled based on 19,202 records for 1971–2002 reflecting limitations mentioned above. After a validation of the data based on these criteria these variables were analysed:

1. For affected people, data from a suspension of public services (1,500,000 affected people in Medellín due to a power blackout for two hours, for example) were excluded.
2. A value for affected people was given to entries on destroyed or affected houses. These estimates

tried to be conservative assuming that only one family lived in each destroyed or affected house.

3. Given the disparity of criteria for differentiating between casualties and affected people, it was assumed that both cases (except for those referred to above) were about direct effects of diverse scales or intensity and therefore they were integrated in one variable.
4. Other detected problems dealt with the geographical location of an event and computation errors were corrected.
5. The used database includes an assessment and complementation by La RED/OSSO. This has been useful not only for this study but also for other ongoing research with the *Inter-American Institute for Weather Change* (IAI) and the *Programme of Disaster Risk Management Indicators* of the *Institute of Environmental Studies of the Inter-American Development Bank* (IDB-IDEA).

After the database was updated and adjusted the information was analysed to confirm the relevance of small and moderate disasters and their accumulated impact compared with extreme events from 1970 to 2002, and for all municipalities where effects of the impact of local disasters were recorded. A hypothesis is that the effects from small and moderate events, accumulated over time, could be equivalent and even bigger than the impact of big disasters (La RED). This hypothesis can be verified through analyses of the losses and damage reported in the *DesInventar* database. However, some requirements are desirable, namely:

a.) Information in available records is incomplete. The sources of information do not always include damage or loss values. In many entries some variables are only expressed qualitatively (e.g. approximately 35 per cent). In some cases numbers are recorded, but in other cases only general effects were noted).
b.) As the information on the entries is not homogeneous, only damages and loss categories are considered for the number of deaths, affected (injured) people, destroyed houses and the number of affected crop hectares.
c.) These data cannot be considered as definitive; they are approximated, and only compare effects with reported damage and losses of big disasters.
d.) This analysis has focused only on small and moderate events excluding figures on big disasters.
e.) Given the type of information, analysis of damage and loss accumulation from small and moderate events is compiled for the national level.

Throughout these 32 years Colombia was affected by several local events that oscillated between small and moderate (table 31.1).

Table 31.1: Number of small and medium disasters in Colombia (1971-2002). **Source:** *DesInventar* database, La RED (2004).

Period	Number of events	Percentage of total
1971-1980	5,226	27.2
1981-1990	5,405	28.1
1991-2000	7,063	36.8
2001-2002	1,508	7.9
1971-2002	**19,202**	**100**

31.3 Small and Moderate Disasters

Disaster implies loss and damage and subsequent impacts that the affected community is unable to absorb or to cushion the effects and recover using its own resources and reserves. The concepts of vulnerability, or predisposition to be affected, and resilience, or capacity of recovery and adaptive behaviour, enter to play an important role due to their significant relation with the possible occurrence of disasters. Hence, disaster is a social context or process, triggered by a natural, technological or anthropogenic phenomenon, which in interaction with a susceptible medium causes intense alterations in the normal functioning of the community. Regarding disasters some processes require special attention. These include population growth, rapid urban development, international financial pressures, degradation of the earth, global warming, and environmental change and war. To take but a limited number of examples, urbanization processes have been an important factor in damage caused by earthquakes in urban areas; population increase helps to explain increases in the number of persons affected by floods and prolonged droughts; and deforestation increases the chances of flooding and landslides (Wisner/Blaikie/Cannon/Davis 1994; Birkmann 2006). Adhering to the hypothesis that the lack of development and vulnerability are correlated, and considering that the lack of capacity to cope, recover, and adapt is

also a factor of vulnerability, particularly taking into account the climate variability and change, Cardona (chap. 3) suggests that vulnerability originates in physical fragility or exposure; the social, economic, and ecological fragility; and the lack of resilience or ability to cope and recover. Seen from this human or social perspective, any understanding of vulnerability also requires careful consideration of the factors or contexts that contribute to human and livelihood vulnerability: the security or insecurity of buildings, infrastructure, and environment; the nature of institutions and social organizations; the levels of income and welfare, etc. These explicatory factors do then become a fundamental part of the equation and understanding of human or social vulnerability.

Risk regarding small disasters usually is not considered as relevant, nevertheless small disasters are a social and environmental problem with big implications. These events are primarily related to persistent hazards such as landslides, avalanches, floods, forest fires, droughts, and so on resulting from socio-ecological processes associated with climate variability and environment deterioration that affect, in a chronic way, the most fragile socio-economical low-income population in rural as well as in urban areas. In general, small and frequent disasters prevent the sustainability of local human development and they reveal in which areas of urban centres the vulnerability is growing and where new hazards or the exacerbation of the already existing hazards are occurring due to inadequate environmental, social, and economic processes.

Taking into account the abovementioned and the report of Marulanda/Cardona (2006) the concept of *intensive risk* refers to concentrated risk manifesting infrequently in specific locations and the concept of *extensive risk* refers to diffuse risk manifesting frequently over wide territories (Maskrey 2008). Global disaster databases and risk indexes reflect principally patterns of *intensive risk* given that *extensive risk* is largely invisible from a global level of observation. *Extensive risk* patterns only become visible from a national level of observation and a higher resolution, and thus have consistently been ignored. Due to this invisibility *extensive risk* has not been a driver of disaster risk reduction, which has focused primarily on saving lives and mitigating against major economic loss. A central hypothesis of the ongoing *2009 ISDR Global Assessment Report on Disaster Risk Reduction* is that whereas mortality and economic loss risks tend to be *intensive*, asset risks in sectors such as housing and agriculture are more *extensive* in character and have pervasive, negative impacts on the livelihoods and lives of poor urban and rural populations. Through testing this hypothesis the Global Assessment Report will make the case for strategies to address *extensive risk* to become central to both disaster and poverty reduction, as well as to climate change adaptation.

Small and moderate disaster analysis, and the definition of large events, create diverse methodological problems, especially two: a) the problem of a threshold from which a disaster is considered as large, and b) given the effects of an event (e.g. an earthquake) on different territorial units, which of these effects should be included or excluded in an analysis of small and moderate disasters, given the singular impacts registered in each unit (i.e. a municipality alone[2]). Without pretending to have an answer to these two problems, the analysis should be inclined to exclude from the database the information of effects related to large disasters. Taking into account the preparation of the database and the difficulties to identify all potential wrong data by a detailed analysis and, particularly, the shortcomings due to several disputed figures of affected people and affected hectares of crops, an outlier (or an extreme value) identification process defining arbitrary thresholds was applied. Although the direct selection of large disasters is an acceptable procedure, the definition of a large disaster is a problem if a systematic approach is attempted. The process of identification of outliers[3] detected the extreme main effects of large hazard events, but their small or moderate effects were considered and the selection should be based on the size of the effects and not because the effects were made by a 'recognized' hazard event.

31.3.1 Effects Caused by Small and Moderate Disasters

In Colombia, for the period from 1971 to 2002, the emergency database (EM-DAT) by the Centre of Epi-

2 The *DesInventar* database contains the information of effects by municipality and not by event.

3 Outliers are obtained using statistical and data mining techniques. Criteria for extreme values were chosen, taking into account when the value in each case could be considered as very large. This means, that the effects in a municipality are considered extreme when they are usually visible or notable at the national level. The values considered as extremes are the following: *Dead people*: more than 500 people; *Injured people*: more than 1,500 people; *Affected houses*: more than 4,500 houses; *Destroyed houses*: more than 2,500 houses; and *Destroyed crop hectares*: more than 80,000 hectares.

Table 31.2: Gross figures of effects as a result of small and moderate disasters. **Source:** *DesInventar* database, La RED (2004).

Period	Deaths	Affected	Destroyed houses	Affected houses	Damaged crop hectares
1971-1980	2,964	204,393	18,588	16,604	327,497
1981-1990	3,812	608,180	19,754	16,044	738,743
1991-2000	2,394	871,374	50,465	163,051	964,450
2001-2002	305	61,584	4,353	21,376	144,023
1971-2002	9,475	1,745,531	93,160	217,075	2,174,713

Table 31.3: Effects per local event on average. **Source**: DesInventar database, La RED (2004).

Period	Death	Affected	Destroyed houses	Affected houses	Damage crop hectares
1971-1980	0.57	39.11	3.56	3.18	62.67
1981-1990	0.71	112.52	3.65	2.97	136.68
1991-2000	0.34	123.37	7.14	23.09	136.55
2001-2002	0.20	40.84	2.89	14.18	95.51
1971-2002	0.49	90.90	4.85	11.30	113.25

demiology of Disasters of the Catholic University of Louvain (chap. 40 by Guha-Sapir), lists at present 97 events that fulfil at least one of these criteria: a) 10 or more dead people; b) at least 100 affected people; c) emergency state has been declared; and, d) international assistance has been required. Summarizing, it is about events that in some way have attracted the attention of authorities or news reports. That is, it deals with visible disasters. However, beyond these notable disasters, there are hundreds, even thousands of events that occurred in the same period which were not listed in these statistics of international organizations on this subject. According to the *DesInventar* database in Colombia more than 19,000 events occurred during the same period. This number of events contrasts considerably with 97 events listed by the EM-DAT disaster database. Therefore, a gross assessment of damages and losses caused by small and moderate events in Colombia from 1971 to 2002 using the *DesInventar* indicates that they have not been marginal. Table 31.2 shows that close to 9,500 dead people, almost 2 million affected people, 93,000 destroyed houses and 217,000 affected houses, as well as close to 2 million destroyed crop hectares were the result of an accumulation of this type of disasters.

During the 1990's, there is both an accumulation trend of larger number of effects and greater records of occurred small disasters. In this period, with exception of the number of death people, the largest damages and losses occurred. They have been much bigger than the average registered by local events during the 32 years studied, as is illustrated by table 31.3.

In table 31.3, the last line shows the overall average values for the whole studied period. The losses and damages related to death people, affected people and destroyed crop hectares of decade 1981–1990 were above average of the period of 32 years, while for the period between 1971 and 1980 only the number of death people by event were above the average of the whole period. A comparison of annual averages for the three decades and for 2001–2002 shows that the latter offers very high values for only two years against periods of ten years.

As the quality of data are similar since the 1970's, the trend towards an increase in the amount of damage and losses by small disasters throughout these years can only be explained by two factors: *first*, the growing of the intensity and recurrence of hazard events; *second*, the increasing vulnerability and volume of exposed elements. The rise of hazard events is detected particularly in some hydrographic basins resulting from the environmental degradation and perhaps due to the gradients of climate variability (i.e. climate change). Taking the growing population and urbanization during the past 40 years into account, a growth in the volume of exposed elements and in their vulnerability can be observed. In any case, it can be argued that the increase and accumulation of risks in Colombia are consequences of rising natural and socio-natural hazard events that are due to the devel-

opment model the country has implemented and maybe due to climate change.

In comparative terms, the accumulation of damage and losses induced by small disasters during the whole period is notable. If they are compared with the biggest disasters Colombia suffered during the past 32 years – i.e. the Nevado del Ruíz volcanic eruption in 1985 and the Quindío earthquake in 1999 – the figures cannot be undervalued as shown in table 31.4.

Table 31.4: Comparison between the effects due to small and extreme disasters**: Sources:** *DesInventar* database, La RED (2004), and report on small disasters for National Department of Planning, ERN-Colombia (2005).

Type of damages and losses	Nevado del Ruíz eruption (1985)	Quindío Earthquake (1999)	Small disasters (1971-2002)
Deaths of people	24,442	1,862	9,475
Affected people	232,546	160,336	1,745,531
Destroyed houses	5,402	35,949	93,160
Affected houses	NA	43,422	217,075
Damage of crop hectares	11,000	NA	2,174,713

Although the number of deaths in the volcanic disaster of 1985 represents an extraordinary event that exceeded predictions of any specialist at that time, the accumulation of deaths caused by small disasters over time also tend to be an elevated figure. It represents 38.8 per cent of the deaths that occurred in Armero and Chinchina through the volcanic eruption. The number of affected people from small disasters is 7.5 times those of large disasters, and this amounts to almost 11 times the figure of the Quindío earthquake of 1999 which severely affected the whole coffee-growing region. Taking the total of destroyed houses into account, the figure for small disasters represents more than 2.5 times the total of destroyed houses in the Quindío earthquake and more than 17 times the destroyed houses in Armero and Chinchina. The houses affected by small disasters are 5 times as high as those for the Quindío earthquake.

31.3.2 Economic Cost of Small and Moderate Disasters

In terms of economic cost the recorded losses from small and moderate local events are very significant. If two categories of economic losses (damaged houses and crop hectares) are considered, the total amount accumulated for 32 years of study exceeds 1,650 million dollars according to table 31.5 of this total, 35.1 per cent corresponds to the amount of destroyed and affected houses and the other part (64.9 per cent) corresponds to the amount of damage from crop hectares.

Table 31.5: Estimated cost of losses and damage caused by small disasters, in 1,000 US$. **Source:** Based on the methodology of the IDB-IDEA Programme of Indicators, IDEA (2005a/b).

Period	Losses in houses	Losses in crops	Total
1971-1980	68,217.00	98,249.10	166,466.10
1981-1990	78,424.50	295,497.20	373,921.70
1991-2000	385,892.33	578,669.70	964,562.03
2001-2002	47,127.42	100,816.45	147,943.87
1971-2002	579,661.25	1,073,232.45	1,652,893.70

This approximation is useful for estimating the magnitude of losses and to make general comparisons.[4] Although in the case of affected crops overestimates are possible due to the valuation of errors or to the difficulty of estimating the real surface affected, it can easily be observed that losses in the agricultural sector are very important, although they are hardly visible.

These are hypothetical values and they neither correspond with real reconstruction expenditures nor to any coverage of losses made by the government. The value of any destroyed house is assumed as the average cost of a social housing unit according to the ex-

4 Methodology proposed by the Risk Indicators Project IDB-IDEA was applied for calculation of losses caused by small disasters. In the case of houses, the total of destroyed houses plus affected houses, where 4 affected houses correspond to a destroyed house has been considered. Estimation of loss is made assuming reconstruction a social interest house (average number of square meters by value of square metre constructed of this type of construction in each period) and without the cost of land. For the case of the loss estimation of crops, it was obtained based on the average cost of the typical hectares of crops in the flooded zones by total number of affected hectares.

isting standards in each country (number of square meters) during the period of analysis. And, the value per square meter of social housing is equivalent to one legally established minimum salary during the same time period. On the other hand, it is proposed that the value of one hectare of crops be calculated on the basis of the weighted average price of usually affected crop areas, taking into account expert opinion in the country at the time of analysis. In most of cases, neither any formal reconstruction programme was made nor any government loans or subsides for reconstruction or recovering have been paid to the affected people. Although these estimates are not accurate, the figures refer to the magnitude of a problem that is worrying and often overlooked. Most affected people come from low-income communities with scarce resources that do not receive any recovery aid from the government when this type of events occurs. In addition, they are recurrently affected by these small disasters at the local level, losing their livelihoods. While this chronic situation may not be relevant from a macroeconomic point of view, it perpetuates their poverty and the underdevelopment of the country. This is a worrying situation as the adaptive strategies of low-income communities are less effective and unsuccessful at present, and because disaster resilience is now diminished to cope with the effects of climate change and climate variability.

Based on the data in tables 31.2 and 31.5 it can be clearly observed that the losses have grown over time in a different way if they are compared with the respective number of events. Thus, between the 1970's and 1980's the number of events grew only by 3.42 per cent but the losses occurred had an unexpected increase of 224.6 per cent. Whereas the increase of events from the 1980's to 1990's was 130.68 per cent, the losses had an extraordinary growth of 257.96 per cent. The importance of these figures expressed in monetary terms can also be seen if the average cost of each recorded event is considered. The average cost for each event for the decade of 1971 to 1980 amounted to US$ 31,853, for the period from 1981 to 1990 it was US$ 69,181, and for 1991 to 2000 it was US$ 136,566.

A comparative analysis of losses caused by small events and some of the recognized extreme disasters with the massive destruction that have occurred in Colombia is useful to assess the impact that small and moderate events have had over time. According to figures of table 31.6, the material losses in current million US$ caused by small disasters during 32 years are 6.7 times the losses caused by the Nevado del Ruíz volcanic disaster in 1985. Even the aggregated losses during the decade (1981–1990) due to small disasters are 1.5 times the losses caused by the same disaster in Armero and Chinchina.

Table 31.6: Losses of extreme hazard events, in current million dollars and in percentage of GDP. **Source:** Extreme events, report on small disasters for National Department of Planning, ERN-Colombia (2005).

Events	Estimated losses	Costs of rehabilitation
Eruption of Ruíz Volcano (1985) Armero	246.05 (0.70)	359.95 (1.02)
Coffee Region Earthquake (1999) Quindío	1,590.81 (1.88)	856.72 (1.01)
Small and moderate events (1971-2002)	1,652.89	NA

NA: It means not available data, but, in most cases, direct investments from State have not been made.

The total of losses from small local events surpassed the material losses caused by the Quindío earthquake in 1999 when the figures of destroyed houses and crop hectares are considered. This means that approximately for every 30 years, the losses from small disasters to housing and agriculture are similar to the losses produced by a large event such as the Quindío disaster. The big difference between the extreme and small disasters mentioned above is that in the first case, any programme of reconstruction has been implemented and significant investments have been made to aid the affected people, whereas in the second case no formal rehabilitation or reconstruction activities have been implemented. This means that people affected by small disasters only in some cases received humanitarian aid but in all cases they did not receive any substantial post-disaster aid for recovery and development.

Nowadays estimates of the economic impact of disasters are very common taking aggregated macroeconomic variables into account, such as the *gross domestic product* (GDP). This has been the approach of the International Financial Institutions as well as of the banks and agencies as the *Economic Commission for Latin America and the Caribbean* (ECLAC). Although it is recognized that the economic losses do not correspond to the real impact of disasters, the economic losses expressed as a percentage of national and sectoral GDP's are certainly useful to illustrate the relevance of small disasters and their impact for

Table 31.7: Accumulated losses of small disasters in million US$ and percentage of the agricultural GDP. **Source:** For the estimate the GDP of the last year of each period was taken using data by the Word Bank (2003).

Period	Losses in crops in current (constant) US$	GDP agricultural sector in current (constant) US$	Losses in sectoral GDP (percentage)
1971-1980	98,25 (172.64)	6,466 (11,352)	1,52
1981-1990	295,50 (689.50)	6,539 (15,257)	4,52
1991-2000	578,67 (758.38)	10,330 (13,358)	5.60
2001-2002	100,82 (138.80)	10,103 (13,909)	1.00
1971-2002	1,073.24 (1,759.32)	(13.909)	(12.65)

Table 31.8: Accumulated losses from small disasters in million US$ and percentage of construction GDP. **Source:** For estimates, the GDP was taken of the last year of each period using data of the Word Bank (2003).

Period	Losses in housing in current (constant) US$	GDP construction sector in current (constant) US$	Losses in sectoral GDP (%)
1971-1980	68.22 (119.87)	1,607.20 (2,824.11)	4.25
1981-1990	78,42 (182.98)	1,993.10 (4,650.58)	3.95
1991-2000	385.89 (505.73)	3,058.10 (4,007.80)	12.62
2001-2002	47.13 (64.88)	3,184.95 (4,354.89)	1.48
1971-2002	579.66 (873.47)	(4.354.89)	(19.92)

Table 31.9: Accumulated losses of small disasters in million US$ and percentage of GDP of Colombia. **Source:** For estimates, the GDP was taken of the last year of each period using data of the Word Bank (2003).

Period	Losses [crops+houses] current (constant) US$	National GDP in current (constant) US$	Participation of losses in per cent of national GDP
1971-1980	166.47 (264.81)	33,400 (53,180)	0,50
1981-1990	373.92 (688.05)	40,274 (74,108)	0,93
1991-2000	964.56 (1,129.24)	83,220 (96,652)	1,16
2001-2002	147.95 (175.94)	84,002 (99,893)	0,18
1971-2002	1,652.89 (2,249.03)	(99,893)	(2.25)

the national economy. In the agriculture sector, for example, small disasters recorded elevated amounts of losses. Table 31.7 shows accumulated losses for the period 1971–1980 that were equivalent to 1.52 per cent of the agricultural GDP for 1980. Furthermore, the impact of small disasters was more significant for the 1980's because the total amount of losses in the sector represented 4.52 per cent of the agricultural GDP for 1990; and it was greater (5.6 per cent) for the 1990's. Losses in the sector have been equivalent to 12.65 per cent of sectoral GDP, constant prices, for the period of 32 years. It is important to say the agriculture is one of the most important sectors of the country's economy.

Table 31.8 shows losses due to the destruction of housing by small disasters in terms of GDP for the construction sector. The amount of losses is considerably smaller than recorded in the agricultural sector, but the impact on the sectoral GDP is quite larger. During the 1970's the losses were equivalent to 4.25 per cent of the construction GDP. In the 1980's it was 3.95 per cent and in the 1990's losses rose to 12.62 per cent. In accumulative terms, damages for housing during the 32 years represented 19.92 % of GDP, at constant prices, in the construction sector. This is another important sector of the economy and employment source in Colombia.

Finally, at an aggregated level, the impact of small disasters has been significant. According to table 31.9, the total of losses for the construction and agricultural sector caused by small disasters during the period of 32 years represents 2.25 per cent of the national GDP for 2002, in constant prices. This is significant taking into account that losses caused by the

Quindío earthquake represented 1.88 per cent of the national GDP of 1999.

Given these figures for small disasters, it is difficult to refer to disasters without any impacts; furthermore among the estimated losses the cost of damage for the infrastructure (i.e. lifelines, facilities, roads, bridges, etc.) and for productive sectors (industry, commerce, electricity and others) were not included.

These figures are not only significant in quantitative terms but they offer evidence that confirms the hypothesis that recurrent and accumulated effects of damage and losses by small disasters can be equivalent and in many cases even larger than by those caused by extreme disasters, whose correlation or simultaneousness of effects are very visible. Even though these small disasters continue to remain 'invisible' and they are not considered as events of concern. The data that were given above illustrate the relevance of these disasters, because they indeed represent a worrying risk situation that exists in all Latin American countries.

31.4 Conclusions

The experience with the application of *DesInventar* for other Latin American and Caribbean countries has given extremely positive results when a wide view is used of the type of events that most frequently appear in these countries. So far the Colombian case study represents the most complete effort to apply this tool and the deepest analysis because it has not only allowed to describe the frequent types of disasters affecting the country, but also to identify in some cases their causes and effects, the high priority attention zones, and the impact small disasters have caused for the economy of specific sectors and at the national level as well.

Small disasters are usually not very relevant from macroeconomic perspective because they are usually not important for contingent liabilities and for fiscal sustainability of a country; this is the reason why they are very often ignored. However, small disasters are certainly relevant from social and microeconomic point of view and; therefore, they should not be ignored by the policy makers and planners.

The main objective of this chapter has been to analyse the results of an evaluation of the proneness of Colombia to small scale and chronic disasters, and the type of impact they have on the local development and for the country from an aggregated perspective. This analysis has detected the spatial variability and dispersion of risk due to events that are rarely recorded in international or national disaster databases, but which pose serious and accumulative development problems for local areas given their probable overall impacts for the country as a whole. In addition, the growing number of small disasters and their effects illustrate that the adaptive strategies of poor communities are less effective now as result of the recurrent destruction of their livelihoods, and due to the reduction of human settlements disaster resilience. Most of these disasters are the result of socio-ecological processes associated with the environmental deterioration and are associated with persistent small events such as landslides, avalanches, flooding, storms, and also lower-scale earthquakes and volcanic eruptions.

With these results it is possible to stress that extreme disasters not necessarily determine the history of disasters. Until now in Colombia the recent history has been dominated by big disasters such as those caused by the Popayan earthquake (1983), the Nevado del Ruíz eruption (1985), the Tierradentro (Paez) earthquake (1994) and the Quindío earthquake (1999). By accepting the relevance of their effects on the population and the economy as a whole, it must also be recognized that each year many small and moderate disasters, that individually do not cause high damages and losses, affect the population and the diverse economic sectors due to their frequency and their accumulated impact over time.

The outcomes of this analysis has been useful for economic analysts and sectoral decision-makers responsible for urban policy development, because they can detect not only the potential impact of extreme events but also the persistence and accumulation of effects of small and local disasters. This stimulates the consideration of risk problems in territorial planning at the local level, the intervention and protection of hydrographic basins, the protection of ecosystems, and the implementation of resource transfer and collective insurance programmes to cover the losses of poor communities. This research reveals that the aggregated impact of small disasters as well as the impact of extreme events also leads to a fiscal exposure and contingent liability for the government to compensate housing and to recover the livelihoods of the poorest people.

32 Climate Change, Natural Hazards and Coastal Ecosystems in Latin-America: A Framework for Analysis

Carmen Lacambra and Kaveh Zahedi

32.1 Introduction[1]

According to the *Intergovernmental Panel on Climate Change* (IPCC), the warming of global climate is now unequivocal. Over the last 100 years (1906–2005), global temperature has increased by 0.74 °C. Global sea level has risen by 17 cm during the 20th century (Rosenzweig/Casassa 2007: 92). Estimates for projected global temperature increases from the 1980's to the end of the 21st century range from 1.8 °C (1.1–2.9 °C) to 4 °C (2.4–6.4 °C) (assuming no additional mitigation measures apart from those already in place in 2000). Global average sea level is expected to rise by 18 to 59 cm by the end of the 21st century (Rosenzweig/Casassa 2007: 92).

As a result of climate change and sea-level rise coasts are projected to be exposed to increasing risks, including coastal erosion. Coastal ecosystems – defined in this chapter as mangrove forests and coral reefs – will be negatively affected. Many millions more people worldwide are projected to be flooded every year (Rosenzweig/Casassa 2007: 109).

Densely-populated and low-lying coastal communities like those in much of Latin America where adaptive capacity is relatively low and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk (Magrin/Gay Garcia 2007: 599).

At the same time coastal ecosystems can potentially provide an important service in helping coastal communities adapt to a changing climate and rising sea levels. Although the coastal defences provided by these ecosystems have long been acknowledged (Lacambra/Moeller/Spencer 2008b), there is not enough information available on the conditions and thresholds needed for coastal ecosystems to adequately protect coastal areas. Furthermore most of the information available has been derived from experiments and observation in Asia, while the potential role of coastal ecosystems as coastal defences in Latin America has been largely overlooked.

This chapter provides an overview of climate change, natural hazards and the role of ecosystems in adapting to these in Latin America, focussing on seven tropical continental Latin-America countries: El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela and Ecuador.[2] It begins with an overview of the natural disasters and their consequences (32.2). This is followed by a brief analysis of the state of coastal ecosystems, specifically mangrove forests and coral reefs, the services they provide to coastal societies, and the impacts of natural hazards and climate change on these ecosystems (32.3). It then reviews existing assessments of vulnerability to climate change and natural hazards (32.4). In conclusion, a framework is proposed for the analysis of how coastal ecosystems respond to, cope with and react to climate change and natural hazards and of the potential role such ecosystems can play in helping coastal communities adapt to the consequences of climate change and increased natural hazards (32.5). Preliminary conclusions are then presented from the application of the framework in the seven Latin-America countries (32.6). Although the proposed framework is best applied at the local level, this chapter provides a regional integrated overview of the topics described above and their interrelationship to highlight the importance of including the natural environmental perspective in vulnerability assessments (32.7).

1 The authors wish to thank UNEP-WCMC for providing the ecosystems distribution data and Dr. Iris Muller, Dr Tom Spencer, Mario Palacios, Martha Vides and the anonymous reviewers of this chapter for their thoughtful comments and contributions.

2 These countries were selected due to their geographical position, presence of the selected coastal ecosystems and their diverse coastal geomorphology.

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Figure 32.1: Region of analysis. **Source:** The authors.

32.2 Natural Disasters in Coastal Tropical Latin America

The IPCC reports that future tropical cyclones (typhoons and hurricanes) are likely to become more intense, with larger peak wind speeds and more heavy rainfall (Rosenzweig/Casassa 2007: 109), leading to greater waves and further floods both from the sea intrusion and freshwater channels. In Latin America the expected increases in *sea-level rise* (SLR), weather and climatic variability and extremes are very likely to affect coastal areas. Adverse impacts would be observed including on low-lying areas, coastal morphology, mangroves (e.g., in Ecuador, Colombia and Venezuela), availability of drinking water (e.g. on the Pacific coast of Costa Rica and Ecuador) (Magrin/Gay Garcia 2007: 583). In order to understand the consequences of increased intensity and possibly frequency of climatic events, it is important to understand current and historical consequences of similar events considering the ability of coastal systems to react to such events.

Tropical Latin America and the Wider Caribbean are regions with a high propensity to natural climate and non-climatic extreme events. Hurricanes, floods, tsunamis, earthquakes, and volcanic eruptions have all been a common feature in the region since records begun. Table 32.1 shows the proportion of natural disasters occurred in coastal areas in the seven selected countries and table 32.2 lists the most common climate related natural disasters along the Caribbean and Pacific coasts of the seven selected countries. Figure 32.1 and 32.2 show the countries of scope and the distribution of population, ecosystems and natural disasters reported along the coastal areas.

Most of the recorded events (table 32.2 and figure 32.2) refer to the late 20th century. It is important to note that an increment in numbers of records could in part explain the increasing incidence of reported events and similarly when comparing between countries a greater number of records could also be related to a greater national capacity to report events rather than to a larger number of events *per se*.

Nevertheless even considering only recent years where records are more reliable (due to the construction of databases and improved measurement techniques), natural disasters have become more frequent. During the past 30 years there have been over 30 disasters per year in the Wider Caribbean region (which includes the selected countries with the exception of Ecuador) causing 226,000 fatalities. That is 7,500 deaths per year and at an annual average cost of

Figure 32.2: Distribution of population, coastal ecosystems and natural disasters reported along the seven selected countries. (Features are not represented in scale). **Sources:** Population (ESRI); events (developed by the authors from DesInventar and own research for the years 1498-2000); mangrove forest (UNEP-WCMC 1997) and coral reefs (UNEP-WCMC 2003).

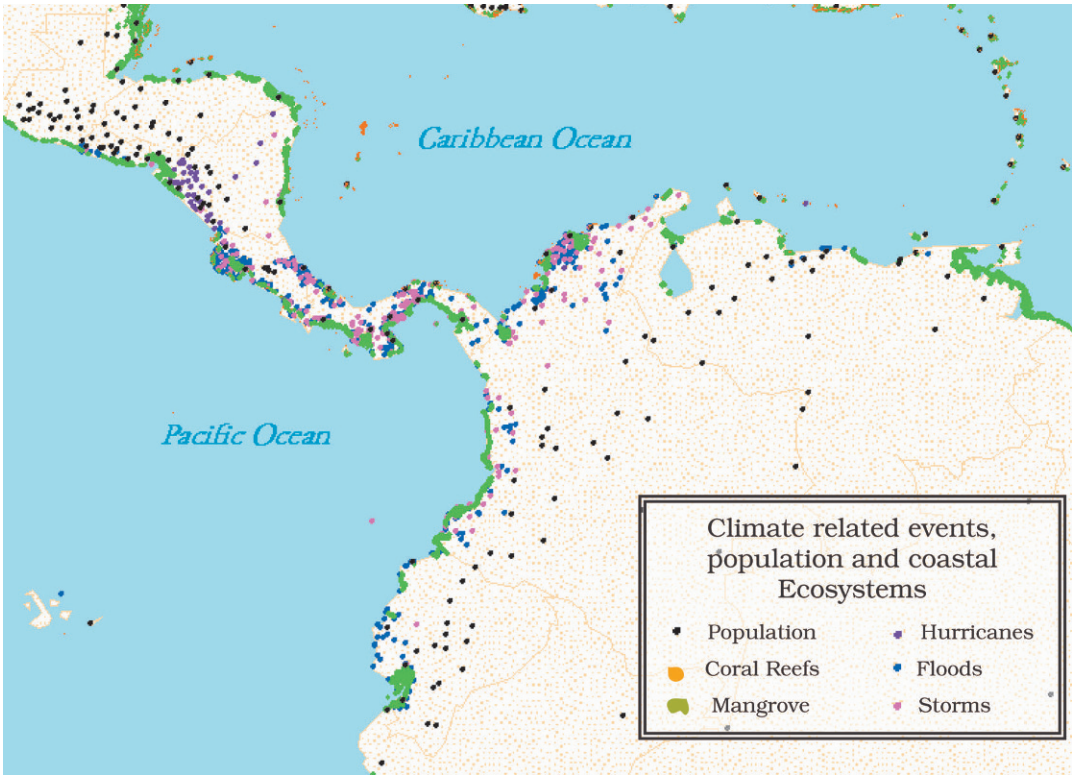


Table 32.1: Number of Natural Disasters reported in the seven selected countries since 1498 until 2002. **Sources:** Lacambra/Möller/Spencer, 2008: 89 and based on the DesInventar database, version 2005 and literature review.

Country	National events	Coastal events*	Coastal municipalities	Selected events	% of total in coastal areas
EL Salvador	955	450	102	80	8
Nicaragua	146	73	49	49	33.5
Costa Rica	5569	2021	1787	1679	30
Panama	2456	2456	2076	1086	44
Colombia	17569	9921	3337	3032	17
Venezuela	795	777	245	154	19
Ecuador	2458	1387	1122	571	23
Total	29948	17085	8718	6651	22

Legend: *National events* include all events despite their origin reported for each country. *Coastal events** include all those events in the 1st order of administrative division. *Coastal municipalities* include those events at the 2nd order administrative division. *Selected events* include those events in coastal municipalities that are of natural origin. *Percentage in coastal areas* refers to the proportion of natural events reported in coastal municipalities with respect to the national reports.

a DesInventar is a public database produced with support of UNDP, La Red and maintained by the Observatorio Sismológico del Sur-Occidente (OSSO). DesInventar (2005): <http://www.desinventar.org/desinventar .html> (7 December 2005).

Figure 32.3: Occurrence of natural disaster events in Latin America and the Caribbean by decade (1900-99). **Source:** Chaveriat (2000: 29, chart 1.3).

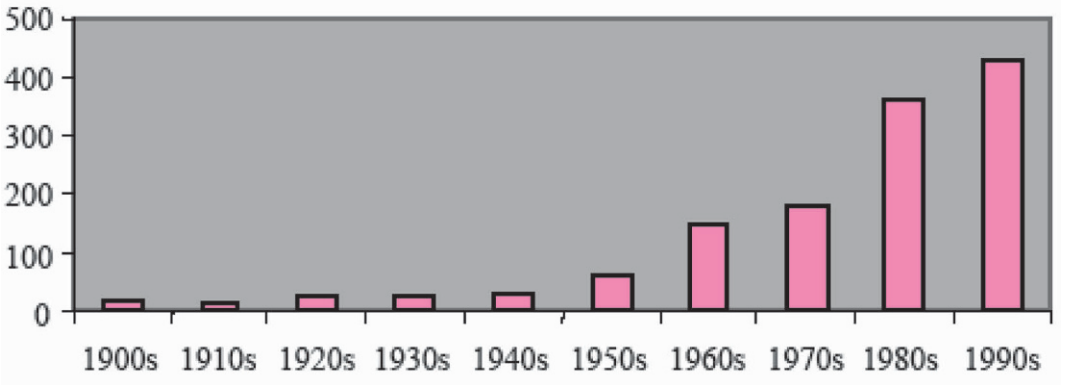


Table 32.2: Natural disasters in coastal areas in the seven selected countries. **Source:** Based on the DesInventar database, version 2005 and literature review.

Coasts Events	Caribbean	Pacific	Total
Total Events	**3365**	**3226**	**6591**
Floods	**1949**	**1487**	**3439**
Storms	**415**	**301**	**716**
Sea surges	**95**	**198**	**293**
Extreme Rains reporting damages	**156**	**92**	**248**
Hurricanes	**37**	**2**	**39**

Explanation: Rains are reported under a different category than hurricanes and storms because countries report them as such and are mostly related to the rains during the wet season which are not storms or hurricanes.

Table 32.3: Consequences of climate and non-climate related disasters in coastal areas of the seven selected countries. **Source:** Based on the DesInventar database, version 2005 and literature review. Reported victims do not include deaths.

	Events reported	Deaths reported	Victims reported	% each coast
Climate related				
Pacific	2764	3451	887150	48.4
Caribbean	2946	2673	2994998	51.6
Total	5710			
Non-Climate related				
Pacific	263	338	305621	51.3
Caribbean	249	306	43339	48.6
Total	512			

between $700 million and $3.3 billion US dollars (Chaveriat 2000: 10).

Table 32.3 summarizes the consequences of climatic and non-climatic events along the coasts of the selected countries. With the projected increase of the number and intensity of such events due to climate change, Latin American countries are highly vulnerable to these extreme weather events and related natural disasters. Some countries have made efforts to adapt, particularly through conservation of key ecosystems, strategies for flood, drought and coastal management. However, the effectiveness of these efforts is outweighed by a lack of basic information, observation and monitoring systems; lack of capacity-building and appropriate political, institutional and technological frameworks; low income; and settlements in vulnerable areas (Magrin/Gay Garcia 2007: 583).

32.3 Coastal Ecosystems

Sea level rise as a consequence of climate change and the projected increase of extreme climatic events will have a severe impact on the region's coastal zones. The ability of coastal ecosystems to adapt to a changing climate and rising sea levels depends not only on their physical and geomorphologic conditions but also on the level of intactness or degradation of the ecosystem (Invemar 2003; Gilman 2004: 10; Ellison 2004: 34).

Several studies have stated that ecosystems act as coastal defences (UNEP-WCMC 2006: 14; Sudmeier-

Table 32.4: Approximation of mangrove distribution in the countries of scope. **Source:** See below in columns of this table.

Country	Sources and Area (km$^{2)}$								
	FAO (2007)	UNEP (2005)	UNEP/ CCAD (2005) UNEP (2003)	FAO (2003a)	Spalding/ *et al.* (1997)	Ellison/ Farnsworth (1996)	Earth trends (2003) data from 1990's	FAO (1980) FAO (2007)	First report known [(a)] (FAO 2003a)
	Total	Total	Total	Total	Total	Caribbean	Total	Total	Total
EL Salvador	280 (2004)	360	347	415		NA	446	467	1,000 (1950)
Nicaragua	690 (1998)	600	681	2,143	1,718	837	943	1,034	1,151 (1979)
Costa Rica	418 (2000)	390	342	410	370	1.8	530	634	392 (1975)
Panama	1,744 (2000)	4,860		1,538	1,814	59	1,801	2,500	3,615 (1969)
Colombia	3,712 (1997)	3,070	3,659	3,540	3,659	821	3,682	4,400	5,013 (1966)
Venezuela	2,500 (1986)	2,600	2,500	2,300	2,500	2,500	6,207	2,600	8,100 (1961)
Ecuador	1,495 (1999)	1,960	2,469	1,478	2,449	NA	2,380	2,030	2,036 (1969)
Total	10,839	13,840		11,821	12,510		15,989	13,665	21,307
Total regional figure reported	43,958	58,310							51,730

Explanation: Ellison/Farnsworth (1996) with estimates for 1990. (a) Figures in this column correspond to the first record reported by FAO (2003a). For each country different figures are shown in parenthesis; references that were consulted by FAO (2003a) include for Salvador (Cueva 1961); Costa Rica (FAO/UNEP 1978); Nicaragua (Direna 1983); Panama (Maci-FAO 1969); Colombia (IGAC 1966); Venezuela (Mac 1961); Ecuador (Clirsen N.d.). The total regional figure refers to the Wider Caribbean Region and to Latin America.

Rieux/Masundire/Rizvi/Rietbergen 2006: 1, 8, 14, 37; Burke/Maidens 2005: 56). It is therefore important to consider the ecosystem services of coastal protection provided by coastal ecosystems as part of the adaptation strategies to climate change.[3] This section presents a brief analysis of the distribution and state of coastal ecosystems (mangrove forests and coral reefs) in the countries of scope, the ecosystem services they provide and how consequences of climate change are likely to affect them.

32.3.1 Mangroves (Distribution, State, Uses and Services)

The area of mangrove forests along the shorelines of the seven selected countries is estimated to range from 11,821 to 21,307 km^2 (table 32.4).

There are some discrepancies among these figures due to both inaccuracies and the use of different methodologies, which do not allow a detailed comparison of the different estimates. But there is a clear trend indicating that the distribution of mangrove forests has decreased substantially over the past 40 years. Reliable area estimates have only been produced since the early 1980's; there are, however, estimates from the 1970's and 1960's that enable us to observe a massive loss of mangroves in the region, particularly in Venezuela and Panama (Ellison/Farnsworth 1996: 551).

Mangroves have been exploited for several purposes since pre-colonial times: building material, fuel and food sources (either by cultivation or extracting), fishing gear construction, utensils construction and associated to important fisheries. Extraction remained and increased with the colonization period,

3 Ecosystem services were defined by the *Millennium Ecosystem Assessment* (MA 2003: 49) as: "Ecosystem services are the benefits people obtain from ecosystems." Coastal ecosystem services and their interactions have been studied by Moberg/Rönnbäck (2003: 30); Turner/Brouwer/Georgiou/Bateman (2000); Adey (2000); Ewel/Twilley/Eong Ong (1998) among others, considering the importance of biodiversity, of specific species relationships, of species richness and resilience and, the need of proper restoration.

Figure 32.4: Healthy Mangrove in the Salamanca National Park (Colombia). **Source:** Photo by Carmen Lacambra.

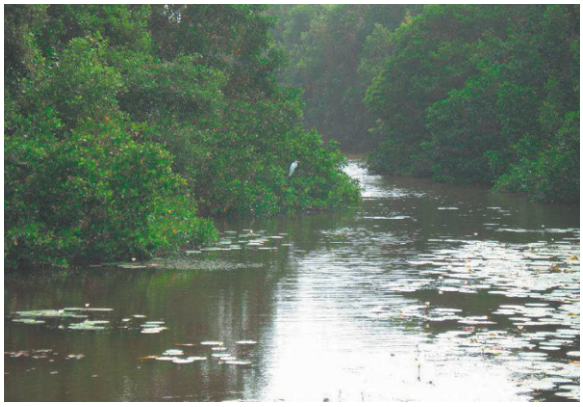


Figure 32.5: Claiming land in a mangrove swamp in Cartagena (Colombia). **Source:** Photo: Correa, El Universal (14 November 2008); at: <http://www.eluniversal.com.co/>.

Figure 32.6: Deteriorated mangrove in Cartagena (Colombia). **Source:** Archive El Universal (September 2008).

vast areas of mangroves were also cut for tannin production until the 1950's (Lugo 2002: 10; Ellison/Farnsworth 1996: 552; Majluf 2002: 19).

The clearance of mangroves for shrimp cultivation has become one of the greatest threats to the ecosystem globally. Within the region, Ecuador has successfully created an industry out of it; during the 1990's the country's revenues from shrimp exports were second, only after oil (Lugo 2002: 10). There are also examples on the sustainable use of mangroves in the wider Caribbean region, particularly in Trinidad, Venezuela, Puerto Rico and Florida (Lugo 2002: 10; Ellison/Farnsworth 1996: 558).

Historically mangroves have been seen as dumping grounds or reclamation areas for rural and urban development. Several cities along the Caribbean and Pacific coasts developed on mangrove areas including the greatest coastal cities in the region: Cartagena, Guayaquil and Maracaibo (Lugo 2002; Alvarez-Leon/Polania 1996; PNUMA 2005). Nowadays mangroves

Table 32.5: Status of coral reefs in Central and South America. **Source:** Modified from Wilkinson (2004).

Region	Coral reef area (km^2)	Destroyed reefs (%)	Reefs recovered and destroyed in 1998 (%)	Reefs in a critical-stage(%)	Reefs at a threatened stage (%)	Reefs at a low or no threat level
Central America	4,630	10	NA	24	19	47
South Tropical America	5,120	15	NA	36	13	36
TOTAL	284,803	20	6.4/16	24	26	30

are still claimed for habitat purposes. Consequences of human activities can be summarized in area loss and changes in hydrological and soil conditions (Figures 32.4, 32.5, 32.6 show different mangroves along the Colombian Caribbean coast.

There are also studies on the economic value of mangroves and their use for coastal protection in Asia and reports on the protection role for communities in Bangladesh and India, but not for the Latin American region. Castiblanco (2002: 39) valuated mangrove forest along the Pacific region of Colombia adding up to 50000 $US dollars per hectare; however the study did not include their role as natural coastal defences.

32.3.2 Coral Reefs (Distribution, State, Uses and Services)

Estimates of global coral reef area vary between 255,000 km^2 (Spalding/Grenfell, 1997: 226) and 284,300 km^2 (Spalding/Ravilious/Green 2001; UNEP-WCMC 2006: 7). Majluf (2002: 14) reports that 26 per cent of global corals are concentrated in Latin America and the Caribbean region.

Although there are still some healthy coral reef communities, the majority of them are under serious risk. According to Bryant, Burke, McManus and Spalding (1998: 21) and UNEP (2000: 44) 29 per cent of the reefs areas in Latin America and the Caribbean region are at considerable risk. Gardner, Côté, Gill, Grant and Watkinson (2003: 958) report a reduction of 80 per cent of hard coral cover in the Caribbean region, 10–50 per cent of which has occurred during the past three decades.

Over-fishing threatens more than 60 per cent of the region's reefs. Additionally, coral populations in the Caribbean have been affected by a series of diseases since 1983. Diseases have affected all coral reef communities but seem to be more intense in those areas where corals are affected by pollution and sedimentation. Estimates of up to 35 per cent of the reefs in Latin American and Wider Caribbean region are affected by pollution and sedimentation; the latter is particularly common in both the Pacific and the Caribbean coasts and enhanced by deforestation (Spalding 2004; Burke/Maidens 2005: 27; Wilkinson 2004: 460).

Coral reefs have been used since pre-colonial times as sources of food and utensils. Nowadays, many communities in the region continue depending on fisheries, crafts, industrial and recreational activities. In some locations, because of the volume of material on sale, such activities may have an important impact on the reefs (Spalding 2004). Recently corals have been harvested and are now reproduced artificially for pharmaceutical companies that have found anti-inflammatories, inmunodepresents, antiviral and other chemical components in different reef species from the Caribbean (Spalding 2004). Burke and Maidens (2005) reports land filling in Panama and Wilkinson (2004: 482) reports the exploitation of reefs at the Pacific coast in Salvador for cement production.

Coral reefs are natural breakwaters to ocean waves and mangrove forests disperse the energy of arriving waves; however this protection capability depends on each ecosystem status and ecological and physical characteristics (Kabdali/Turker 2002: 153). Cesar, Burke and Pet-Soede (2003: 10) calculated the value of coastal protection by coral reefs along the Wider Caribbean coast, excluding the USA, at approximately 1.3 billion US dollars. Adding fisheries, tourism and recreation and the value of biodiversity figures reached almost 4.0 billion US dollars. The value of coral reefs for coastal protection was also estimated by Burke and Maidens (2005: 14) who gave a similar figure of 700–2.200 million US dollars per year and including the entire Wider Caribbean Region estimates of up to 420 millions of US dollars of annual losses were calculated as a consequence of the coral degradation in the region.

32.3.3 Impact of Natural Hazards and Climate Change on Coastal Ecosystems

The impacts of natural hazards were examined as part of the coastal ecosystems' dynamics[4] and of damages and responses to hurricane impacts.[5] The damage to corals varies with the orientation and position of the substratum and the size and characteristics of exposed corals.[6] Lugo, Rogers and Nixon (1999: 106) conclude that highly structured coastal ecosystems can develop in spite of the constant destructive action of hurricanes. For Rogers, Suchanek and Pecora (1982: 542) the intensity, type, and duration of the stress influences the impact to reefs and their recovery times.

The effects of hurricanes Allen (1981), Hugo (1990), Andrew (1992), and Mitch (1998) on ecosystems were reported in greater detail, most of such reports were on Florida.[7] In summary, the broad consequences of impacts to coastal ecosystems described in these studies include: a) for corals: bleaching, breaking, rooting out and burying; and b) for mangroves: defoliation, tree breaking, detached vegetation, sedimentation, massive tree mortality, delayed mortality, species turnover, change soil characteristics, selective pressure on organisms, siltation.

Hurricanes are the most recurrent cause reported to explain massive mangrove mortalities worldwide; however, other causes include tsunamis, floods, impoundment, runoff diversion, subsidence, hyper-salinity, frosts and pollution (Jimenez/Lugo/Cintron 1985: 179). All of which, with the exception of tsunamis and pollution, can directly or indirectly be related to consequences of climate change.

The impacts on the Mesoamerican reefs have been concentrated mostly on anthropogenic disturbances. Although natural hazards are considered, these events and their impacts have not been a main topic of concern so far. Hurricanes can temporarily cause dramatic sea level rise. In 1961, hurricane Hattie swept Belize with winds up to 320 km/h and destroying reefs that took more than 20 years to recover (Stoddart 1974). However, the strength and altitude of waves are not the only hazard for reefs; rains associated with hurricanes and storms lead to an increase of the sedimentation in areas close to the river mouths (Burke /Maidens 2005: 36).

Coral reef bleaching has been used as a direct indicator of climate change impact on living environments, as the increase of bleaching events has been related to rising sea surface temperature. However, not all thermal related stresses can be attributed to climate change. Changes in sea temperature are also attributed to the El Niño event and seasonal changes. [8] Regarding sea level rise as a consequence of climate change, studies report more concerns related to the pressure of human impacts on the ecosystems rather than from climate change as such. Healthy and undisturbed reefs would have a greater chance to cope and adapt to a greater depth and to reduced light conditions. Although there are adaptation models, still there are other major pressures that would not allow reefs to migrate (Walling/Creary-Chevannes 2005; Vides/Sierra Correa 2003; Wilkinson 2004: 468; IDEAM 2001). In summary, some of the projected consequences of climate change on coral reefs include: decrease in growth as a consequence of higher temperatures, bleaching and more physical damage caused by more intense and frequent storms (Hoegh-Guldberg 1999; Wilkinson 2004; Buddemeier/Kleypas/Aronson 2004: 14; Burke/Maidens 2005: 33).

Nevertheless most scientific information available on the impacts of hurricanes on mangrove forests has been based on three events: Mitch, George, Joan and Andrew. Hurricanes Mitch and Joan were the only ones impacting on Central America and mangroves in both coasts were impacted in different ways by them. Coral reefs in San Blas in Panama and Bahia Chengue in Colombia were impacted by hurricanes Allen (1980) and Lenny (1999) respectively (Lacambra/Moeller/Spencer 2008b: 11). At the global level and in particular for this region key questions regarding the processes and capacity of coastal ecosystems to absorb forces that are a product of natural events still remain valid and there is still much research needed.

4 See Bengtsson/Nilsson/Franc/Menozzi 2000: 40; Elmqvist/Folker/Nyström/Peterson/Bengtsson/Walker/Norberg (2003: 489).

5 See Cahoon/Hensel/Rybczyk/Mckee/Proffitt/Perez 2003; Lacambra/Moeller/Spencer 2008a; Swiadek (1997).

6 See Woodley/Chornesky/Clifford/Jackson/Kaufman/Knowlton/Lang/Pearson/Porter/Rooney/Ry-laarsdam/Tunnicliffe/Wahle/Wulff/Curtis/Dallmeyer/Jupp/Koehl/Neigel/Sides (1981: 750).

7 See Lodge/McDowell (1991); Pimms/Davis/Loope/Roman/Smith/Tilmant (1994); Roman/Aumen/Trexler/Fennema/Loftus/Soukup (1994); Smith/Robblee/Wanless/Doyle (1994); Lugo (2000: 245); Hensel/ Proffitt (2002).

8 See Hoegh-Guldberg (1994: 7, 1999: 840); Hughes/Baird/Bellwood/Card/Connolly/Folke/Grosberg/Hoegh-Guldberg/Jackson/Kleypas/Lough/Marshall/Nystro/Palumbi/Pandolfi/Rosen/Roughgarden 2003: 930).

Table 32.6: 20 indicators more frequently reported to be used in vulnerability analyses. Indicators are presented in order and according to frequency of use. **Sources:** Brooks/Adger/Kelly (2005); Blaikie/Cannon/Davis/Wisner (1994); Mancilla (1996); Cardona (2004); Adrianto/Matsuda (2002); Alcantara-Ayalam (2002); Briguglio (2003); UNEP (2005); Chang (2004); Bush/Neal/Young/Pilkey (1999); FAO (2001).

Indicator (1 to 10)	Used in LA before?	Indicator (10 to 20)	Used in LA before?
Type of construction	yes	Response capacity	yes
Drinking water availability	yes	Protection	yes
Nation economic openness, independence	yes	Attitudes/beliefs	yes
Income	yes	GDP	yes
Population density	yes	Build area	no
People's education and opportunities	yes	Forest cover	no
Fauna & flora characteristics	no	Literacy	yes
Related with closeness to rivers	yes	Dependence on the environment	yes
Coast's characteristics	no	Slope	no
Protected area	yes	Erosion	yes

32.4 Vulnerability and Climate Change

Coastal areas will be under more pressure from the combination of increasing climatic events and rising sea level on the one hand, and growing populations and demand for resources on the other. Without integrated policies involving land planning in accordance with local physical dynamics, prevention and attention to disasters and climate change, consequences of climatic events (tables 32.1, 32.2, 32.3) are likely to increase; resulting on greater damage to human populations and their livelihoods and to ecosystem services previously described which are not yet fully valued and understood.

For this reason it is important to take into consideration both the national strategies to address climate change in order to understand priorities and capabilities as well as the impacts of climate change in coastal areas. Policies and national strategies are described at the end of this section. Impacts of climate change in coastal areas have been assessed through vulnerability assessments only at the local level, in very specific areas and often disintegrated to other events[9].

Climate change will have an influence on natural climatic events in the region and to understand its potential damage on population, infrastructure and natural environment it is important to also understand current processes and dynamics and the different ways they can be affected as well as their coping capabilities: "As climatic changes occur, natural resource management techniques can be applied to increase the resilience of ecosystems, key uncertainties exist that limit our ability to project climate change impacts on ecosystems."[10]

It is not the aim of this chapter to present a discussion on the different concepts and approaches to vulnerability in the region, but rather to contribute to those approaches from an environmental perspective considering the physical processes involved in natural events along coastal areas and historical changes in the landscape, either natural or man-made. Table 32.6 presents 20 parameters/indicators most commonly used to measure a coastal community or a region's vulnerability to climate change, natural hazards, and poverty.

Among them are only seven indicators that are related to the natural environment and to the geomorphologic dynamics of a region. From those seven indicators, only 3 have been used in the region: erosion, dependence on the environment and protected areas.

9 According to the IPCC "vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes". "Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC 2007c: 883).

10 See: Fischlin/Midgley/Price/Leemans/Gopal/Turley/Rounsevell/Dube/Tarazona/Velichko (2007: 246, 249).

Table 32.7: Approaches to vulnerability and vulnerability assessments in the region. **Source**: The authors.

Authors	Approaches to assess vulnerability
Wilches Chaux (1989a)	Multidisciplinary: physical, economical, social, political, techni-cal, ideologi-cal, cultural, educative, ecological and institutional
Lavell (1999); Lavell/Cardona (2000); Sygna 2005)	Characteristics of the societies impacted by events, development models and economic activities; social networks
Campos Rojas/Florez Ortiz/Zeledón (2000); Cardona (2004)	Description of the impacts of natural disasters
Krol/Jaeger/ Bronstert/ Krywkow (2001); INVEMAR (2003)	Vulnerability of ecosystems, water availability and society, considering climate change, water availability, agriculture and socio-economic activities
Mata/Campos/Basso/ Compagnucci/ Fearnside/ Magrin/Marengo/Moreno/ Suárez/Solman/Villamizar (2001); CRIMN (2000)	Climate change impacts, adaptation and vulnerability
Durán (2002); Cardona (2004)	Legal and regulation frameworks, institutions and policies
Chang (2004)	Socio-economic approach; historical events are considered not the socio-eco-logical resilience of communities
Buch/Jimenez/Arce/ Velásquez/Gálvez (2004)	Livelihood, infrastructure, population, education, health, hazards, land use and preparedness. Most vulnerable areas are those where land has been poorly managed
IDEAM (1997); Bove/O'Brien/Elsner/ Landsea/Niu (1998); Sanchez/ Vargas/ González/Pabón (2001); Villagrán (2003); Glave (2001).	El Niño Phenomena
PNUMA (2001); Leon (1996); Kreimer/ Munasinghe/ Preece (1992); PNUD (1991); IPCC (2001a)	Cities and urban infrastructure
IPCC Common methodology (IPCC-CZMS 1992)	Ecuador, Salvador, Colombia and Venezuela

None of which really reflect the systems' resilience[11], nor their vulnerability or capacity to cope either with climate change or any of the natural events. The natural environment has not been considered in many territorial and landscape planning initiatives despite the region's dependence on this environment.

Thanks to La Red[12] and its publications, there is a regional platform for information exchange that is increasingly being used by a greater multidisciplinary audience. This platform has allowed researchers and policy-makers access to disaster management analyses, concepts, statistics and impacts of disasters on the society across Latin America.

Natural events have normally been analysed independently, and possible interrelations between events have not been considered. At the national and local level there are some initiatives mostly related to the El Nino phenomena. Some national institutions involved with disaster prevention and attention were created to attend affected populations during El Niño years and encourage research on this event. The ENSO affects both the Pacific and the Caribbean coast, despite the fact that most of the published information seems to be targeted at the Pacific Ocean. However, analyses integrating land use changes over time with historical or recent climatic events in coastal areas remain still scarce. Recently Nicaragua, Colombia and Panama have included risk assessments as part of their coastal municipalities territorial planning. All initiatives originated from national environmental authorities. Al-

11 Resilience as defined by the IPCC: *The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change*. IPCC (2007c: 880).

12 La Red is a network of professionals working on social studies in natural disasters prevention in Latin America since 1992. <http://www.desenredando.org/>.

though these are still pilot initiatives the aim is to implement such plans nationally.

32.5 Framework for Analysis

Climate events and natural hazards are part of the region's physical dynamics; however, unstable institutions and economies, concentration of people in vulnerable areas and the lack of planning mechanisms, increase even more the region's susceptibility to natural disasters and the consequences of climate change (Cardona 2003; Chang 2004: 22; Lavell 1999; PNUMA 2005).

The IPCC reports a great uncertainty regarding climate change and its impacts on the region and recognized the need for integrative vulnerability studies for preserving biodiversity and ecosystem services already pressured by changes in land use (Fischlin/Midgley/Price/Leemans/Gopal/Turley/Rounsevell/Dube/Tarazona/Velichko 2007), coastal areas are particularly in need of this type of analysis.

Considering the above, the proposed framework aims to provide a tool that assesses coastal areas' vulnerability to the impacts of climate change related to SLR and changes on climatic events intensity and frequency, at the local level. The model has been constructed from an environmental perspective acknowledging the interrelations between the environment and communities surrounding it or/and depending on it. Furthermore the model has been built considering the existing information in the region.

The authors acknowledge the existence, value and accuracy of coastal vulnerability frameworks used globally and in the region such as by Szlafsztein (2007) in Brazil; by Ortiz Perez and Mendez Linares (2006) in Mexico; by Klein and Nicholls (1999) and Kaiser (2006) at the global level. The proposed framework integrates these results. This type of information is feeding it and the way it integrates them and the historical analysis contributes to the existing knowledge.

Components of vulnerability are broad and interrelated. To ease data gathering and understand some interrelations this model classifies the impacts and responses in different components and for each one a series of indicators and parameters have been proposed. For description purposes, the components of vulnerability in this approach are: human-cultural, economy, policy, bio-physical and infrastructure. As an environmental perspective, the environmental component is much more developed than any other one; however, the same approach can be applied and branches developed for the other components as well.

The natural environment provides goods and services to communities transforming it and using it according to their needs, social structure, traditions, and economic activities. At the same time communities create social networks, institutions and policies that regulate exploitation and uses of the natural environment, among other activities within a society. Hence despite the apparent division on the components there is constant feedback and interrelation between them.

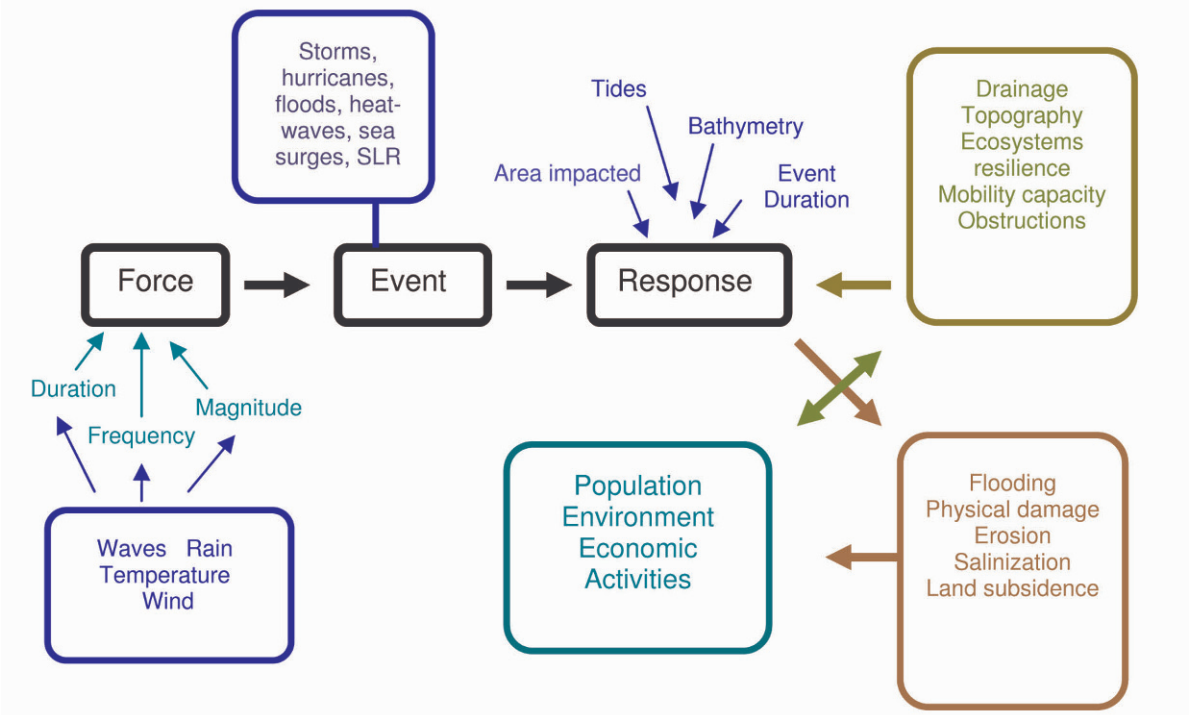
Perhaps regionally the most important consequences of climate change in coastal areas are sea level rise and its consequences and the change on frequency and intensity of natural disasters (Magrin/Gay Garcia 2007). If at the moment the physical dynamics of natural disasters are poorly understood within the region, the possibility to address more frequent and more intense events in the future is smaller. The same reasoning is applied to each natural system's capacity to respond (natural or man-made). There is an intrinsic capacity to resist natural forces in each system; if their current capacity to respond to actual events is unknown it will be further more difficult to plan for prevention for the short and long term.

This approach is based on the FER (*Force Event Response*) model, described in figure 32.7. It is a summarized representation of the forces affecting coastal areas, with or without climate change and of the potential consequences from the geophysical perspective. One force or the sum of them, originates natural events that become hazards and potential disasters. Despite of the origin of this force being a hurricane, a storm, severe rains etc, the system is having an impact upon which it will respond, as illustrated by Holling's (2001: 5) resilience model.

Depending on the characteristics of the system there can be no response, a complete change, and a temporal change. In the coastal areas the consequences of the forces of these natural events are flooding, physical damage, erosion, saline intrusion and land subsidence. These consequences will have an effect on human communities inhabiting coastal areas as well as on any activities developed there. However, as coastal areas have been transformed the impact of such forces does not only depend on an area's biogeophysical dynamics but also on those transformations.

In figure 32.8 these relationships are simplified in terms of information gathering. Each component has intrinsic capabilities independent of the occurrence of

Figure 32.7: Force Event Reponses (FER) applied to climate related events in coastal areas. **Source:** Modified from Lacambra/Moeller/Spencer (2008:84).



The Force Event Response (FER) diagram represents the different forces impacting on the coastal areas in the region, together with possible responses and physical and natural characteristics that will influence these responses. Impacting forces and responses vary with each event. This particular FER represents those forces influenced by climate change.

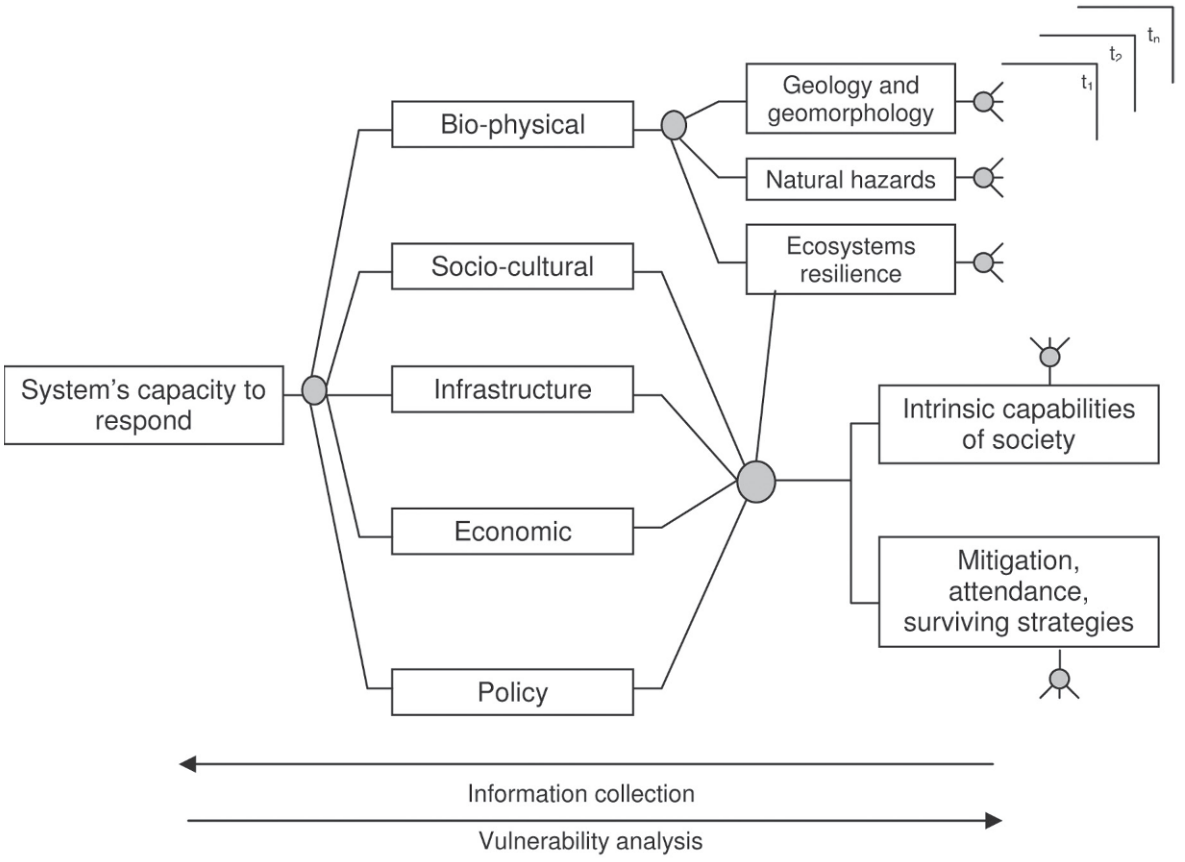
climate change and disasters that make the system more or less vulnerable. Also each component has a series of strategies to mitigate or to respond to each particular event. Biophysical responses to natural events have been classified into four categories: drainage, topography, the system's mobility capacity (migration) and ecosystems resilience. There are other physical characteristics on the impacted area, and related to each event that also influence on the responses: area, natural hazards, frequency, duration, bathymetry, and tides.

Parameters related to the ecosystem's resilience have been selected according to the ecosystem's intrinsic capacity to defend itself. The ecosystem's health for it determines its capacity to respond, defend and recover from an event and pressures on the ecosystems affect the intrinsic defence and health of these ecosystems.

It is at the local level that an integral vulnerability assessment considering ecological and physical variables is addressed. This is due to the type of indicators used and their change through time which are normally particular to each area. Each locality's development, economic activities, population distribution and governance policies (in relation to ecosystems, planning and disasters/risk) is considered. In order to establish the present vulnerability in each particular site, and for it to be comparable to the site itself, the same parameters are applied to different stages of development in history in the assessed area. The model applied to the same site in different historical settings allows identifying current and past drivers of vulnerability and its changes through time.

The model has already been validated at the local level in two study sites on Cartagena in the Caribbean and on Tumaco in the Pacific coast, both in Colombia. Because information from different disciplines and qualitative and quantitative information are treated in the same way the application of the framework requires expert knowledge of the area, ground proofing of information and holds a certain degree of subjectivity. However, it represents a good tool to understand the factors influencing an area's vulnerability. It allows the user to distinguish between those fac-

Figure 32.8: Decision tree, information collecting and vulnerability assessment. **Source:** The authors.



tors that are directly related to the natural events and those that are linked to the communities inhabiting such areas. The strength of the method is that it uses simple, basic information and expert knowledge from the area, as well as the processes (physical and human related) that have contributed to a site's vulnerability through time. The method introduced here can be used for several periods in history, covering centuries, decades or years. For the particular case studies applied, much of the change has been attributed to the past 50 years, perhaps if more detailed information existed for the other periods (1500's, 1800's and early 1900's) changes within each period could be as noticeable as those reported recently.

32.6 Preliminary Results

The primary conclusions here have resulted from a broad scale integrated analysis using the framework. Far from disagreeing with current approaches to climate change in the 7 countries analysed the authors' view is that these strategies should be complemented with climate change impact assessments. It is at the local level that climate change consequences will be felt and planning mechanisms ought to be aware of the possible consequences of climate change in order to provide feasible solutions to local communities. Other relevant facts summarized in table 32.8 and resulting from the integrated analysis have been outlined below:

- More than 30 per cent of the regional population inhabits coastal areas directly exposed to extreme climatic events.
- Approximately 70 per cent of coastal population in the region is rural or inhabits towns or cities smaller than 1 million people.
- These coastal areas represent 13,242 km of shoreline or roughly 45 per cent of the 7 countries' perimeters. They also report 25 per cent of events, most of which are
- related to floods resulting from rain, storms, or rains upland causing floods in coastal areas.
- Almost 85 per cent of the reported events (a total of 5,588 events) occurred between 1980 and 2004.

Table 32.8: Characteristics of the region's coastal areas. **Sources:** Alonso/Ramirez/Diaz/Segura/Castillo/Chatwin (2007:31); Chatwin (2007); CIA Factbook[a]; CIE[b]; DANE (2005)[c] INE (2001)[d]; INEC-Costa Rica (2000)[e]; INEC-Ecuador (2001)[f]; INEC-Nicaragua (2005)[g]; Ministerio de Economia – El Salvador (2007)[h]; PNUMA (2003); Restrepo/Kjerfve (2004); Rodriguez/Windevoxhel (1998:11); WRI (2003)[i].

Characteristics	El Salvador	Nicaragua	Costa Rica	Panama	Colombia	Venezuela	Ecuador	Total
National territory (km^2)	21,040	129,494	51,100	78,200	1,138,910	912,050	283,560	2,614,354
Land	20,720	120,254	50,660	75,990	1,038,700	882,050	276,840	2,465,214
Sea	320	9,240	440	2,210	988,000	135,995	6,720	149,140
Coasts length (km)	307	910	1,290	2,490	3,208	2800	2,237	13,242
Total perimeter	852	2141	1929	3045	9212	7793	4247	29,219
% of perimeter coastline	36%	43%	67%	82%	35%	36%	53%	45%
coast/territory rate	0.015	0.008	0.025	0.033	0.003	0.003	0.008	0.005
Continental shelf 200 m (km^2)	17,659	68,557	14,849	44,169	16,190	123,623	31507	316,554
EEZ area (km^2)	91,900	159,800	542,060	274,600	706,134	385,674	1,095,441	3,255,609
Superficial drainage Pacific (%)	100	10	53	69	20	0	100	
Superficial drainage Caribbean (%)	0	90	47	31	80	100	0	
Coastal features	Along the Pacific: Lagoons, cliffs, coastal plains, mangrove swamps, estuaries, rocky coasts	Along the Caribbean: narrow beaches, mangrove swamps. Along the Pacific: beaches, mangrove swamps, savannas, cliffs	Along the Caribbean: Wide coastal plains in the north, narrow coastal areas in the south. Along the Pacific: Irregular shoreline, narrow coastal lines with steep slopes	Along the Caribbean: narrow mangrove areas and beaches, cliffs, estuaries, rocky and sandy coasts. Along the Pacific: Irregular shoreline, mangrove swamps, mudflats, wide beaches, estuaries, islands.	Along the Caribbean: dwarf mangrove forests, deltas, beaches, cliffs, coastal lagoons, sandy beaches. Along the Pacific: extensive mangrove forests, deltas, mudflats, wide beaches, intertidal areas, cliffs.	Mangrove forest, dry tropical forest, coastal lagoons, cliffs, estuaries, deltas, sandy beaches, lowland plain areas	Mangrove forest, intertidal areas, estuaries, beaches and cliffs	
Mangrove area (Km2)	268	1,550	410	1,708	3070	2500	1950	11456
Coral reefs (Km)	1	455	2.5	320	2860	480	<50	4100 approx

Characteristics	El Salvador	Nicaragua	Costa Rica	Panama	Colombia	Venezuela	Ecuador	Total
Population	6,948,073	5,675,356	4,133,884	3,242,173	44,379,598	26,023,528	13,755,680	104,158,292
Pop density (Hab/Km^2)	335.33	47.19	81.60	42.67	42.73	29.50	49.69	42.25
% population in CZ*	13	24	7	50	30	15	61	30% approx
Main Metropolitan area	San Salvador	Managua	San Jose	Panama City	Bogota	Caracas	Guayaquil	
Main Coastal cities Caribbean		Puerto Cabezas, Bluefields, El Bluff	Puerto Limon	Colon	Barranquilla, Cartagena	Maracaibo		
Pacific	Acajutla, La Libertad, Puerto triunfo, Puerto Cucuto, La union	San Juan del Sur Potosi	Punta Arenas	Panama city	Buenaventura and Tumaco		Guayaquil	
Population more than 1 million in Coastal areas	none	none	none	Panama city	Cartagena and Barranquilla	Maracaibo	Guayaquil	
Cities in deltas and estuaries		Puerto Morazan Linda Vista Puerto Somoza Bluefields	Puntarenas	Panama city Colon Bocas del toro	Barranquilla, Tumaco, Cartagena	Maracaibo Caripito, perdernales	Guayaquil	
% of total events reported in coastal areas	8	33.5	30	44	17	19	23	25%
Reported to be impacted by	Floods, hurricanes, storms, sea surges, volcanic eruptions, landslides, earthquakes, tsunami	Storms, hurricanes, floods, earthquakes, tsunami,	Floods, droughts, storms, sea surges, rains, volcanic eruption, landslides, earthquakes,	Floods, droughts, storms, sea surges, rain, earthquakes, landslides	Floods, storms, hurricanes, landslides, rains, tsunamis, sea surges, volcanic eruptions	Floods, hurricanes, sea surges, rain, tsunami, earthquakes, landslides,	Earthquakes, floods, sea surges, rains, landslides, tsunami	
Most commonly event reported	floods	hurricane	floods	floods	floods	rain	floods	

*This figure refers to the population in coastal areas that would be directly influenced by extreme climatic events in coastal areas. If the towns or cities are located within 200km of the sea but there is a geographic accident separating them from the sea this cities have not been included.

** Including the Galapagos Islands

a CIA, 2008: *The World Factbook*; at: < https://www.cia.gov/library/publications/the-world-factbook/index.html>.
b CIE, 2000: "Censo de Población Panamá"; at: <http://www.contraloria.gob.pa/dec/cuadros.aspx?ID=081601>.
c DANE [Departamento Administrativo Macional de Estadistica. Censo de Poblacion], 2005; at: <http://www.dane.gov.co/> (14 March 2007).
d INE [Instituto Nacional de Estadística – Venezuela], 2001; at: <http://www.ine.gob.ve/poblacion/censopoblacionvivienda.asp> (22 February 2008).
e INEC [Instituto Nacional de Estadisticas y Censos – Costa Rica], 2000; at: <http://www.inec.go.cr/> (16 January 2008).
f INEC. [Instituto Nacional de Estadisticas y Censos – Ecuador], 2001; at: <http://www.inec.gov.ec/default.asp> (16 January 2008).
g INEC [Instituto Nacional de Estadisticas y Censos – Nicaragua], 2005; at: <http://www.inec.go.ni/> (2 March 2008).
h Ministerio de Economia, Censo de Poblacion y Vivienda 2007, El Salvador; at: <http://www.censos.gob.sv/sitepoblacion/index.html; (16 January 2008).
i WRI [World Resources Institute], 2003: "Coastal and Marine Ecosystems", in: "EarthTrends Country Profile"; at: <http://earthtrends.wri.org/country_profiles/index.php?theme=1>.

68 per cent of the reported events that are related to climatic factors have occurred during the past 25 years. 93 per cent of deaths have been caused by climatic events, but less than 7 per cent of climate related events reported deaths. Non-catastrophic events such as rains and floods caused by severe or long rainy seasons have caused almost 90 per cent of victims in the coastal areas.

- The most commonly reported effects of climate-related events are injuries and loss of life, as well as damage to crops, houses and infrastructure.
- The increase in population and urbanization during the past 30 years along coastal areas has contributed to an increase in reported events. However, the increase in reporting can also be the result of improved recording methods on such events.
- 90 per cent of reported natural disasters are related to climatic events.
- Floods account for 50 per cent of the events reported in coastal areas, while deforestation along river basins directly impacts on floods in lowland areas. With greater precipitation and less forest cover, coastal floods are likely to be more frequent.
- Considering that approximately 70 per cent of the coastal population within the 7 selected countries is rural or inhabiting towns and small cities with less than 1 million people[13] and, despite the fact that the natural environment supports and provides livelihoods to these coastal communities, the damages it suffers as a consequence of extreme events are very rarely reported; nor are direct damages, such as those damages to the services the ecosystems might provide (source of food, water and shelter).

32.7 Conclusions

There is a need to understand the regional consequences of climate change at the bio-geophysical level in coastal areas, in particular considering that natural events related with climate will be more frequent and more intense. Although countries have produced policies for disaster prevention, understanding of the physical forces driving these events and their relationship with the landscape and the natural ecosystems does not seem to occur. Understanding of these dynamics as well as other coastal dynamics will lead to a better implementation of current policies and a more rapid adaptation to climate change.

Among the issues needed far greater attention are directed to the following problems:

- More policy analysis is needed on how best to address the consequences of climate change in coastal areas, especially as an integral part of *Coastal Zone Management* (CZM) strategies.
- There is a need to understand the physical processes involved with coastal events, their interrelationship with climate change and the role of natural ecosystems, and to integrate that information with corresponding policy; i.e. independent of climate change, adequate land planning is required for preventing natural disasters.
- Although consequences of sea level rise have been accounted for at the local level in all seven countries, there seems to be a lack of integration between climate change policies and policies on natural disasters, between climate change and ecosystem policies and between environmental and

13 This figure has been calculated from the National Populations Census, considering those coastal cities with population greater than 1 million people and that are directly impacted by coastal hazards.

natural-disasters-related policies, at least in coastal zones. Confronting climate change requires a more integrated and cross-cutting policy approach than on any policy issue in the recent past.

- All seven countries are highly diverse countries and promote and protect their biodiversity through their respective environmental authorities. While ecosystems and the biodiversity they contain have been acknowledged as an important issue, the services provided by such ecosystems are not well known. There is a need to enhance research on the services provided by coastal ecosystems and integrate it with vulnerability analysis on coastal areas.
- There is a need for research on the regional, national and local resilience of coastal ecosystems to the different natural events. While there are studies in other regions of the world, the region's geomorphology, oceanography, climate and natural environment are different and could produce equally different results.
- The inclusion of environmental indicators in vulnerability analysis, for coastal hazards, is a good tool to understand past events; how they have modelled the current landscape; and how the natural environment can protect against some forces of climatic events or ameliorate such forces before they reach populations.
- There is a need to include the impact of natural events in coastal areas into climate change research and policies. There is a regional need to elaborate SLR assessments at the national level with updated information that takes into account the coastal dynamics of each particular site.

Despite the uses and services provided by coastal ecosystems and the various initiatives for their protection, mangroves and coral reefs are being degraded at great speed. If these coastal ecosystems are not in a good condition, they might not be able to respond to climate change and its impacts and to help the region's coastal communities protect themselves and adapt to a changing climate.

33 Flood Loss Redistribution in a Third World Megacity: The Case of Mumbai

Monalisa Chatterjee

33.1 Introduction[1]

Loss redistribution[2] is an embedded coping[3] mechanism that plays a significant role in sustaining low income populations during times of crisis. Mumbai provides evidence of existing and emerging loss redistribution practices that may be representative of slums in many other Third World mega cities. In Mumbai slum, populations typically have access to more than one method of loss redistribution, depending on a variety of socio-economic factors, to assist in the recovery process after floods. The study identifies these socio- economic factors that impact the type and number of sources available to affected households and in turn also serve as an indicator of resilience in these communities.

Loss redistribution is widely believed to be one of the primary strategies used by members of poor societies to cope with the effects of natural hazards like flooding (White/Burton/Kates 1978). However, apart from anecdotal evidence (and limited case studies in which hazard loss is not the main focus), little is known about the salience, structure, function and varieties of this strategy as it is actually practiced (Basu 1997; Baydas/Bahloul 1995; Goetz/Gupta 1996; Sumarto/Suryahadi/Pritchett 2003; Zeller/Sharma 2000). The main objective of this chapter is to identify and analyse examples of contemporary flood loss redistribution networks in slums of Mumbai, India.[4] This will: (1) add to the growing body of research on the role of social capital in human sustainability; and (2) permit an assessment of the potential of these informal networks for broader use, perhaps in formal systems of flood vulnerability reduction and flood hazard management.

The main hypothesis guiding the research is that individual poor households affected by floods have access to a wide range of alternative support networks that provide important – though often overlooked - cushions against hazard impacts. This chapter is based on decades of research by geographers on vulnerability and human adjustment to environmental perturbations where research suggests that humans choose suitable coping measures influenced by such factors as social structure, past experiences, available resources, pools of information, cultural preferences, and individual capabilities of members, among others (Blaikie/Cannon/Davis/Wisner 1994; Mitchell 1989a; White/Burton/Kates 1978; Wisner 1998). These adjustments span a wide range of choices from the structural to the behavioural, from the anticipatory to the reactive, and from those that are employed by private individuals to those that can only be practiced collectively by governments, businesses or civil organizations (Mitchell 2008).

The initial section of the chapter (33.2) provides background information about flood loss redistribution in the context of natural hazards research. This is followed by a discussion on monsoon-related flood problems, urbanization and vulnerability of poor populations in Mumbai, India (33.3). Interim findings on flood loss redistribution among slum dwellers are outlined (33.4) and results are elaborated (33.5). These provide the basis for more general conclusions based on the research completed to date (33.6).

1 The author is grateful to Prof. James K. Mitchell for his valuable inputs and suggestions.

2 Loss redistribution is a process by which losses suffered by affected population is shared by local, regional and global societies. It has its formal and informal forms. Ability to redistribute losses reflects the capacity to cope, recover and adapt for specific communities.

3 Coping is a capacity to respond and recover from something stressful, e.g. disaster.

4 It forms part of a doctoral dissertation on 'Urban Flood Loss Sharing and Redistribution Mechanisms among the Impoverished Industrial Population of Mumbai' Department of Geography, Rutgers University.

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33.2 Loss Redistribution and Hazard Risk

Capabilities in loss redistribution have been a strong factor in defining vulnerabilities for different communities in developed and developing countries. In the United States, human adjustments to floods by loss redistribution were introduced in the 1940's when White (1945) and later others (Kates/Burton 1986a, 1986b) shifted attention from engineered methods of controlling floods to land use planning and effective adjustments by people living in floodplains. This perspective emphasized the rational behaviour of affected individuals in reducing losses by better land use and redistribution policies. However, in a developing country context this approach is altered as rational behaviour among affected households is constrained by socio-political, economic and cultural factors (Robbins 2004; Smith 2002). Under the influence of structural forces and its impact on entitlement (Oliver-Smith 2004), hazard vulnerability and resilience in communities of developing countries is a function of economic, socio-political, infrastructural, ecological and personal assets (Bohle, 2001). Here resources rely on the social, political and economic networks of support and loss sharing (Nathan 2009) and studies show that access to various social networks also plays a significant role in developing people's self perception of their vulnerability (Dershem/Gzirishvili 1998). Redistribution of hazard losses can be part of a formal risk mitigation system like flood insurance in the United States (Burby 2001) or a more informal embedded system where losses are shared among interlinked (Baydas/Bahloul 1995) and interdependent communities (Basu 1997).

In developing countries of Latin America, South East and South Asia, low income communities show increasing reliance on the transfer of resources by means of remittances (Adams 1998; Woodruff/Zenteno 2007; Yang 2007). Furthermore, remittances are used by receiving households, especially in urban communities, as insurance against sudden fluctuations of income and related shocks (Yang/Choi 2007).

Urbanization isolates populations as people migrate away from their social setting and relocate themselves in different physical, social and economic environments (Blaikie/Cannon/Davis/Wisner 1994; Keyder 2005; McGranahan/Jacobi/Songsore/Surjadi/Kjellen 2001; Wisner 2003). In the city new migrants, especially the poor, do not reproduce traditional social and economic associations from their rural places of origin, that can be used for support in the event of a disaster (Pelling 2003; Wisner 2003). Although, the process of building social capital in the neighbourhood begins as soon as the migrants move into the settlements, nascent forms of associations are rarely enough to permit adequate disaster recovery, especially when whole neighbourhoods are equally affected. Under such circumstances, slum dwellers – who are the most vulnerable of all exposed groups – make and maintain different types of safety and recovery support networks. These networks are often layered and complex, requiring considerable attention, skills and resources if they are to function effectively (Alexander 1978). When floods threaten or occur, affected populations employ such networks to draw on sources of assistance that are structurally, geographically, socially and economically separated from them. In places like Mumbai, the overall vulnerability or resilience of flood-affected populations depends significantly on their capacity to manage these network affiliations (Moser 1998).

In some rural post-flood situations it has been found that low-income households rely disproportionately on their employers for credit needed to recover from losses. This arrangement is often recurrent and is acceptable to both parties because the entitlement offered by the lender is economically valuable to the employer[5] (Basu 1997). Similar arrangements have been observed in cities where displaced slum inhabitants do not have access to other traditional forms of support. This adds a new layer to the traditional mix of basic social, political and religious arrangements that are found in India. These bridging and linking aspects (Sumarto/Suryahadi/Pritchett 2003) serve to bring population groups of separate social classes and background into direct association (Mitchell 2006). Moreover, in places that are exposed to forces of globalization, individuals can take advantage of new linkages to expand their access to resources permanently, thereby increasing opportunities for safe and sustainable development (Roberts 2005; Sen 1981).

Contemporary global change research interest is to understand how structural forces affect and alter the concept of vulnerability and human security in societies of different regions and distinguish specific communities that benefit and suffer from its impact (Brauch 2005a; IHDP 2005). Furthermore, identification of marginalized communities excluded from

5 Skilled workers offer entitlements like working extra hours, working at subsidized rates. These are economically viable only for employers and not for any other financial or private institutions.

Box 33.1: Mumbai Facts. **Source:** Risbud (2003); Arunachalamn (2005); Gupta (2007).

Total Area = 437.71 km^2
Number of Wards = 24
Total Population = 16,360,000 (2001)
Expected Population = 25,000,000 (2025)
Rate of Increase = 3.7 per cent
Total Slum Population = 54–65 per cent of total population
Topography = Linear central bowl or depression with low lines of hills on either side
Annual Rainfall = 2300 mm (90 per cent in Monsoon season between June – August)
Flood Frequency = Parts of Mumbai are inundated every year
Reasons for Flooding = Low ground levels, dilapidated drains, obstructions of utilities, encroachments along '*Nallas*' (drains), slums along outfalls, increase in runoff coefficients, loss of holding ponds, siltation of drains

emerging layers and networks of safety provide social locations that need strong institutional and state interventions to prevent consequences of discriminations (Chari/Gupta, 2003) and ensure basic provisions of human security.

33.3 Monsoon Floods and Vulnerability in Mumbai

Mumbai is a flood prone mega-city that has fifty four per cent (Risbud 2003) of its population in the informal economy. An event in the recent past illustrates the consequences of excessive monsoon rainfall on such a city. On 26 July 2005, Mumbai and its surrounding areas received up to 940 mm of rain followed by 700 mm during the next two days. This downpour, which was considerably larger than those experienced in any day of the monsoon period in the past hundred years (Arunachalam 2005), resulted in 672 deaths in Mumbai with at least 300 more in surrounding areas (Government of Maharashtra 2005). In addition there was extensive loss of property especially among the inhabitants of low-income communities, many of whom lost all their possessions. Moreover, there was widespread damage to transport and communication systems within the city, as well as public buildings including schools, offices, storehouses of medicines, grains, etc. Commercial activities for the entire city were disrupted for more than seven days. Many observers attributed these problems to haphazard and unprecedented growth of the city into marginal locations that are more severely affected by out of the ordinary natural processes (Mehta[6] 2005; Nariman[7] 2005; Sachdeva[8] 2005; Sekhar[9] 2005). Monsoons in the following years, though of lesser intensity, also reflect the effect of continuous growth and haphazard construction without taking into account the risk of floods in the future (Bhagat/Guha/Chattopadhyay 2006).

Mumbai is representative of many fast-growing and transforming large cities in developping countries like Sao Paulo, Dhaka, Mexico City, Delhi, Jakarta, Shanghai, Seoul, Lagos, etc. (Dawson/Edwards 2004) where low income settlements primarily house the informal sector of the city. In addition to growing informal settlements Mumbai is also witnessing the process of extensive informalization of work and polarized occupation distribution of workers where the division of high and low income classes are further widening (Sita/Bhagat 2007). Mumbai therefore provides a suitable example to analyze the emerging trends of vulnerability and human security in a mega-city that is restructuring away from dependence on industry and towards investment in services.

Vulnerability to hazards in Mumbai is largely a product of the lack of access by poor populations to much-needed affordable low-income housing in the city and suburban areas and lack of participation by these same populations in the making of public decisions about urban development. The impacts of international neo-liberal trends in philosophies of economic investment (e.g. increased private risk-taking, decreased collective welfare payments) have been markedly evident since the 1990's, affecting then mainstream economic sectors like the city's textile industries and typical industrial workers (Rao 2006). Those industries are in severe decline and centrally located industrial and workers' residential areas are now being redeveloped as commercial and high-income residential zones to support the rapidly growing service sector. The final land rezoning decision for the last

6 Mehta, T. 2005. "Decentralise Planning, Management." *Times of India*: August 6.
7 Nariman, F S. 2005. "Make Mumbai a City State." *Mumbai Mirror*: August 4.
8 Sachdeva, S D. 2005. "A Mess of Our Own Making" *Times of India*: August 14.
9 Sekhar, V. 2005. "How the airport ate up Mithi River." *Times of India*: August 1.

1800 acres available for redevelopment in central Mumbai remains to be taken (Correa 2006). However, it is already clear that textile workers and other conventional industrial workers have lost the battle to retain their jobs and homes to opponents comprising a coalition of builders, landowners, and development authorities for the city and state (D'monte 2006). Disintegration of the city's old industries and the advent of a service economy have set the scene for the removal of existing workers. Like everyday incoming immigrants they are being relocated to peripheral residential settlements that lack adequate infrastructure and basic facilities. The global land market has driven up the value of land in central Mumbai to the point where such displacements have the effect of redistributing both the fading middle-income populations and the growing low-income populations. In other words, the levels and locus of flood vulnerability are being shifted to new sites in Mumbai. Here globalization has an immediate effect on the distribution of vulnerability because communities that are not involved in - and hence not connected to - the global system, are excluded from the benefits of the existing local support network. Furthermore, the growing visibility and influence of native *marathi* speaking populations of Maharashtra in Mumbai (Appadurai 2001) has further isolated others from existing support networks. As a result even more disadvantaged sub-communities are segregated within the larger slum settlements that are already generally deprived.

In 2005, floods in Mumbai opened up several public debates about problems of urban planning and development, but very little was done to reduce losses borne by low-income communities. During preliminary fieldwork (in July and August 2005) it was observed that immediate and random distribution of relief in the form of food, water, and medicines is the only assistance the low-income population received at the individual level. Populations that were included in existing local religious, political and social communities had priority for access to relief. This method of disaster assistance had two main disadvantages. First, it increased the dependency of poor communities on municipal authorities and non-governmental organizations that often performed in an erratic manner. Second, alternative larger, more effective and more sustainable networks of protection, that might otherwise have been employed, were not made sufficient use of. As a consequence, flooded local communities received haphazard and usually inadequate attention triggered by political connections and mass media publicity rather than actual need. This conclusion is substantiated by research on similar cases in other developing countries (Bankoff/Frerks/Hilhorst 2004; Pelling 2003).

Since the reliability of the public support system after floods in Mumbai is inconsistent and somewhat limited to providing immediate relief, marginal populations of the city's informal economy are increasingly dependent on ad hoc arrangements that help recovery. These arrangements are individually developed and maintained unlike institutionalized formal support systems. Securing the means to recover was already a serious problem for low income populations before the destruction of the local industries. Now, with large numbers of workers being forced to migrate to the peripheral shantytowns, the inadequacies of this system are being reproduced in a far wider spread of places. Repercussions for the formal sector of society are also increasing.

33.4 Flood Loss Redistribution Measures Practiced by the Slum Population

The analysis of loss redistribution by slum dwellers in Mumbai shows that the flood loss redistribution system of the low income population living in cities of developing countries is a set of diversified and multiple layered complex arrangements. Furthermore, the study confirms that although this system is an effective method of empowerment and loss reduction for slum households in general, there are marginalized population groups left out of these support networks due to internal (cultural, social and political) discriminations or external (labour demands, skill, type of industry) exclusions.

Surveyed respondents comprised workers in the following industries: manufacturing; chemical and pharmaceuticals; engineering goods; printing, packaging and transportation, and construction.[10] The pool of respondents ranged from permanent employees to casual labourers hired as daily wage earners (table 33.1).

On average each household had access to approximately five (4.8) sources of emergency economic assistance in form of monetary support for damage coverage, bonuses, allowances, easy loans, etc. Table

10 Employers have been classified on the basis of markets, for example, industries and factories that produced goods for the international markets have been classified as 'internationally connected' employers.

Box 33.2: Methodology[a]. **Source**: The author.

I. Questionnaire Surveys – 50 Households randomly selected in two flood affected slumsSections in Questionnaire – (For this paper, results from section 1, 6 and 7 are analyzed and presented. Each section contained categorical and open-ended enquiries)
(1) Socio economic cultural profile of the respondents
(2) Characteristics of flood vulnerability including physical vulnerability, infrastruc-ture availability, access to basic amenities
(3) Flood impact, extent of losses, and type of direct and indirect losses
(4) Methods adopted by individuals to immediately survive from floods
(5) Government, NGO and other institutional support or aid and relief received
(6) Access to formal and informal financial facilities, sources of credit and loans
(7) Specific loss sharing mechanisms adopted and sources applied to reduce losses
(8) Awareness and perceptions about insurance coverage for flood losses, insights into the idea of suitable products to redistribute flood risks.

II. Ethnographic study of selected settlements was used to understand and evaluate lifestyle, resources and attitude of slum dwellers about their vulnerability, potential risk from recurrent floods, their perception on the causes of these losses and responsibility for dealing with it.

III. Analysis: Data are grouped by evolving themes and cross-tabulated to develop typologies of practices, processes, choices and opinions. Chi Square tests are used to identify relations between different social, economic and mitigation variables.

a This chapter presents some results of the fieldwork conducted in 2007 in Mumbai.

Table 33.1: Distribution of Respondents by Employments Type. **Source:** The author's primary fieldwork in Mumbai in 2007.

Type of Employment	Permanent	Temporary	Seasonal	Daily	Total
Manufacturing	18	5	3	3	29
Engineering Goods	2	0	0	0	2
Data Processing	1	0	0	0	1
Chemical and Pharmaceuticals	8	0	0	0	8
Printing , Packaging and Transportation	4	3	0	0	7
Others (construction)	0	3	0	0	3
Total	33	11	3	3	50

33.2 below demonstrates that all 50 households had at least one source of economic assistance (rank 1). The great majority (80 per cent) could draw on up to five sources simultaneously (rank 5). After floods, employers and money lenders are the leading sources of financial help, followed by family members, informal establishments and friends.

It is noteworthy that formal banks and neighbours are the least approached sources after floods as 98 per cent and 92 per cent of households' surveyed chose not to rank them as options. First options of economic support selected by respondents are employers (30 per cent), family members (24 per cent) and local traders (22 per cent). Accepted alternatives that are ranked second are again employers for 26 per cent of respondents, however, family members and local traders are replaced by money lenders (16 per cent) and religious organizations (14 per cent). Employers remain a prominent source of help even as the third option for 22 per cent of surveyed households followed by informal establishments (16 per cent). As the fourth and fifth option, informal establishments turn into an important source. At rank 5 means like arrangements with money lender (28 per cent), family members (22 per cent) are observed to be other leading options of support. Almost two third of the population have used friends as sources of economic assistance, however, friends are not prominent in any specific ranks but are more or less present as a preference in all ranks.

Table 33.2: Rank Wise Distribution of Sources of Financial Support after Floods. **Source:** The author's primary fieldwork in Mumbai in 2007.

Sources of economic assistance after floods	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Total	No Rank
Neighbours	0	0	3	1	0	0	4	46
Friends	3	6	5	5	5	8	32	18
Family Members	12	6	4	1	11	0	34	14
Religious organization	1	7	0	6	0	0	14	36
Money Lenders	4	8	5	5	14	3	39	16
Local Traders	11	5	4	2	0	0	22	28
Self Help Associations	3	1	1	3	0	0	8	42
Informal Establishments	0	2	8	12	10	1	33	17
Employers	15	13	11	6	0	1	46	4
Formal Banks	1	0	0	0	0	0	1	49
Total	50	48	46	43	40	13	240	

33.5 Findings and Discussion

Collected data clearly indicate that the flood loss redistribution system for slum residents is multiple layered and spatially complex; the same household often has access to several different types of financial support concomitantly and vulnerable populations can avail themselves of assistance from networks at many overlapping spatial scales; these can involve communities that are geographically, socially and economically separate from them. Jewellery shop owners who exchange cash for pawned items and storekeepers who provide goods and credit both are part of exclusively local networks. Networks of self-help groups, religious organizations and informal establishments are local or city wide. Family members and employers are part of networks that can be local, metropolitan or global in scope. Therefore loss redistribution strategies of slum dwellers are affected by internal, local and regional, national and global factors.

The impact of structural forces is evident in the role of employers and deserves further comment. In the contemporary era of global economic restructuring, employers at the city, national and global level have become significant providers of emergency support for Mumbai's hazard affected slum dwellers. This is partly due to the growing ease with which skilled individuals can access easy loans, information and support networks that permit them to leave present employers and set up their own businesses. The indirect impact of globalization in Mumbai therefore has made skilled workers a valuable asset for employers. As a result employers are careful to supply support to their employees to ensure minimum attrition. This inclination, however, is particularly noticeable in the case of permanent workers (with or without contracts) (table 33.3). Cross tabulation of employment type and employer-provided economic assistance shows that employers are the most preferred source of support for 31 per cent of the survey respondents. The statistical relationship (Chi Square test[11]) between employee type and employer-provided economic assistance is also highly significant (^{2}<*0.00*).

Neo-liberal economic policies probably also play a role in encouraging employer-provided emergency support. Employers seem to prefer assisting individual workers to absorb the costs of flooding because this relieves employers of responsibilities to protect entire communities at risk. Moreover, in a mobile labour market, factory owners who are unable to support and retain workers might otherwise be subject to the indirect impacts of the flood hazard (Basu 1997). For the employer, therefore, advancing financial assistance or easy loans to the worker is a form of insurance to assure that the future income is not affected. Hence a common arrangement adopted in Mumbai is

11 The Chi Square test is used in this study to examine if two variables are independent or related. A chi-square probability of 0.05 or less is commonly interpreted as a justification for rejecting the zero hypothesis that the variables are unrelated.

Table 33.3: Economic Assistance from Employers Categorized by Employment Type of Respondents. **Source:** The author's primary fieldwork in Mumbai in 2007.

Employee Type and Economic Assistance from Employer	Economic Assistance Source Employers (Ranks 0-6)						Total
	0	1	2	3	4	6	
NA	0	0	1	0	0	0	1
Permanent	0	11	9	10	5	0	35
Seasonal	3	0	0	0	0	0	3
Temporary	1	4	3	2	0	1	11
Total	4	15	13	12	5	1	50

to work additional hours for the employers in lieu of the support forwarded after floods. Approximately 70 per cent of the workers surveyed affirmed working extra hours after floods. However, working extra hours in some cases is not a formal repayment of the loan but a gesture of gratitude and assurance for future support. Among the surveyed population only 63 per cent of the respondents that worked extra hours claimed to have made a formal (written or verbal) contract for financial support and repayment of loan. For the 37 per cent respondents that worked extra hours the arrangement is a matter of understanding between the 'malik' (employer) and the worker. In the later case, workers are more likely to be exploited because the number of extra hours worked could be worth more than the support provided. Furthermore, working extra hours for future aid is also an investment without having the means to claim a repayment because getting support in the future is not in the workers' control but is dependent on the attitude of individual employers.

The practice of seeking assistance from employers appears to be confined to employees of companies that produce goods for non-local markets. Respondents who work in factories that produce local goods for local markets do not get significant economic assistance from their employers. One possible reason for this inconsistency is that local employers do not hire skilled workers and therefore do not need to support them during emergencies to keep them available for later employment. Another reason might be that locally situated employers cannot call on extra-local resources; after suffering flood losses they do not have the means to assist their employees.

The other prominent group that provides economic assistance to slum population is the immediate or extended family living near or abroad. Family members living in other parts of the city are the foremost sources of support for slum inhabitants. This is for two reasons. First, those family members are not likely to be so affected by flooding. Second, because they live relatively nearby these relatives can be contacted quickly in the event of a flood. Applying to and getting support from them is both faster (due to proximity) and more straightforward (because of their heightened awareness) than with other potential sources of support. Furthermore, the relationships with relatives that live in the same city are not only likely to be semi-continuous, they are easier to maintain and available for quick activation when needed. Although there is no clear evidence to show, if these appeals are primarily horizontal (i.e. between siblings or cousins) or vertical (i.e. between generations and those related by marriage), an apparent dependency exists between new migrants and relatives who have been living in the city for some years. Chi square tests show that the association between years of residence and reliance on economic assistance from family members is highly significant for this dataset ($^2 < 0.00$). New migrants are more likely to be located near water bodies and therefore are more at risk from floods in the monsoon. Furthermore, since they are recent settlers they do not have a well-developed aid network to approach and consequently are reliant on older family members in the city or back in the villages. Older migrants (living in the city for more than 20 years) also show a degree of dependence on family members. Often this involves horizontal exchange but where it is vertical, the flow of resources is from younger family members (e.g. people working in the Middle East) to older relatives in Mumbai.

Although employers, family members and local traders dominate the informal loss redistribution system, other agents have also been significant for certain types of marginal populations. Inherent social and cultural factors are important influence on the effectiveness of these sources. For instance, religious organizations are an important source of aid to small ghettos of religious minorities within larger slum settlements (table 33.4). Table 33.2 shows religious organ-

Table 33.4: Economic assistance from religious organization categorized by religion of affected households. **Source:** The author's primary fieldwork in Mumbai in 2007.

Religion of respondent and economic assistance from religious organization	Economic assistance source religious organization ranks (0-4)					Total
	0	1	2	3	4	
Christian	3	0	4	0	1	8
Hindu	29	0	0	0	4	33
Muslim	4	1	3	0	1	9
Total	36	1	7	0	6	50

izations ranked as second and fourth sources by seven and six households respectively. Chi square tests of variables like the religion of the household surveyed and financial assistance from a religious organization are highly significant with $^2< 0.00$. Table 33.4 illustrates a relationship where religious organizations are higher ranked support sources for minority groups of Muslim (44 per cent) and Christian (50 per cent) households. For Hindu households however, it is an additional source of support for only 12 per cent of surveyed households. Religious organizations are most effective at the ward and city level because such associations need to be continuously nourished if they are to be useful. As a result it is noted that 72 per cent of respondents did not avail support from religious organizations.

Informal establishments are in a special category as members need to participate in them for a long period of time before they can approach the members with requests for support. Continuing contribution to the financial pool with other members of the group is essential to be able to use informal networks. Participating in informal arrangements provides extra remuneration and therefore is a common practice among slum dwellers. Collected data indicates that informal establishments provide acceptable sources of loss redistribution and 33 households have used them for additional support after floods. However, they are not the chief network of support for any family. The chi square test shows that religion ($^2<0.00$) and years of residence in the present place ($^2<0.00$) signify an association with the use of informal establishments for support after floods. The results therefore suggest that the cultural and socio economic characteristics of individual households, like religion and the number of years they have been living in the present address, affect their ability of using support from informal establishments to recover after floods.

Self-help groups are the first source of support for 3 families in the survey (table 33.2). Here the financial arrangements among members of the group are more formal in nature because the money is openly accounted for and the affected population is entitled to support simply by joining the association. This offers some advantages because members can claim support first and contribute later, which is the reverse of practice for members in informal establishments.

Results from the study show that both internal and external agencies are important components of the flood loss redistribution system. However, all sources of support are not equally influenced by local and global forces. Type of loss redistribution is reflected in the kind of arrangements observed between the affected and supporting members. Table 33.5 explains the type of arrangements organized by scale. For instance, local traders and money lenders are dominant sources in the local loop of assistance whereas employers and family members are more prominent as the wider circles of support. This distinction further highlights the emerging impact of local and global forces on flood loss redistribution. It also demonstrates the co-existence of traditional and contemporary mechanisms where flood victims use two different types of safety networks simultaneously. Because of the diversity in cultural, social, political and economic groups found in cities the range of alternatives is more complex for urban dwellers than for rural residents. Table 33.5 shows that the transaction is more likely to change from informal to the formal as the victims begin to draw on non-local sources of support. However, a considerable amount of flexibility exists even in the formal circles where both formal and informal arrangements can be made with different types of employees.

Emerging trends show that individuals in slums of cities like Mumbai are connected on many levels with expanding sources of support. The urban environment provides an enhanced degree of complexity in networks which are utilized by affected low income households simultaneously to redistribute their losses. The growing presence of employers in the flood redistribution of slum dwellers illustrates the gradual pen-

Table 33.5: Formal and informal arrangements of support. **Source:** The author's primary fieldwork in Mumbai in 2007.

Sources of economic assistance after floods	Neighbours	Friends	Family members	Informal establishments	Money Lenders	Local Traders	Self Help Groups	Religious Organization	Employers	Formal Banks
Local	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**F**	NA	IN	NA
Ward	NA	**IN**	**IN**	**IN**	**IN**	NA	NA	**F**	NA	NA
City	NA	**IN**	**IN**	NA	NA	NA	NA	**F**	**IN/F**	NA
National	NA	NA	**IN/F**	NA	NA	NA	NA	NA	**IN/F**	**F**
Global	NA	NA	**IN/F**	NA	NA	NA	NA	NA	**IN/F**	NA

Legend: Here informal (IN) means that the exchange is not accounted for in any formal system. Similarly, formal (F) means of economic assistance are those where the transaction is accounted in some formal agency.

etration of private sector commercial institutions into what was formerly a support system that relied mainly on intimate bonds among kin and loosely organized involvement by government or community organizations.

Having access to multiple sources of flood loss redistribution was observed to be directly related to coping and recovery among the affected households. Ethnographic study of the surveyed households demonstrated that households with diversified loss redistribution had regained their prior lifestyle, i.e. had required household assets, children studying in private schools, etc. Furthermore, many of these households were able to adopt structural adjustments like raising the foundation of their rooms, adding a higher platform or second floor to their house to ensure against future losses from floods. While households with access to fewer networks of loss redistribution absorbed the losses by themselves, and therefore were living in degenerated conditions. Type and number of loss redistribution sources were observed to play an important role in defining resilience among slum dwellers of Mumbai.

33.6 Conclusion

In developing countries like India there exist various layers of post-disaster coping strategies and adjustments to hazard and its impact, though the type and mix is somewhat different from those of the more developed world. Among others, observed loss-redistribution adjustments include: resource transfers from family (Morduch 1999); cash or in-kind advances from employers in return for overtime work or extra labour (Basu 1997); community lending and saving organizations (Baydas/Bahloul 1995); social support from community networks (Dershem/Gzirishvili 1998); income diversification (Dercon 2005); and credit from money lenders (Lapenu 2002). All of these loss redistribution measures are operating in Mumbai, often in complex combinations and under the influence of external and internal forces. Indeed, hazard vulnerability in Mumbai is defined by the degree of access to several support networks. Membership in fewer networks adds another layer of complexities that increases the household's vulnerability (Moser 1998) to suffer excessively from floods. Conversely, for industrial workers and their families, who live in the slum neighbourhoods of Mumbai, resilience is aided by participation in a range of support networks as well as by the possession of labour skills for which there is a high demand.

The types of support provided by employers to permanent and skilled employees living in Mumbai's slum settlements operate at 'soft locations' (Marcuse/Kempen 2000) within the flood redistributive system where a more structured and formal mechanism of flood loss adjustment, involving employers and workers, might be infused. However, this study also reveals that semi-skilled temporary or seasonal and daily casual workers cannot presently take advantage of this soft location. Their exclusion from the existing informal support system renders unskilled labourers more vulnerable than skilled workers. Perhaps there are possibilities for assisting the unskilled by promoting self-help groups under the broader banner of micro-finance schemes. While self-help groups assisted only a small pool (16 per cent) of households surveyed, they were the most preferred choice for unskilled workers. More effort might be directed towards improving awareness and knowledge of this alternative among slum dwellers.

Adjustments to flood losses are typically mixes of proactive and voluntary, reactive and compelled steps

(Mitchell 2007). In the case of slum populations in Mumbai it might seem that lack of resources and expediency ensure that reactive and compelled adjustments dominate the available alternatives. However, many of the arrangements that are activated in the wake of flooding depend heavily on the existence of pre-existing relations between victims and organizations or individuals in the community, that are cultivated before the flood event. In these cases the line between proactive and reactive adjustments is difficult to draw. Proactive and voluntary methods comprise making and maintaining arrangements with employers, family members; establishing informal arrangements of money investments; participating in religious communities, self help groups, and other such mechanisms of income diversification. Reactive and compelled options are borrowing from the local trader and money lenders, etc. Flood loss redistribution systems can broadly incorporate three types of societal bodies; (1) family and kin; (2) community (including social, political and religious population groups), and (3) formal (mainly economic) organizations comprising employers, banks, and other financial institutions. In Mumbai these groups are interwoven in a complex mode rather than being separate. For example, private financial institutions (e.g. local traders, money lenders) are part of a flood-affected household's immediate intimate community and family members (e.g. siblings and offspring, working in Dubai) who support slum dwellers are a part of a globe-spanning community.

Cities have heterogeneous populations with different cultural, socio-political and economic attributes that classify vulnerability differently for particular communities. Coping with natural and anthropogenic disasters exacerbated by global change processes therefore needs multiple alternatives and layers of support that will provide effective and variegated methods of loss reduction and human development for populations with different characteristics and constraints. In this case the unskilled workers, new migrants and socially or religiously unconnected households represent the marginalized population that remain outside most networks of useful loss sharing and are perennially affected by hazard events. Policy interventions from state and urban development organizations therefore need to target such specific groups to provide options for recovery and lasting security to slum dwellers in cities of developing countries.

34 Coping with Water- and Wastewater-related Risks in Megacity Delhi

Reena Singh

34.1 Introduction[1]

Megacities are not only concentrations of people, enterprises, growth and opportunities, but also nodes of inadequacies, crises, shocks, and vulnerabilities which are marked by complex socio-ecological processes as well as exceptional dynamisms of formal and informal settings. There has been phenomenal growth of megacities[2] in the recent past which accommodate about 10 per cent of the world's urban population (UNFPA 2007: 10). These are highly dynamic urban centres and their maintenance thereof relies upon chains of consumption that pull in resources like water, food, and power on one hand and generates huge volumes of waste on the other (Pelling 2007a: 1). Apart from being threatened by consequences of external events, megacities are also generators of hazardous consequences themselves and as such are 'victim and culprit' at the same time (Kraas 2007: 13). Today megacities are subjected to increasing risk and vulnerability due to overcrowded living conditions, infrastructural stress, escalating inequality, social segregation, conflicts, as well as failure of government to adequately care for environmental and social well-being.

Undersupply of basic infrastructure is affecting the large urban population and living with infrastructural stress is increasingly becoming a common urban characteristic. Consequently, urban citizens are frequent victims of denial of 'rights to basic services'; inadequate provisions of water, sewerage and sanitation threatens their security against harmful exposures which translates into hazardous environmental and health implications through specific patterns of vulnerability, of physical, socio-economic, and political origins. Therefore, providing quantitatively and qualitatively adequate basic services to all becomes a major responsibility of good urban governance and a prerequisite to ensure environmental and health security.

There is a broad consensus globally that health is central for human security and development. Human security in a broader sense also encompasses deprivation from: good governance, access to basic services, health care and basic human rights, as well as impoverishment, pollution, illiteracy, and exposures to other maladies (Ogata/Sen 2003: 6). Increasing infrastructural stress and ill-designed urban regulation are making cities huge centres of harmful perturbations posing enormous threats to environment and public health securities. Disadvantaged social groups are continuously exposed to the day-to-day crisis of access to food, water, and sanitation. They are compelled to spend time and money in securing food and water, managing their own waste, and treating themselves against avoidable water-related illnesses like diarrhoea, dysentery, cholera, malaria, dengue, etc.

In this context the main objective of the following case study on Delhi is to analyse potential risks related to water and sewerage; causes of defencelessness threatening environmental and human health security in this regard, and further to explore the coping strategies and adaptation measures in response to the prevailing situation of multiple stresses that enable urban citizens to continue to live with risk. This chapter focuses specifically on problem areas relevant for development policies and on structural and non-struc-

1 This chapter represents a part of the author's PhD thesis entitled "Wastewater Problems and Social Vulnerability in Megacity Delhi/India" that was submitted to the Faculty of Mathematics and Natural Sciences, Department of Geography, University of Cologne, Germany in September 2008.

2 "The United Nations (UN) coined the term megacities in the 1970's to designate all urban agglomerations with a population of 8 million or more. In the 1990's, the UN raised the population threshold to 10 million, following the practice of institutions such as the Asian Development Bank. The UN estimates that there are 19 megacities in the world at the beginning of the 21st century" (Brockerhoff 2000: 10).

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Box 34.1: Different forms of settlement colonies in Delhi. **Source**: Batra (2005: 2-3).

Planned/Approved colonies: These are colonies that are approved by the zonal agencies and form part of the Master Plan of Delhi.
Slums: These are settlements that are notified as per provisions of Section 3 of the Slum Areas (Improvement and Clearance) Act, 1956 as too dilapidated or suffering from other disadvantages in terms of ventilation, etc.
Unauthorized colonies: These are colonies created on land that is not meant for residential use.
Regularized unauthorized colonies: These are unauthorized colonies which are regularized by government agencies.
Urban/Urbanized Villages: These are villages that having been overrun by the city of Delhi are now, by notification of the Delhi Government urban development department, declared as urbanized villages.
Jhuggi Jhompri (JJ) clusters: These are normally shanty constructions made by migrant workers in Delhi, largely on government agency land or 'encroached' land. In a number of documents JJ clusters are also referred to as squatter settlements.
Resettlement colonies: The term is often used loosely (and incorrectly) to cover also relocated colonies. These colonies tend to be better off than JJ relocation colonies e.g. plot sizes etc. are usually larger. Some of the resettlement colonies now have the same standards as other planned colony.

tural solutions aiming at a reduction of social defencelessness and strengthening resilience.

34.2 Megacity Delhi: Statement of the Problem

Delhi is one of the fastest growing megacities in the world. It supports a population of about 14.1 million (tenfold more than it was originally planned for), making it the sixth largest city in the world and second largest city in India, next only to Mumbai (United Nations 2004: 7). Only within the last decade its population has increased by 46 per cent. Thereof 45 per cent was natural growth and 55 per cent was due to net immigration (Govt. of NCT of Delhi 2002: 32). Much of this immigration is poverty-induced as a large number of poor villagers, particularly from the neighbouring states, come to the capital in search of job opportunities (Chakrabarti 2002: 5). Delhi's multifaceted development and economic growth has always attracted a large number of migrants leading to unplanned mushrooming of illegal residential colonies at unfavourable locations for accommodating the huge influx of people. This is one of the reasons why Delhi's urban scenario has become complex and difficult to be managed by the limited capabilities of the local bodies. About 45 per cent of Delhi's population is residing in some form of unplanned/informal settlements (Batra 2005: 2). Apart from the planned/approved colonies and informal slums, there exist various other forms of settlements in Delhi (box 34.1).

The city itself is affected by a high degree of fragmentation between upper class quarters and squatter settlements of the urban poor, attesting strong heterogeneity within close proximity. Such steep social gradients resulted in physical and social boundaries, and different types of access to water and sewerage have developed. Many problems hindering an equitable supply are due to the complexities pertaining to such close coexistence of formal and informal settlement quarters, as well as to technical and legal constraints in providing the unplanned/informal quarters with proper water and sewer connections at the household premises.

According to the 2003 data Delhi generated 3,267 *million litres per day* (MLD) of wastewater including 218 MLD from industrial sources. The corresponding treatment capacity during the same year was 2,330 MLD but the actually utilized capacity was only 1,478 MLD (CPCB 2004: 1). This wide gap between the wastewater generation and the actual wastewater treatment exists even today. Wastewater generated from domestic, commercial, and industrial sources enter the same sewer system without segregation. Moreover, to a large extent the main trunk sewer is either not functioning at all or working only partially due to the damaged and silted sewers (Controller and Auditor General of India 2004: 102). Additionally, Delhi receives about 89 per cent of total rainfall only during the monsoon months of June-September (IMD 2005: 1). The dilapidated and silted drainage system of the city is further burdened with additional storm water causing severe problems of monsoon flooding and inundation of low-lying areas.

The government has augmented the water supply, upgraded the treatment capacity, expanded and rehabilitated sewers, provided community sanitation, and invested heavily in upgrading the water quality in the 23 km stretch of river Yamuna crossing the city (Centre for Science and Environment 2005: 1). But in reality all such endeavours have yielded only limited re-

Table 34.1: Trends in population growth, water, and sewerage in Delhi. **Source**: CPCB (2004: 14).

Years	Population (Lakhs =100,000)	Population (million)	Water Requirement (MGD)	Water Available (MGD)	Sewage Generation (MGD)	Sewage Treatment Capacity (MGD)
1961	26.59	2.659	211	77	169	67
1971	40.66	4.066	324	173	259	97
1981	62.20	6.220	495	252	396	130
1991	93.70	9.370	749	469	599	250
2001	137.80	13.780	1096	650	877	497
2011	182.00	18.200	1468	919	1174	814

sults as the social communities continue to be exposed to water and wastewater hazards and grapple with the inadequacies of the water system's infrastructure. Thus, the government has been unsuccessful to grant basic rights to safe water and adequate sewerage to all even after decades of planning.

Sewerage contamination of water supply is a major cause for increasing waterborne diseases like diarrhoea, dysentery, typhoid, etc. which forms the most common illness of adults and children in the city. Moreover, puddles of stagnant wastewater form breading ground for disease carrying vectors (mosquitoes, flies, etc.), which is quantifiably attributable to consumption of contaminated water, open drainage, open defecation, and unsafe garbage disposal. Delhi also suffers a huge burden of vector-borne diseases like malaria and dengue fever. According to data reported by a small sample of 22 index hospitals under the Municipal Corporation of Delhi 77,355 cases of gastroenteritis, 1,784 cases of cholera, and more than 900 cases of malaria were reported in a 12-month period (Jan-Dec 2004)[3]. In 2006, there was an outbreak of dengue in Delhi where 2,950 cases and 65 deaths were reported (Agarwal/Srivastava/Choudhary/Kaushik 2007: xii). The same health report indicates that the prevalence of these diseases is almost double amongst the urban poor compared to those of urban rich, what only shows the defencelessness of the urban poor against the health insecurities and their incapability to cope with them.

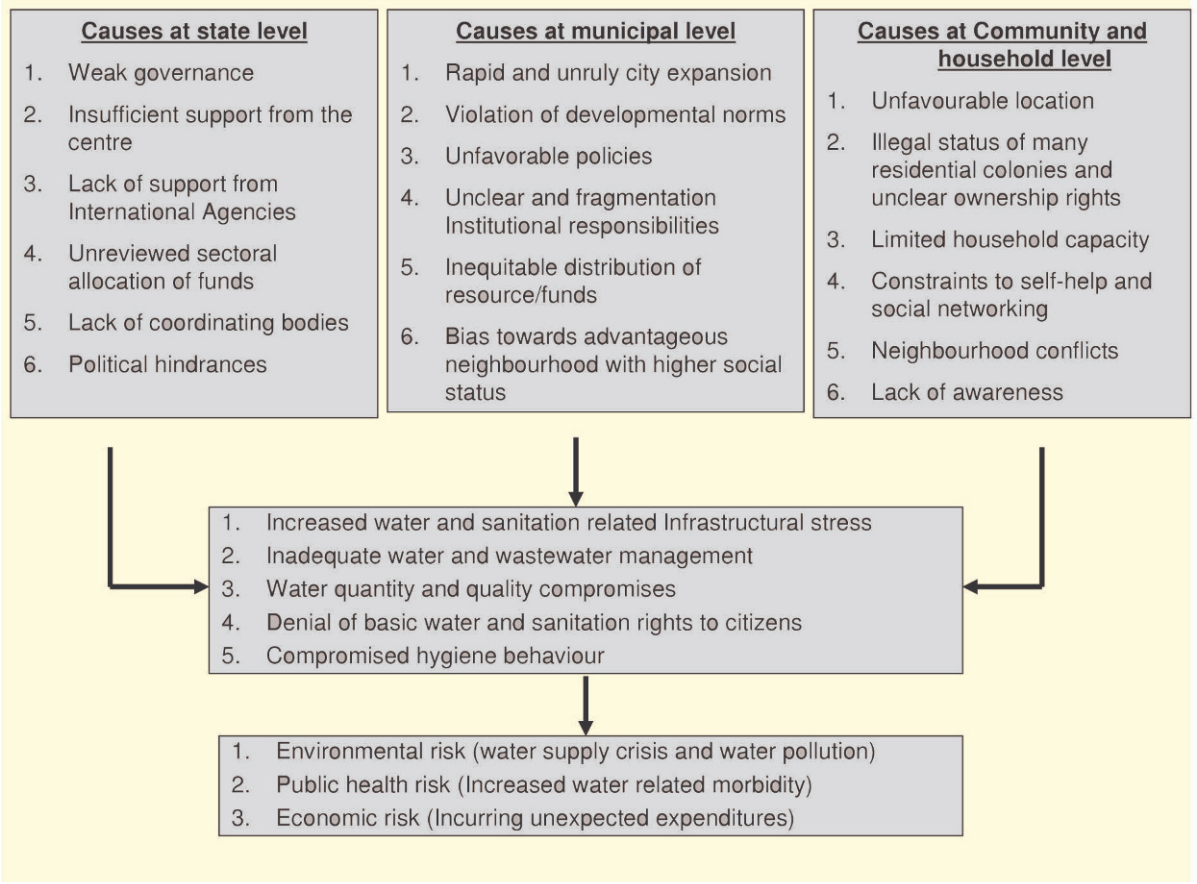
34.3 Causes for Water and Sewerage Inadequacies in Delhi

Urbanization has increased rapidly in Delhi, a settlement of about 9.2 lakhs (920.000) in 1947, increased to 137.8 lakhs (13.78 million) in 2001, 153 lakhs (15.3 million) in 2005, and is estimated to reach 182 lakhs (18.2 million) by 2011. On the other hand the status of water and sewerage in the city has continued to deteriorate as water requirement has increased to 1,468 million gallons per day (MGD) without a corresponding increase in the water availability options. Moreover, the increased generation of wastewater has not been matched with an augmentation of the sewerage treatment capacity (table 34.1). The existing sewerage treatment capacity is also under-utilized because of deficiency in the sewerage network including insufficient coverage, ageing and damaged sewer lines and siltation. Therefore, only a part of the generated wastewater are actually collected and effectively treated while the balance enters the open drains and finally joins the river Yamuna, which form drinking water source for downstream communities.

Since the city has been expanding in a haphazard manner planning has not been very successful. The frequent violation of developmental norms has left large areas still poor and unserviced with basic amenities. The continued population growth, immigration, and scarcity of suitable habitation compel people to settle in unfavourable areas, and unresponsive utilities combine to create a water supply crisis as well as wastewater disposal and sanitation deficiencies. Moreover, improvements in water supply, sewerage, and sanitation have merely meant increasing physical coverage whereas the quality of provided services is highly substandard and its maintenance is grossly neglected. The conventional way of piped supply and sewers are neither affordable to poor communities nor easily accessible without high government subsi-

3 Bureau of Health Intelligence, Health Department under Municipal Corporation of Delhi: Data as reported by 22 Index hospitals of Delhi.

Figure 34.1: Causes and Implications of Inadequate Water and Sewerage in Urban Areas **Source**: Designed by the author, adapted from UN Habitat (2003: 103).



dies and support. Thereby, a lack of access to safe water supply and sewerage can be indirectly related to poor governance reflected through an inability of the government to invest in water system and sanitation improvements.

There is a significant inequality in the regional distribution of basic services particularly water, sewerage, and sanitation services depending on the social and legal status of the respective colonies (CPCB 2004: 24; Zérah 2000: 68). The increasing demand confronting the water system infrastructure by growing urban populations, skewed distribution of basic amenities, and biased investment towards affluent zones has resulted in numerous islands of informal and unserviced settlement areas within the city, with unhealthy living conditions. Present policies do not outline any scope for provisions of sewers in squatter and illegal settlement quarters. Large proportions of unauthorized areas cannot be provided with individual piped water supply and sanitation because of the problem of legality pertaining to their land ownership rights. Thereby, only about half of the population is legally connected to water and sewerage while large parts of the unserved population either remain unconnected or make illegal provisions, and are therefore subjected to compromised hygiene.

In the national capital territory of Delhi, water supply and wastewater service go together and are a public responsibility. The *Delhi Jal Board* (DJB) is responsible for production and distribution of drinking water, treatment and disposal of wastewater, as well as water quality control in Delhi (Ruet/Saravanan/Zérah, 2002: 127). Furthermore, there are several other authorities engaged in the development and maintenance of water supply and sewerage and water pollution monitoring in the city, namely, the *Delhi Development Authority* (DDA), the *Municipal Corporation of Delhi* (MCD), the *Delhi Cantonment Board* (DCB), and the *New Delhi Municipal Corporation* (NDMC). Conflicting priorities of different authorities and lack of a common action plan affects delivery of services for the city in general. In addition,

the administrative zones, water supply zones, and sewerage zones do not match, which again leads to planning and organizational problems which further hinder the provision and maintenance of water and sanitation services for all.

When the city economy is developing at a good rate of 12.6 per cent, which is higher than the national economic growth (Govt. of NCT of Delhi, 2006: 8), it should be rather easy to expand the basic infrastructure facilities and maintain them in good standard. But, multiple causes like inequitable infrastructural expansion depending on the socio-legal status of the locality, un-reviewed investments, and various political, institutional, and social-economic problems constrain the equal infrastructural provision and access by all urbanites. A range of causes simultaneously exists at the state, municipal, and community levels leading to inadequacies of basic services and social defencelessness which are finally reflected as environment degradation and on the social communities as health burdens and other allied costs in terms of time and effort involved for managing their own water needs and waste disposal and protecting themselves against hazardous environmental exposures (figure 34.1).

34.4 Risks Associated with Improper Management of Water and Wastewater

Risk in human terms is "a situation in which human values (including humans themselves) are at stake and where the outcome is uncertain" (Jaeger/Renn/Rosa/Webler 2001: 17). Today many risks are eco-centric, i.e. they are linked to environmental problems or related to environmental conditions (Jaeger/Renn/Rosa/Webler 2001: 9), "to be at risk is to be under threat of harm" (Pelling 2003: 5) by unfavourable consequences. The improper management of wastewater creates hazardous conditions, water pollution and environmental degradation, exposure to which is regarded as a matter of risk that threatens the ecosystem and human health security, and indirectly threatens the economy.

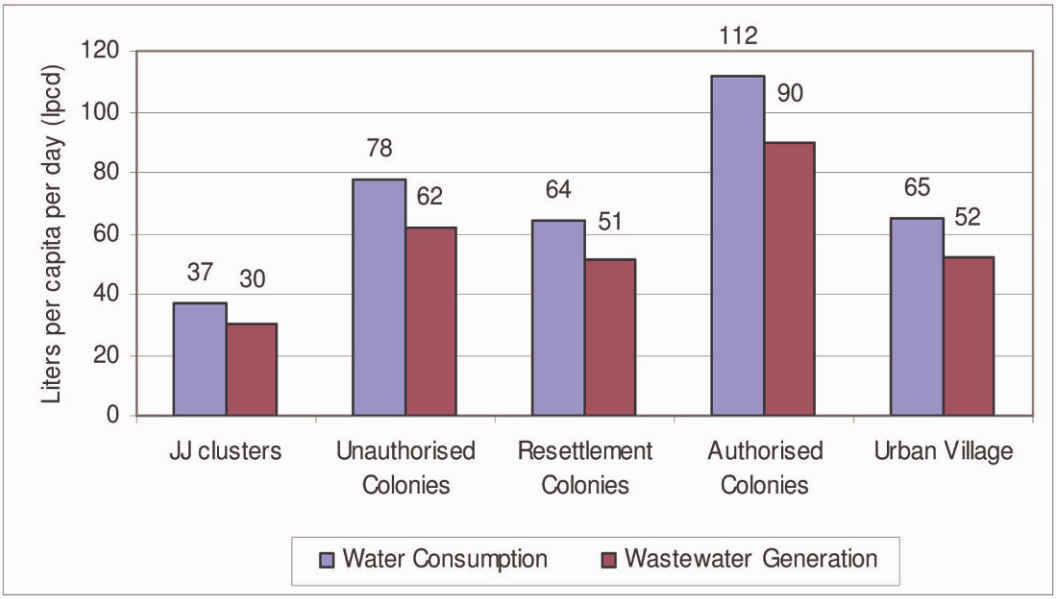
Even if the water and sanitation services are not officially provided by the state, under whose jurisdiction one is residing, still each living human being somehow obtains drinking water and also disposes of wastewater (Solo 1999: 118) though, not in an environmentally safe and hygienic manner. Health is significantly compromised at lower levels of water and sewerage services. Apart from improved hygiene behaviour, public health gains and household security is derived from provisions of qualitatively safe and quantitatively sufficient volumes of water and access of adequate sewerage for all. Further health improvements may also occur at higher levels of service associated with drinking water quality control and improved sanitation at the household as an effect of improved socio-economic status, better social capital, and good city governance.

With optimal levels of water and sewerage services where piped water supply and wastewater disposal facility exists in the household, health risks were observed to be low due to fewer chances of wastewater exposure. When the level of access is insufficient, i.e. only to the very basic ones, and no proper maintenance is undertaken, an exposure to wastewater takes place most of the time and thus keeps the community at high health risks. Even a basic access to sewerage and sanitation facilities with a regular maintenance reduces the chances of wastewater exposure. Low health risk is only attained with an optimal access to water and sewerage facilities in households.

There are numerous sources of water catering to the needs of various residential colonies in Delhi. Shortage of piped water is compensated with groundwater accessible through hand pumps. In addition people also relied on water tanker services. The *Delhi Jal Board* (DJB) provides free water tankers while the private water tankers charge a high price. Results of a household survey[4] (figure 34.2) shows that the JJ clusters which are settlements without sewerage are currently using only 37 *litres per capita per day* (lpcd) of water, whereas unauthorized colonies also without sewerage facilities are using 78 lpcd, even more than the resettlement colonies (64 lpcd), which are somehow networked with sewer systems although not of a

4 A comprehensive household survey was conducted by the author and V. Selbach, with the help of students from the University of Delhi (who were carefully trained to administer the designed questionnaire), during the years 2005 and 2006. Purposive-random sampling techniques were applied to choose the respondent household from various kinds of colonies using the Delhi Eicher map and satellite images. Preference was given to involve the household (wherever possible) within close proximity to canals, water and sewer pipes, open drains, hand pumps, etc. Adequate representation of socio-economic hierarchies was also kept in mind. Key informants of the households were interviewed, including both male and female participants. In total, seven test sites were chosen from three different locational settings and 696 households were interviewed covering a population of 4,358 persons.

Figure 34.2: The average volume of water used and wastewater generated (lpcd). **Source:** Own household survey, 2005-2006, N = 696.



desired quality. This explains the private arrangements of water supply sorted by unauthorized colonies due to the comparatively higher water purchasing power of the residents there than those of the resettlement colonies. Normally, 80 per cent of the water supplied results in wastewater. Therefore, usage of water without proper provision for wastewater collection network like in informal colonies leads to huge volumes of uncollected sewage flowing in open drains and canals to enter the river Yamuna and other water bodies

Untapped as well as insufficiently treated sewerage joining the river Yamuna led to higher quantity of ammonia in the water which was declared to be beyond treatable limits.[5] Since the river provides a source of drinking water for the people living downstream, the water quality criteria of the river needs to be maintained as a high priority. But the extent of environmental imbalance is so severe that the water quality of the Yamuna which should ideally be fit for bathing, swimming, and recreation actually is unfit even for agricultural purposes (SulabhEnvis, 2003: 7).

Freshwater lines, which often run close to drains, are frequently affected by the 'siphon-effect', which is the intake of contaminated wastewater into the freshwater system due to a decrease in pressure (Krafft/Wolf/Aggarwal 2003: 23) causing numerous leakages and resulting in contaminated water supply for end users. The groundwater quality in various parts of the city is also precarious. Harmful pollutants seep into the groundwater from a variety of sources including irrigation, septic tanks, sewage, injection wells, sewage percolation via cesspools and unlined drains, solid waste disposal, and an accumulation of industrial wastewater on land, etc. Residents were continuously warned not to consume groundwater through red painted hand pumps in areas where the *Delhi Jal Board* (DJB) had diagnosed the water to be of unsafe quality. About 77 per cent of the surveyed households reported water quality problems in terms of yellowish colour and bad odour. But only 35 per cent of the households used some means for water purification like boiling of water or using water filters and aqua guards for drinking water.

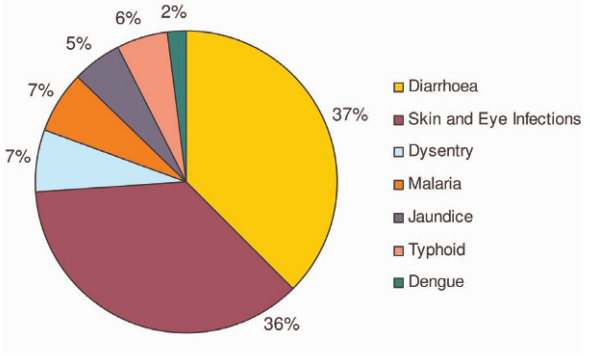
Open defecation and public washing was also commonly carried out by marginalized groups in localities deprived of public facilities. In such case, puddles of wastewater lying in the open were unavoidable to be contacted by them during the course of their everyday spatial mobility in and around the area. Narrow and unmetalled lanes of surveyed unauthorized colonies and JJ clusters were in pathetic condition due to all time stagnation of flooded wastewater – even during the non-monsoon period. Nearness of open drains, frequent drain overflows, taking to public washing, and open defecation are all means of directly getting into physical contact with wastewater. In some cases children fell into these open drains while playing

5 Times News Network: "Ammonia hits water treatment", in: *Times of India-Delhi (*14 November 2007): 3.

and lost their life. This further reiterates the interlinkages between increasing human insecurity due to a poor water system related to the infrastructural development in the city.

No primarily epidemiological study was conducted and thus no attempt was made to establish a relationship between these diseases and wastewater nuisance. Commonly reported illnesses documented that waterborne and water-related diseases exist all year round, but they rose considerably when the monsoon started. Apart from fever and cold, which were extensively reported from all kinds of localities as a regular phenomenon, diarrhoea, vomiting, dysentery, malaria, dengue, jaundice, as well as skin and eye infections were also common diseases prevalent among the surveyed communities. Diarrhoea and dysentery alone contributed to about half of the total disease burden (figure 34.3).

Figure 34.3: Burden of waterborne and water-related diseases. **Source:** Own household survey 2005-2006, N = 696.



However, morbidity differed across the types of colonies and the level of vulnerability. JJ clusters, unauthorized, and resettlement colonies report about 75 per cent of the total morbidity, whereas authorized colonies and urban villages had only one-forth of the total reported morbidity. Water-borne diarrhoea infection was common, more so amongst the social communities where piped water supply was served, which can be attributed to sewage leakages into the water pipes. Skin irritation, rashes, and eye infections like allergic and infectious conjunctivitis which is caused due to direct contact with infectious pathogens (viral or bacterial) were also highly reported from those localities where exposure to raw sewage was unavoidable and hygiene behaviour was compromised due to the quantitative and qualitative supply crisis, primarily in informal quarters.

The direct economic burden due to water, sanitation, and hygiene-related health implications acts further as a decrementing factor on household finances that was already difficult for the marginalized poor families to endure. Per capita expenditure on the treatment of water-related diseases on an average ranged between 160–180 INR[6] annually for each person, which could be largely avoided by households if the required standard of hygiene is maintained. In the case of households having large families, the percentage of household income spent on treatment would increase enormously. Residents of the authorized colonies spent the maximum of about 220 INR, which was largely because they had the preference and financial capability to avail of private practitioners, whereas residents of informal quarters with lower household income preferred to go to the public health clinics for these ailments. Nevertheless, water- and sanitation-related health implications were posing an increasing economic risk for urban citizens.

When families are impoverished, e.g. residents of JJ clusters who were largely daily wage earners or domestic helpers, and their household earning was less than 2,000 INR monthly, even a marginal unexpected increase in household expenditure would be a pressure on the family. Taking an average family size of six members, household annual expenditure on water-related minor health ailments and managing their wastes for lower income families (earning < 2,000 INR) was ranging between 5–8 per cent of household income and only about 0.5–1.5 per cent of household income for higher income families (earning >10,000 INR). In addition, there was a loss of working days when workers suffered from various ailments which indirectly led to an economic loss for the family, particularly if the earning member of the family was sick. The intention here is to hint at the additional economic burden which is largely avoidable by (1) combating environmental degradation, (2) extending an efficient water and sewerage system, and (3) achieving a reduction in water-related morbidity.

34.5 Coping and Adaptation as Components of a Resilient System

Human societies are in a constant process of responding and adapting to their changing environment surrounding as well as influencing them. Adaptation in

6 1 USD = 39.88 INR (rates at 2008.02.28, 17:08:30 UTC).

the context of the human dimension refers to the actions which the human community (at a different scale) takes in order to better cope with, manage or adjust to changing conditions, stress, and hazard risk (Smith/Wandel 2006: 282). Studies on various aspects of social vulnerability have shown that 'living with risk' needs to be based on coping strategies and adaptation techniques, and any vulnerability assessment needs to serve as a means of improving human capacities to respond and actively manage the risks (Bohle 2006: 189). These aspects clearly indicate the importance of effective responses towards strengthening defences against risks of varying nature (sudden events as well as continuous stresses) and in doing so enhancing resilience building. Apart from other aspects like good governance, diverse option availability and accessibility, awareness, education and communication at city level, local coping strategies are considered to be key factors in determining a community's resilience (Davis/Haghebaert/Peppiatt, 2004: 8).

Resilience is surely not just absence of vulnerability. It refers directly to the ability to function with the spectrum of uncertainties associated with the dynamics of a megacity system and indirectly to the capacity of people, communities, agencies, infrastructure "in the first place to prevent and mitigate losses and then secondly, if damage does occur, to maintain normal living conditions as far as possible and manage recovery from the impact" (Buckle/Mars/Smale 2000: 13). In this respect residents of a megacity system become more vulnerable if the prevailing socio-political structure restricts their capability to respond effectively towards prevailing risks.

The relation between vulnerability and resilience is rightly expressed in the terms "vulnerability comes from loss of resilience" (Holling 1995: 24) and "resilience depends on, among other things, the effectiveness of the risk response and the capability to respond in the future" (Alwang/Siegel/Jørgensen 2001: 10). Although the response capacity is clearly an attribute of the system as a whole that exists prior to the event (sudden shocks as well as continuous stresses), it gets operational or functional only when the event strikes or the stress exceeds tolerance. At a higher scale, a city itself is a complex adaptive system wherein the system is responding to the constant changes taking place.

Slow changes over time get absorbed within the coping thresholds[7] in the case of human society and get rectified to some extent by the self-correcting mechanisms for the environment. Since humans are constantly exposed to environmental changes and stresses, they are continuously coping and adapting to them, but once the threshold of coping and adaptation capacity is crossed hazardous outbreak strikes, calls for further responses, and again the process of coping and adaptation restarts. Although there are limits to the thresholds, "they are not necessarily fixed" (Yohe/Tol 2002: 26).

Adaptation and coping capacity also prepares the system for future risks and stresses, but in cases when stresses or changes exceed the thresholds of endurance capacity, hazardous outbreaks or unavoidable events strike (e.g. an outbreak of dengue fever or diarrhoea). These are occasions which again call for the coping capacity to get operational; actors need to adapt and learn from the experience, modify their preventive as well as coping responses, and strengthen their capabilities, which would presumably increase the threshold to a higher level. Good governance, education awareness, and communication are required elements for strengthening resilience.

34.6 Responses to Water and Wastewater Problems

Response and adaptation as well as mitigation efforts towards water and wastewater problems or any other forms of risks, hazards, or period of threats are all important coping measures to achieve human, environmental, livelihood, and health security. Response exists even before the occurrence of an event (as preventive strategies) and operates after the event (as coping and adaptation strategies). Human responses heavily depend on their prior experience, awareness about the severity of consequences, their perception of the problem, as well as their social and material capabilities to cope with the situation. People use their own capabilities, skills, talents, knowledge, and technologies to deal with the crisis situation, which might not necessarily be sudden extreme events. Even in everyday life, people's knowledge and their level of understanding play an important role in perceiving risks, and in turn it moulds their decision-making and actions (Hauger/de Boye/Geldof/Mikkelsen 2003: 12).

In this study, water supply and wastewater disposal related risks were understood by people only as health hazards. Aesthetic degradation due to wastewa-

7 A threshold is defined as a point between alternate regimes in ecological or social-ecological systems (Resilience Alliance and SFI 2004: 1).

ter nuisance and related long-term threats were not considered as a risk to their social well-being; more so by social communities of poor economic strata. In the absence of adequate water and sewer facilities, social groups chose various adaptation and coping strategies depending on their capabilities, perception, and available options. Their responses ranged from emotion driven 'doing nothing' to adoption of action oriented preventive, adaptive and coping measures for dealing with water and sewerage problems depending on family particularities, and available resources at the household level.

34.6.1 Preventive Responses

Social community and institutions, based on their previous experience, may start responding to anticipated events even before they occur. Adoption of preventive measures, precautions, and similar strategies to minimize the impact are categorized as preventive responses. These responses are strategies which help building the coping capabilities of the social communities.

The residents of certain surveyed localities, being aware of the grim infrastructural and water system related problems in their immediate neighbourhood, took precautions by elevating the entrance of their houses to prevent wastewater overflows and floods from entering their households. They covered open drains with stone slabs and got the windows and doors netted in order to safeguard against mosquito problems, etc. They try to adopt preventive behaviour like restricting their water consumption, purifying the drinking water, etc.

34.6.2 Adaptive Responses

Adaptive responses are actions and strategies undertaken after the event has occurred. The social community and environment adjust to the changes and get gradually adapted to the new system. This is more on a long-term basis, e.g. the continuation of living in unhygienic surroundings without feeling bothered is also seen as a 'situational adaptation'. Adaptation was about facing the fact that infrastructural inadequacy was inevitable at the given socio-political situation; it involved acceptance of the condition and making changes accordingly to strike a harmony.

It was repeatedly noticed in the study area that communities which frequently faced wastewater and sanitation problems in their households had somehow adapted to this prevailing situation and were not much bothered, or at least they denied to be grossly affected by the uncertainty and irregularity of its maintenance. They were no longer bothered to see or get exposed to puddles of wastewater and day-long lying garbage and filth. They seemed to have mentally accepted the prevailing pathetic sanitation condition of their neighbourhood and remained satisfied as long as they could maintain their household premises clean.

Adaptive responses also include activities which would strengthen people's capabilities to endure future shocks of at least similar nature, e.g. by the installation of sewer pipes of larger diameter, having alternative arrangements for water supply, having access to multiple relying options, etc.

34.6.3 Coping Responses

Coping responses refer to the process of managing crisis circumstances and seeking to minimize, reduce or tolerate stress. They may include short-term and temporary actions too which are needed to manage the hazardous event or stresses. Coping responses get operationalized particularly after the event strikes and may need short- as well as long-term measures to reduce its impact immediately, as well as for future occurrences, e.g. flooding due to sewer blockage which needed to be cleaned either by sewer staff of the city municipality or by private cleaners immediately, and also called for proper maintenance of the sewer lines regularly. The water crisis was augmented by buying tankers of water or getting water from other places, etc.

These responses also include activities undertaken by organized social groups such as the Resident's Welfare Associations (RWAs) of the residential colony for restoring normalcy as well as reducing implications. Apart from other activities such actions may comprise of measures for developing economic and social safety networks and providing a forum for communication; facilitate learning from each others experiences.

Human response falls simultaneously into more than one category as they are not mutually exclusive. Kind of social responses and some commonly practised measures at household levels for managing water- and wastewater-related problems in different residential colonies surveyed are listed in table 34.2.

Table 34.2: Household strategies for managing the water and wastewater problem in different residential colonies: Delhi. **Source:** Own household survey 2005-2006.

Type of colony	Measures taken for wastewater disposal problems
JJ cluster	• Illegally connect to the water and sewer network. • Get water from distant sources or from other colonies having piped water supply. • Cover the open drains by stone slabs. • Channel the household wastewater to the ditch and manually empty it into the nearby drain. • Spread oil on stagnant water to avoid the breeding of mosquitoes.
Resettlement	• Store water for use during short supply period. • Buy water from water vendors. • Spray oil or disinfectants on stagnant water. • Clean the drains individually. • Report to local political leader who would approach the Municipal Corporation office and get the work done.
Authorized	• Resident Welfare Association usually looks after the maintenance of water and sewer system. • Use motor pumps to draw water also buy water and use individual water filters. • In case of sewer problem complain to the Municipal Corporation office or employ a private cleaner.
Unauthorized	• Disposal into on-site septic tanks. • Channel the household wastewater to the open drains. • Raise entrance to the house. • Reuse the water to minimize the disposal and reduce water demand. • Clean individually.
Urban Village	• Use boring pumps to withdraw groundwater. • Clean individually or hire private cleaners. • Mostly try to take precautions while going out of the house.

34.7 Constraints to Effective Responding.

A common explanation for the inadequacies of the water system infrastructure in Delhi is the very rapid population growth, which overwhelms the capacity of the local authority to improve and extend provision. But many rapidly growing cities in Latin America and Europe have nonetheless managed to improve water and sanitation provision with improved governance and institutional efficiency in the management system (UN-Habitat 2003). Urban system resilience is greatly enhanced by an efficient institutional structure and a beneficial relationship between the municipal and national government (Solway 1994; Pelling 2003: 81) and an involvement of all stakeholders.

A weak institutional organization coupled with poor urban governance have led to numerous obstacles which have directly hindered an efficient management and adequate infrastructural access on one hand and indirectly threatened human health and environmental security on the other. Under such circumstances at the city level social communities even if they have the potentials to help themselves find it increasingly difficult to deal with the problem of securing health and livelihood security as they are faced with numerous economic, political and legal constraints acting as limiting factors to their developmental attempts.

The worsening problem of water system management and inadequate sanitation in Delhi attests that current governmental actions have been highly inadequate in alleviating the situation. Years of planning and infrastructural upgrading have also failed to achieve declared goals and the developmental results have not benefited all social communities equally. The manifold managerial, governance, and resource constraints for effective responses, and a failure to provide an adequate water and sewerage disposal facility for all can be summarized at the institutional and community level (table 34.3).

Table 34.3: Constraints for improving water and sewerage services. **Source:** Own findings.

Institutional Level	Community Level
1. Multiple agencies-in-charge	1. 'Illegal' status of the colonies
2. Fragmented and unclear departmental responsibility	2. Financial incapability
3. Lack of managerial coordination and accountability	3. Over-dependence upon the government
4. Underqualified operating and maintenance staff	4. Lacking civic responsibility
5. Improper financial management	5. Prevailing local politics
6. Unstable managerial positions	6. Lack of information and awareness
7. Undue political influences	7. Lack of cooperation and social networking
8. General apathy towards people's grievances	8. Burden of other household problems

34.8 Conclusion and Discussion

An effective response has always proven to reduce potential risks and decrease the need for serious action. Since the water- and wastewater-related hazards can be considerably eliminated and avoided, timely responses to the risk are needed that can prevent potential environmental- and health-related emergencies in the future. Moreover, they can also be helpful in reducing financial burden for the household by directly saving time spent on wastewater- and sanitation-related hassles for useful economic activities and also through reduced expenditure on water-related illness by improved sanitation and hygiene conditions.

It is clear from this discussion that in fast growing urban areas institutions for water, wastewater, and sanitation issues are increasingly getting complex. Various institutional legal and social constraints have hindered effective responses towards the management of problems related to sewerage and sanitation services for a large number of poor people. Effective actions to reduce water- and wastewater-related risk by an efficient response needs to be taken at the national, regional, community as well as household level, and further linked to each other. All these actions need to be within a time-bound framework. There are multiple factors in play which need to be taken into consideration while planning for urban settings which implies looking for integrated solutions at an affordable price.

Despite governmental responses with new plans and policies, the water system infrastructure has remained highly inadequate. The government of a megacity, like Delhi, must plan and design the provision of basic service to cater adequately to the huge 'illegal' population of informal quarters as well. Future efforts and policies must aim at overcoming the obstacles and expanding *private sector participation* (PSP) to improve efficiency and performance management as well as improve public information systems and transparency of these operations. Moreover, encouragement of the private sector financing and higher cost recovery would provide a stronger financial base and lessen the burden on the scarce public funds.

Based on their perception and capabilities households act to reduce the implications of wastewater nuisance by taking up precautionary actions where possible and endure the unavoidable circumstances when these household measures fail. Local measures are capable of providing preventions for a short time but the long-term structural solution to the problems is beyond the capabilities of a household, which urgently require a need-based effective response from the civic agencies to be executed with proper coordination at the community, zone, and state level.

Actions at the household and community level are important and highly required but unless there is a strong political will to remove the root causes of infrastructural inadequacies and hindrances to effective responses, the currently unplanned actions would continue to be superficial and all planned interventions and agendas would only show unsatisfactorily limited results. People's involvement at all levels – from planning to implementation – can be helpful in building trust and making the provision and maintenance of water- and sanitation-related basic services 'everyone's business'.

35 Politics of Displacement and Vulnerability

Nanda Kishor

The intricacies in the development of a country are leading to several debates which are worth mentioning and run through the whole process of public policy. Among these, the politics of development, the politics of displacement and inequalities along with vulnerability take a primordial position. Although the present work does not deal with all concepts involved in development and displacement in detail, it does deal with key issues which have changed the lives of millions who have borne the brunt of the development of the country and accepted the sacrifice of their belongings and putting themselves in the position of the vulnerable.

35.1 Introduction

India is a country with multiple diversities and cultures. The country has gone through different phases since its independence. She had to face the wrath of colonial rule for very long time, and this paralyzed the growth of the country severely. It is often argued (Sen 1996) that outside India, the reforms have been fairly universally welcomed, but they have been, since their inception, the subject of severe debate within India. The controversies have been extensive, and the arguments on each side are quite firm and forceful. The path which was chosen after independence to pursue development appeared astoundingly humanitarian and progressive, but to the dismay of the people, it did not allow the country to progress the way she wanted to. This chapter critically reviews the concept of development, at the cost of people, the politics of development and it also shows the risks involved in such unplanned development plans leading to different vulnerabilities.

The term 'development' envisages a battery of changes – changes for the betterment of the community. It involves the notion of progress, growth, improvement, and welfare of the collective. 'Development' has to be an innovative process leading to the structural transformation of social systems. The development is multifaceted and it is not always progressive as it is supposed to be by its definition. Sometimes, "both history and daily experiences teach us that development processes, be they spontaneous or induced, bring not just benefits. True development is undoubtedly beneficial to very many people. But development changes the status quo and such change usually entails social disruption and undesirable consequences for some population segments" (Cernea 1996: 1515). This chapter analyses for three typical cases displacement due to unplanned development taken up by the Government of the State of Andhra Pradesh (India) in its capital Hyderabad.

Hyderabad is one of the six metropolitan cities and is located in the Deccan Plateau in south India. It is the capital city of the province called Andhra Pradesh with a population of 3.829753 million people (2001 census of India).[1] It is situated at an altitude of 536 metres above sea level on the eastern side of India. The city is one of the fastest growing cities with respect to information and technology.

35.2 The Politics of Development

The concept, 'politics of development' is crucial for the understanding of the complexity of the concept of displacement. The highest numbers of displacements in the country are 'development-induced displacements'. So displacement cannot be studied in isolation and without controlling aspects of development the undercurrents of all paths of devastating development may not be understood. In explaining how 'politics' has entered into development Adrian Leftwich (2000: 4) argued to locate politics in development, "the central and dominant variable determining not only the conception and shape of development, but developmental failure or success in all human so-

1 See at: <http://www.censusindia.gov.in/Tables_Published/A-Series/A-Series_links/t_00_005.aspx>.

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cieties, is their politics." To put it in more appropriate words, politics is not simply important, but it is crucial for both understanding and promoting development. It shapes and in turn influences by the character, structure, and capacity of the state. But the question why states are so political and development is also made political arises. The answer is clear in all the activities of conflict, cooperation, negotiation involved in the use, production and distribution of resources, whether material or ideal, whether at local, national or international levels, or public domains have politics as an inherent component. This definition almost makes the concept very clear and gives a perfect platform for further arguments.

The meticulous answer by Government agencies on the unplanned developments in India use concepts like globalization and its pressure on all countries to grow stronger, and take a leap in their development so as to compete with other countries in the world. But, even the so-called globalization failed to produce any results in making India grow stronger, especially with regard to the marginalized sections of its society who have remained poor for generations. Joseph Stiglitz (2002: 5) argues that "those who vilify globalization too often overlook its benefits. But the proponents of globalization have been, if anything, even more unbalanced. To them, globalization is progress; developing countries must accept it, if they are to grow and to fight poverty effectively. But to many in the developing world, globalization has not brought the promised economic benefits. A growing divide between the haves and have-nots has left increasing numbers in the Third World in dire poverty, living on less than a dollar a day." Also in India the poor have remained poorer and the rich are becoming richer. Development does not serve those who sacrifice for the sake of development and India's development pattern documents this.

35.3 Politics of Displacement

After many debates many scholars (Cernea 1986, 1995, 1996, 1998, 1999; Goyal 1996; De wet 2001; Mathur 1995; Thukral 1996; Kothari 1996) agree that displacement is a political process. This offers a platform for the following argument. It is essential to know what exactly displacement means and what is involved in it. Walter Fernanades (1995: 280) defined displacement as

> an unequal struggle for the control of the natural resources and the powerful minority will continue to appropriate most of them to their own benefit. This process of the further impoverishment of the marginalized sections and transfer of their resources will continue, unless the weak organize themselves to resist this onslaught.

This definition explains what displacement is, who does it and for whom, the impact of such an action, and what has to be done to overcome this problem. Chris De Wet (2001: 1638) described what displacement is all about. "Displacement is a move which is effectively permanent, in the sense that the area where people used to live has been transformed by the intervention, and there is no going back." Displacement with resettlement should be distinguished from resettlement, where people may simply have to go out of the way and make provision for themselves, and which should perhaps be termed 'expulsion'.

Table 35.1: Global distribution of projects by the type of development. **Source:** World Bank (1990).

Type of Displacement	Projects with Resettlement		People Displaced	
	Number	%	Number	%
Dams	39	26.6	1,233,000	62.8
Transportation	36	24.7	3,11,000	15.8
Water supply, sewerage	18	12.3	59,000	3.0
Thermal(including mining)	15	10.3	94,000	4.8
Urban infrastructure	12	8.2	73,000	3.7
Irrigation, canals	7	4.8	71,000	3.6
Environmental protection	5	3.4	74,000	3.8
Industry	4	2.7	2,000	0.1
Forestry	2	1.4	45,000	2.3
Other	8	5.5	1,000	0
TOTAL	146	100	1,963,000	100

Unfortunately, dam-related displacement was identified with all other development-related displacements and this error has influenced the provisions for rehabilitation (Dhagmawar/De/Verma 2003). Smitu Kothari (1996) argues that efforts at minimizing displacement or improving resettlement will only be marginal, palliative, and temporary if they are not conceptualized in a wider socio-political context. Planners and administrators invariably capitalize on and manipulate the relatively weaker socio-economic and political

Table 35.2: Presence of resettlement and rehabilitation policies in India. **Source**: Cernea (1996).

States	Number of Bank-financed Projects				Policy Framework			
	Irrigation	Power	Infra-structure	Total	National Policy*	State-wide R& R Policy	Government Orders/ Resolution	Sector Specific Policy
Andhra Pradesh	1		1	2			Yes	
Bihar	-	2		2			Yes	
Gujarat	1			1				
Haryana	-		1	1				
Himachal Pradesh	-	1		1				
Karnataka	1			1			Yes	
Kerala	-	1		1		Yes		
Madhya Pradesh	-	2	1	3		Yes		
Maharashtra	1	3	2	6		Yes		
Orissa	-	2	1	3			Yes	Water being prepared
Punjab	1		1	2		Yes		
Tamil Nadu	-	1		1				Water being prepared
Uttar Pradesh	-	1		1				
West Bengal	-	1	1	2				Coal
Agencies								
NTPC**		5			Yes			Power
CIL		2			Yes			Coal

Legend: *) National Highways II; **) National Thermal Power Corporation

position most people are facing. Their numbers are underestimated, they are treated indifferently and only minimal cash compensation, if at all, is paid. There is an extraordinary unwillingness to grant them clear rights, such as security of tenure on alternative developed land sites.

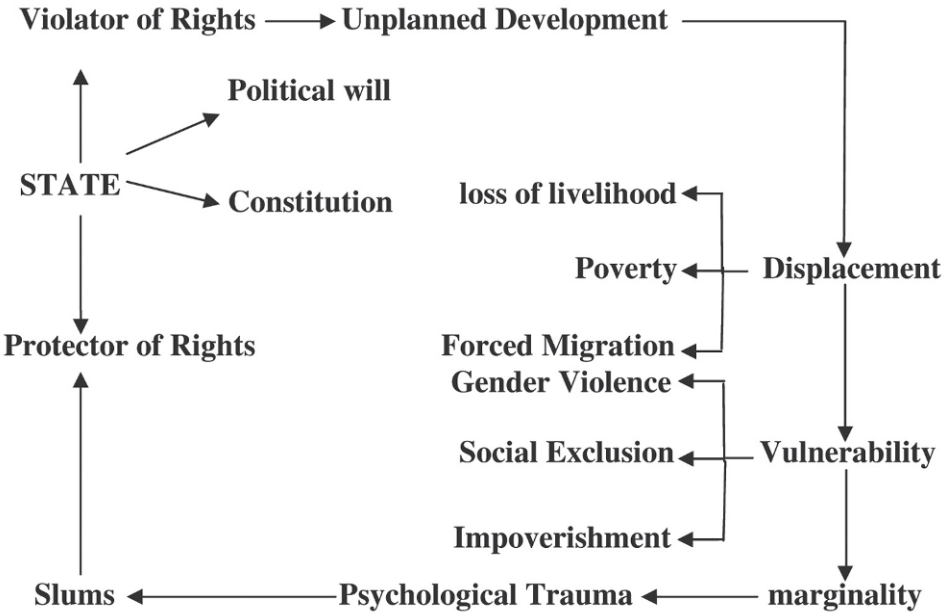
The problem is a negation of the participation by the people in the process of planning and implementation. Equal participation is a main component of democracy. Democracy is not only a desirable feature of development, but a necessary feature as well. The forced displacement of populations caused by many infrastructural development programmes epitomizes one category of disruptive changes that may occur as by-products of economic growth (Cernea 1996). It is interesting to note the public policy responses to forced displacement, the magnitude, social content (discontent) and severity of the adverse effects.

The social analysis has to delve beneath the ethnographic surface in order to identify the macro processes and the local matters that must be addressed by development planners. Later this analysis should be used in both academic and applied forms to enable the displaced to get justice. The law permitting the acquisition of land must be examined in a more meticulous way as the whole process of displacement starts with the failure of the standards of the *Land Acquisition Act* of the government of India.

35.4 Land Acquisition Act and its Coercive Aspect

Each displacement in the state has been arbitrary and can even be termed as forced eviction. The top-down approach has not been changed into a bottom-up ap-

Figure 35.1: Role of the state in development, displacement and the consequences of displacement. **Source:** Based on primary data compiled by the author.



proach. Most of the educated among of victims of development and displacement are not even aware that this *Land Acquisition Act* exists, with which land acquisition must comply. This draconian law is more than one hundred years old. In 1894 the first ever land acquisition act was formulated under the British rule and it has remained the base for the present act. The latest land acquisitions in Hyderabad documents the usage of this act. The information issued to the farmers and others for the acquisition and compensation of their land is entitled 'Land Acquisition Act of 1894 under the section 12 (2) - Form no. 9'. Whereas the Land Acquisition Act of 1894 categorically states that "any person or agency obstructing the process of acquisition on conviction before a magistrate is liable to imprisonment, for any term not exceeding one month, or to fine not exceeding five hundred rupees or both." The act ignores the resettlement question. Indeed, this is the starting point for the history of unplanned displacements in India. There have been a few amendments to this act in the year 1984 and later also but the basic structure remains unchanged. This law is still kept as an asset by the government as it offers a simple way of acquiring land without any big hurdle. The growing pace of development under 'liberalization' has increased the intensity of such displacements to the extent that communities living in their traditional settings are getting displaced with the loss of their traditional sources of livelihood. Once displaced, the people affected by such a project are pushed into an open-market situation as individuals and must compete for their survival in a hostile new environment. A majority of them are lost in this new race of development. There have been several national resettlement and rehabilitation policies which are not mandatory to any province in the country but remain as a base and are allowed to have their own resettlement and rehabilitation policies.

Empirical evidences give us a clear picture of the displacements and its vulgarity. Three cases are not sufficient to generalize about displacement in India, but the history of displacement and vulnerability allows drawing generalizations where the trauma and the risk which the people have gone through and go through only varies in degree.

Figure 35.1 above points to certain causes and the consequences of displacement through several different factors along with models like those on impoverishment (Cernea 1996, 1998; Mahapatra 1999). However, it does not show all those factors leading to and happening after displacement as there are a number of vulnerability risks. It shows how the state as a violator of the people's rights initiates unplanned development leading to displacement. This displacement has three major consequences: a) a loss of livelihood, b) poverty, and c) forced migration, and these three consequences lead to vulnerability along with gender violence, social exclusion, and risks of impoverishment. All these factors together contribute to marginality and through the psychological trauma the people

are pushed to set up new slums or to join the existing slums and again appeal to the government to protect their rights by recognizing them as coming from the slums. This whole process of accepting and recognizing which remains with the state and the state's decision remains with the political will by invoking the rights of the citizens which are constitutionally recognized. The process continues as the state again comes up with an unplanned development and, being a protector of the rights, it turns out to be the violator of these very rights. It is a vicious circle in which the citizens are totally vulnerable as the state has been using coercive methods to carry out involuntary displacements. Most of these factors are explained below in the section dedicated to adverse consequences of displacement and vulnerability issues.

First three cases will be introduced and then the adverse consequences will be discussed. These three cases were chosen to justify the concepts of displacement of people with land titles and the displacement of people without such land titles. The empirical work was carried out through a stratified proportionate random sampling with a diachronic method of assessment (pre-displacement and post resettlement). Focused group discussions were held as part of the work along with case study method, and finally, a triangulation method was adopted to crosscheck the available data.

35.4.1 Project of Multi Modal Transport System

The first case addresses the *Multi Modal Transport System* (MMTS) in Hyderabad in the year 2002. There was a place called Nirankari Nagar near Lakdikapool[2] behind the Ranga Reddy District collector office (figure 35.2). The place comes under the survey No. 2, Block L, Ward no. 83 covering 21,820 square metres in the Greater Hyderabad Municipal Corporation. The people were residing in this locality for the past thirty to thirty-five years. All of them belonged either to the Scheduled Caste (marginalized groups in India) or to backward classes including Muslims. The land belonged to the South Central Railway and it wanted to have the MMTS project at the advice of the state government of Andhra Pradesh with the approval by the Government of India. The MMTS project was of utmost importance among all government projects in the city. Due to the traffic havoc and scarcity of buses in the city, the government had planned for an alternative with railways. The politics for this project had started long back but the people were not aware of the project until the regional newspaper *Eenadu* reported that this locality would be displaced for the project when there was less than 90 days to start the acquisition process. Although the land did not belong to them, the inhabitants of the locality pleaded with the authorities, asking them to stop the displacement as they had resided in the locality for more than thirty years. As all plans had already been made it was just a mandatory function for the authorities to give the required notification before land acquisition. The people thought the last resort could be approaching the courts as they had invested all their earning in constructing their houses.

When the people of the locality resisted leaving the locality, the authorities considered playing different politics. The people of the locality were asked to find a place to stay wherever they wished in the city, but on the condition that all 398 families would have to be resettled in the same place. After all efforts failed to relocate them to a common place, the people returned to the authorities resisting against their displacement. The role played by the politicians at different stages is very significant. While the then ruling *Telugu Desam Party* (TDP is a regional party) remained silent on this issue as the project was initiated by the party, the National Congress Party as the opposition did not undertake any effort to come to the rescue of the people. The leader of the Congress Party, Mr. Janardhan Reddy was not very happy with these people as they had not voted for them. The national *Bharatiya Janata Party* (BJP) sent a representative, Mr. Bandaru Dattatreya, the then Railway Minister for State of the Government of India, but he could not do much besides consoling the people and assuring them that no arbitrary action would succeed. Then the BJP was the ruling party in the central government and it was supported by the TDP as a coalition partner. The political parties of the Left did not help either. The threat of losing power made the minister not to take any progressive measure. The Mayor of the city, Mr. Teegala Krishna Reddy, wanted to visit the place after hearing about the protest. But the authorities, like the Revenue Department officials, convinced the Mayor that there were no problems with regard to the displacement.

The government took arbitrary measures and lodged a false complaint against the leader of the locality and arrested him. Policemen forcefully evacuated the people and cleared the locality by destroying

2 This is an area in Hyderabad the first case study dealt with. The displaced people were living in the place that belonged to the South Central Railway of India.

all structures which were built during several years of hardship and hope. The government moved all members to a place called NTR Nagar for resettlement and allotted them small houses which were already built for another purpose, but it did not keep any promise ranging from providing rice, money, and a feast. Although the locality from where the people were displaced was declared a slum by the *Municipal Corporation of Hyderabad* (MCH) and was receiving funds for the development of the slums from the World Bank and Asian Development Bank, these funds were never used and never reached the people. The argument of the displaced was that they were paying for all amenities provided by the government. But in turn the government never gave them proper facilities and finally put them in a place which is far away from their working place. The consequences of this displacement leading to vulnerability are dealt with more elaborately below.

35.4.2 Information and Technology (IT) Park at Cyberabad

The second case is an illustration of how capitalist forces can be the worst agencies to the poor in disguise. Within the city of Hyderabad there is a part called Cyberabad that has become the hub of information and technology. A large number of economic migrants from Andhra Pradesh and Karnataka had settled in a place called Manikonda. There were 439 families living by cutting stones, working in construction and as drivers. After IT companies like Microsoft, Wipro, Infosys and Polaris settled in this part, there was much construction. All 439 families were involved in construction for these companies. The land issue was disputed when the *Andhra Pradesh Industrial and Investment Corporation* (APIICL) extended the land for the IT companies, and one occasion which served as a platform to acquire this land was a visit of the CEO of Microsoft, Mr. Bill Gates, in 2004. When he visited the city the government proposed to evacuate all families and to use the place for more IT companies. As the people were all informal dwellers, they were requested to vacate the place within a month. This is the time when the politics of displacement sneaked in; the authorities used the *divide and rule* method. One of the leaders of the locality called Tirupati was taken to the IT minister, Mr. Sabita Indra Reddy, and wooed with gifts and assured of full support that he required. The leader convinced a large number of the people that they had all come to the city with nothing but that the government was ready to give them a house and proper resettlement. This convinced many people and most of them followed this leader to get displaced and resettled. The major hurdle against the government was solved more easily than the authorities expected.

Another reality of forced eviction followed and the people were sent to a village ten kilometres away to a place called Indra Reddy Nagar, but to the dismay of the displaced, the host community did not allow the displaced to enter their village. Although the land belonged to the government it could not do much. The people in the nearby village were upset that some outsiders were being given free land. This gave rise to a violence of a different kind and the host community began to intimidate the displacees, with the women being worst hit, as will be discussed below in dealing with vulnerability and gender. Due to the pressure from academic groups, the government took some steps to get houses built for them, but to the consternation of the people, during this process the government came up with another infrastructure project of the *Outer Ring Road* (ORR) for the city. Thus, the people were pushed into multiple displacements and had to move again to a semi forest opposite to the first allotted place of resettlement.

35.4.3 International Airport Project

The third case refers to the International Airport Project, the most devastating and one of the biggest displacements in Hyderabad. The government of Andhra Pradesh, under the leadership of former Chief Minister Chandra Babu Naidu of the Telugu Desam Party (TDP), had proposed the plan for an International Airport in the year 2000, but it had not received any assurance as new leaders took over in Andhra Pradesh after the elections. The TDP lost the elections and the Congress Party came to power in 2004 and instantaneously got the approval of the Central Government of India that was also led by the Congress Party, and started the work. Both the IT park in Cyberabad and the International Airport projects were launched under the same legislator, Mrs. Sabita Indra Reddy. Although a formal announcement was made about the land acquisition, just fifteen days before the actual date of displacement the people of the four villages were informed. This short notice came as a shock as there were a number of ceremonies planned for several months already in this locality. The people approached the legislator, Mrs. S. I. Reddy, for additional time to complete all ceremonies in the village. The legislator, Mrs.

Figure 35.2: The three sites of displacement in the mega city of Hyderabad: 1) MMTS station Lakdikapool; 2) Cyberabad Info Tech park; and 3) the International Airport. **Source:** Corporate Infobase Ltd. and Municipal Corporation of Hyderabad; at: <http://www.ghmc.gov.in/hyd/hydmap.asp>.

S. I. Reddy granted fifteen more days and promised proper compensation and resettlement to all affected people as they had land titles. She also explained the inevitability of having such a project and made it clear that the project was certain to happen. When these processes were going on, the people were in a di-

lemma, whether to move from the place or to stay there and protest. After the given time, the authorities came with the police forces and asked the people to vacate. On 13 May 2004, more than 500 Special Police Forces involuntarily displaced the people and they were moved in lorries like animals, and the land was forcefully acquired.

The Government of Andhra Pradesh acquired 5,480 acres of land for this project and more than eleven villages were affected either fully or partially (Reddy 2006). Out of the 5,480 acres of land 3,400 acres belonged to private owners who have land titles (Pattas), the other 1,600 acres were considered as government land that had been occupied by the local people, especially by the people belonging to the Schedule caste and other backward classes for agricultural purposes fifty or sixty years ago. The people of these villages were dependent on the flora and on agricultural crops. Although compensation was provided to these people, it was negligible. The categorization of the land for compensation remained dubious and no justifications were given by the concerned authorities. The compensation was far below market values. Adding to the wound of displacement the people who had been living on the assigned lands were in troubled waters as the compensation scheme was pathetic for them. Although the people were organized in the *Shamshabad International Airport Land Loser's Welfare Association* (SIALLWEL) it could not bring any pressure on the government. People received 250 square yards as compensation to build houses. Several demands were submitted to the land acquisition officer, one was to employ one person from a family in the construction of the airport which was agreed but never became a reality.

35.4.4 Adverse Consequence of Displacement Leading to Vulnerability

Displacement by nature itself will lead to vulnerability, and if it is in the urban arena the agony cannot appropriately be explained. Vulnerability can be explained according to Kasperson (2001: 7) as: "the degree to which an exposure unit is susceptible to harm due to exposure to a perturbation or stress, and the ability (or lack thereof) of the exposure unit to cope, recover, or fundamentally adapt (become a new system or become extinct)." This is the same situation faced by all the displacees of all three crucial cases. The number of people displaced and loss of all or part of their productive assets, employment, and loss of livelihoods are immesurable as it just does not involve the measurable assets but also involves pyschological trauma.

The many stories from the field refer to an extreme level of psychological and physical trauma. In the NTR Nagar (1st resettlement colony) when a boy named Salim was asked what he wanted to become in the future, he replied that he wanted to become a doctor and treat his fellow residents, but his dreams were shattered and now he is without school and the family is no more capable of assisting him as he has 6 older sisters waiting to be married off. Another case of a boy called Tofique Ahmed is more depressing. After the displacement his father lost his job and later ended up as an alcohol addict and died in an accident close to the new locality, currently the boy is 16 years old and is responsible for his family. He works with a construction group doing manual labour. He has managed to enrol two of his sisters in a Madarasa for their education by sacrificing his own. A girl Sailaja was a top student in her previous school and she had dreams to become a civil servant but as the new locality had no school she was forced to do household work.

The vulnerability level at the Indra Reddy Nagar resettlement colony is the worst in all three resettlements. The people were residing without even a proper shelter. They were displaced in 2004 and were doomed to remain without proper housing facilities until May 2005. Their huts were so small that a person could not stand and it was built with small wooden sticks and leaves. The worst part was that, during the summer when throughout Andhra Pradesh it rained incessantly, their belongings got washed away along with the huts and the people had to take shelter in one of the buildings in the vicinity which were under construction. As the people had tapped the power from the electric poles directly many of the children were electrocuted. In one such incident a boy called Ravi passed away and he was the only son of the family. The resettlement colony made people extremely vulnerable during the nights. The resettlement colony is so far away from the city and it is surrounded by a small forest where snakes would sneak through the houses and were seen on the small roads of the colony. There are several incidents where elderly people and children got bitten by the snakes.

In the International Airport resettlement colony the agony of the people has been unimaginable. Adding to the shock, several elderly people passed away with cardiac arrests as they lost everything, at the expense of mere compensation. The system exposed them to extreme stress, crises, and shocks at the dis-

placement site of the International Airport area. One person, Mr. Krishna, who is the president of the *Shamshabad Mandal Differently Abled Peoples Association*, lost his father due to cardiac arrest when the displacement took place, and his mother also passed away within two months due to the separation from her husband as it came as a shock for her. Mr. J Narasimha lost both parents due to the shock of losing the land of their livelihood. There are hundreds of examples which are depressing and each case documents the autocratic way used by the government and yet again failing to keep the promises it made to the people.

35.4.5 Human Rights Abuse, Human Security Approach and A Gender Perspective

The displacement has caused several vulnerabilities including cultural alienation, dispossession of land resources, human rights abuse, and lowering of living standards. Due to its crosscutting nature no social or equity and distribution analysis can proceed without a discussion of gender. Thus, a growing constituency of policymakers, social advisers, and gender scholars address gender mainstreaming and 'engendering' activities. They use gender conceptually and practically to approach a whole array of issues ranging from forced migration to development cooperation and health. Here the process will be reviewed which led to the mainstreaming of gender in national development, at least at the de jure level. The tragedy of displacement due to development projects is compounded because the affected bear the cost without sharing the benefits. In the case of women, of course they had even lesser access, as mere passive recipients in fallouts.

There is an attempt to link human security issues and other societal, economic, and development challenges India is currently experiencing due to globalization and privatization. The individual and their interests are under threat from the state behaving in a coercive manner to suppress the freedom of its people by working for vested economic and political interests. According to the human security concept there is a need for protection from "sudden and hurtful disruptions in patterns of daily life" (UNDP 1994: 22). This aspect of daily life further identified some core elements which reflect the basic needs of human security: economic, food, health, environmental, personal, community, and political security (UNDP 1994: 23–25). The concepts of human security, peace, and development can be related in a more cohesive manner. Human security is formulated on the premise of rights and entitlements that were articulated and adopted in the *Universal Declaration on Human Rights* (UDHR)[3]. The UDHR states that the basic socio-political and economic conditions should be guaranteed to every human being, and that "every one has the right to life, liberty and security of the person" (Art. 3, UDHR).

The Commission on Human Security, chaired by Nobel laureate Amartya Sen and Sadako Ogata (CHS 2003), calls for an integration of policy responses to address the interconnectivity of threats to human security. The report focused on human security issues in the light of democratic principles and development dealing with the security in protecting the people from violent conflict, encouraging fair trade, and markets to benefit the extremely poor, ensuring universal access to basic education and healthcare facilities. Its greatest strength is its focus on larger socio-economic and political threats.

These threats are noticed in all three case studies on Hyderabad that noted five human rights challenges. The Indian Constitution provides certain rights which are not respected but abused by some government agencies. These rights define the situation as the right a) to development and self-determination, b) to participation, c) to life and livelihood, d) as the right of vulnerable groups, and e) as the right to remedy arising from development-induced displacement. The Indian Constitution also mentions some rights explicitly or implicitly among the fundamental rights (Art. 19, 21, 29, 31), as guiding principles of state policy (38, 41, 46, 47, 48A), as special provisions relating to certain classes (Art. 330, 342), and as right to constitutional remedies (Art. 32). If the government is to seriously address problems of the *resettlement and rehabilitation* (R&R) process, it must introduce a rights-based approach to the respective national policy.

Only in the past few decades a gender perspective has been offered by scholars (Vandana Shiva 1993; Ganguly Thukral 1996, Goyal 1996; Cernea 1997; Vasudha 1998) and different organizations working on women's issues. The adoption of the convention on the elimination of all forms of discrimination against women in 1979 was an important step in addressing the imbalances in gender-related issues. The UN (2002) issued a report on Women, Peace and Security

3 United Nations, 1948: *Universal Declaration of Human Rights*. General Assembly Resolution 217A (III), UN Doc A/810 at 71 (New York: United Nations); at: <http://www.udhr.org>.

based on Security Council resolution 1325 adopted in 2000. The study acknowledges that more has to be done to achieve the expected goal.

Vandana Shiva (1993) argued that women's underdevelopment was not due to insufficient and inadequate participation, but due to their enforced and asymmetric participation whereby they bore the cost but were excluded from the benefits. This refers to a different set of ideas on the process of displacement and resettlement of women where women have been neglected in the policy process. The authorities in charge of the relocation did not understand the problems of women in adjusting to the new locality. Since, even under normal circumstances, society has yet to treat women equally, the displaced women will need additional attention to cope with the changed circumstances until they can become equals. The traumas of displacements are directly connected with the rights of women and their civil liberties. There is a need to maintain the social rights of all those who are vulnerable, but the required attention has so far not been granted. Úrsula Oswald Spring (2006) argued that

> human rights and its phases of development do not guarantee minimal life conditions, but reinforce the individualization process increasing social vulnerability. On the contrary, social rights reinforce networks and create within diverse cultural contexts and cosmovisions options for resilience building, reduction of social vulnerability, self reliance and peaceful conflict resolutions.

The women need time to adjust to the new community and all communities are not safe for women. For example, men in resettlement colonies do not have toilet facilities, so, they go out to the field but it is not easy for women to do the same during the daytime. There are other examples to document that women are worst hit in any developmental project. A shocking and disgraceful situation occurred at the Indra Reddy Nagar resettlement colony. Uma was pregnant and when it was raining heavily in Andhra Pradesh during the summer, due to the unhealthy conditions at the resettlement colony she got sick at night, and as the colony had no transportation facility or health centre Uma passed away without proper medical care, along with the child.

The future of the women and children has been taken for granted by the authorities. The children who are displaced have no proper education and the utter poverty has made them vulnerable at one level and on the other hand there are instances of children becoming anti-social elements by indulging in theft and other crimes. Due to the burden some parents have even sold their children and there are instances that a girl was sold for a low price like a commodity. Women trafficking and child abuse have been other major factors of vulnerability.[4] The women are mere passive recipients. First of all children and women are vulnerable in the family during post displacement situations. Thus, there is a necessity to emphasize education.

35.5 Conclusion

The debate on resettlement and rehabilitation cannot occur in isolation. Many decisions of this generation will affect the needs of coming generations and this generation is not entitled to transfer a devastated future to coming generations for which every citizen will be blamed and held responsible.

- *First*, involuntary displacement is a phenomenon which should be understood in a humane way. An experience is required to asses the best way. The human security issues involved in development and displacement must be understood by the agencies involved in the process. Human rights abuses must end as well as the vulnerability this causes and to the risks involved in such projects.
- *Secondly*, there is a growing consensus among policymakers and the academic community on the overwhelming exposure and risk of impoverishment and on rights to protection and assistance. In reality, however, a bewildering array of motives for development-induced displacement prevails. The members of civil society should take the responsibility and make sure that the marginalized people are not harassed, and that their rights are not abused. The civil society has to respond positively and make it possible that a more egalitarian society may emerge.
- *Third*, the absence of (and inability to enforce) legal frameworks is a major factor of concern, there is a growing attention to the (human) rights and entitlements of those displaced as a consequence of conflict and development, although there is little consensus on appropriate institutional responses. The resettlement of internally displaced people has, until recently, been treated as a peripheral issue, the reasons for this are varied and interconnected – including the absence of international attention, the marginal status and the lacking

4 In a previous volume of this book series these issues have been analysed for other countries by Truong (2009) and Perpinian/Villareal/Oswald Spring (2009).

'voice' of the displaced, and the limited attention devoted to the subject by social scientists and other disciplines. This mindset has to change and the world must respond in a more cohesive manner and practice solidarity with the displaced communities.

- *Lastly*, the development-induced displacements leading to social, economic and political vulnerability, and moving to psychological trauma must be given a pause and any development should be egalitarian, only then a country can progress towards the right direction and build a conducive and healthy environment for everyone to live in. This is the responsibility of every human being who is concerned about the world.

36 Linking Oriental and Western Thinking to Mitigate Flood Risk

Xiaomeng Shen

"水能载舟，亦能覆舟" (魏征，580-643)

"Water can carry a boat or sink it." (Wei Zheng, 580-643).

36.1 Introduction

This famous quote by the Chinese Prime Minister Wei Zheng of the Tang Dynasty (618–907) uses the characteristics of water as a metaphor to describe the relationship between a ruler and his/her people. People are symbolized by water which can be utilized and be beneficial for the ruler; the ruler is symbolized by the boat which relies on the water to carry it. However, water can be an ambivalent double cross. Once the harmony between the water and the boat is disturbed, water brings destruction.

This relationship can be transferred to the relationship between water and human beings. Water is indispensable for human life as it does not only provide natural resource services essential for the development of human civilization, but also nurtures intellectual inspiration. Philosophers such as Confucius (551 BC–479 BC) meditated on the source of life and exclaimed: 'Water, ah water!' trying to find the fundamental principles of life (Allan 1997: 31). Maybe the Chinese have conferred a unique meaning to water in the intellectual domain; however, it is not only the Chinese who have shown a propensity towards water in the course of history. Pohl (1993) pointed out the significance of the natural event of flooding on human civilizations: "The frightening as well as fruitful floods of Euphrates and Tigris in Mesopotamia, and the floods of the Nile in Egypt or of the Yangtze and the Huanghe in China have greatly influenced the development of mankind" (Pohl 2003: 196). Wittfogel even contends that the need for irrigation and flood protection is a decisive factor which laid the foundation of a societal form (Wittfogel 1955: 44–45).

Despite the environmental services and intellectual inspiration that water and flood events provide for humankind, the power of water is also manifested in destruction. Floods often have great negative impacts on human well-being. They cause loss of human life, economic damage, damages to ecosystems, aggravate human health problems, and damage historical and cultural sites. In the last decade of the 20th century floods killed 100,000 worldwide and affected over 1.4 billion people (Jonkman 2005: 151–152). According to Munich Re, about one third of all reported damages and one third of all economic losses are flood-related. Over the last few decades there have been more casualties due to flooding than caused by all other natural catastrophes together (Kron 2003: 80). During the period from January 1975 to June 2002, freshwater flood events are reported to have killed 176,864 people and affected 2.27 billion according to the International Disaster Database (EM-DAT) of CRED (Jonkman 2005: 158).

Less developed countries are especially affected by floods. According to CRED data, among the ten most deadly floods since 1931 China is listed seven times (table 36.1), and among the floods that affected most people since 1989, China is listed even nine times (table 36.2). Among the top ten most important flood disasters for the period from 1900 to 2009 (sorted by economic damage costs at the national level), China has been listed four times (table 36.3). According to another source of the five floods with highest casualties since 1978, China is listed twice (table 36.4; Jonkman 2005: 158). Flood mitigation is gaining more and more importance, posing an ever challenging task.

What are the major discourses in the international flood risk management community? How do the Chinese flood experts and managers perceive and cope with flood risk? Can different cultures learn from each other's experiences, based on the link between

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their thinking? This chapter endeavours to examine the flood risk management strategies in China by conducting a case study in Wuhan, China and explore the potential of mutual learning within the global community in order to better cope with risk and disaster. Section 36.2 will discuss the main discourses on flood risk management. The field site chosen for the case study and research design will be elaborated upon in 36.3. Then research results will be presented (36.4), followed by discussion and conclusion (36.5).

Table 36.1: Overview of the ten flood events with most people killed. **Source:** UniversitÈ Catholique de Louvain, Brussels, Belgium, EM-DAT: The OFDA/CRED International Disaster Database; Created on: 2 June 2009. Data version: v12.07; at: <www.em-dat.net>.

Country	Date	Number Killed
People's Republic of China, general flood	July 1931	3,700,000
People's Republic of China, general flood	July 1959	2,000,000
People's Republic of China, general flood	July 1939	500,000
People's Republic of China, general flood	1935	142,000
People's Republic of China, general flood	1911	100,000
People's Republic of China, general flood	July 1949	57,000
Guatemala, –	October 1949	40,000
People's Republic of China, general flood	August 1954	30,000
Venezuela, Flash flood	15 December 1999	30,000
Bangladesh, –	July 1974	28,700

36.2 Flood Mitigation

Currently, there are two main discourses on flood disasters. The dominant view considers floods to be a natural disaster. The alternative discourse sees flood disasters as being jointly produced by the interaction of the physical hazard and social vulnerabilities. The latter discourse brings to the fore social relations, structures, institutions, and governance as well as political processes in understanding flood disasters (Lebel/Nikitina/Manuta 2006: 3; Dixit 2003: 166; Stefanovic 2003: 231; Few 2003: 47). As a consequence of differences in perspectives within these discourses, the implications for flood mitigation strategies are different as well.

Table 36.2: Overview of the ten flood events with most affected people. **Source:** UniversitÈ Catholique de Louvain, Brussels, Belgium, EM-DAT: The OFDA/CRED International Disaster Database; Created on: 2 June 2009. Data version: v12.07; at: <www.em-dat.net>.

Country	Date	No. Total Affected
People's Republic of China, general flood	01.07.1998	238,973,000
People's Republic of China, general flood	01.06.1991	210,232,227
People's Republic of China, general flood	30.06.1996	154,634,000
People's Republic of China, general flood	23.06.2003	150,146,000
India, –	08.07.1993	128,000,000
People's Republic of China, general flood	15.05.1995	114,470,249
People's Republic of China, general flood	15.06.2007	105,004,000
People's Republic of China, general flood	23.06.1999	101,024,000
People's Republic of China, –	14.07.1989	100,010,000
People's Republic of China, flash flood	08.06.2002	80,035,257

If the first approach is applied, the focus is on physical events. The implication for mitigation is the prediction of their magnitude and occurrence using hydrological and meteorological science. Technical measures such as dykes and dams are solutions to alleviate floods. However, these technical measures only intensify flood problems and this approach largely ignores the mitigation potential during the normal time between two flood events (Dixit 2003: 166). This hazard-led approach does not involve the affected people in the decision-making about mitigation. Instead, mitigation is carried out in a bureaucratic manner through a top-down approach (Dixit 2003: 166).

Certainly, short-term reductionist strategies have their place at certain times and within certain scales. However, numerous studies revealed that disasters are not only the outcome of natural hazards, but also of socio-economic structures and political processes that make individuals and families vulnerable (Lebel/Nikitina/Manuta 2006: 3; Wisner/Blaikie/Cannon/Davis 2004: 216; Dixit 2003: 166). This perspective is la-

Table 36.3: Top ten most important flood disasters for the period from 1900 to 2009 – sorted by economic damage costs at the national level. **Source:** UniversitÈ Catholique de Louvain, Brussels, Belgium, EM-DAT: The OFDA/CRED International Disaster Database; Created on: 2 June 2009. Data version: v12.07; at: <www.em-dat.net>.

Country	Date	Damage (thousand US$)
People's Republic of China, general flood	01.07.1998	30,000,000
Democratic Peopleís Republic of Korea, general flood	01.08.1995	15,000,000
People's Republic of China, general flood	30.06.1996	12,600,000
United States of America, general flood	24.06.1993	12,000,000
Germany, –	11.08.2002	11,600,000
United States of America, general flood	09.06.2008	10,000,000
Italy, general flood	01.11.1994	9,300,000
People's Republic of China, general flood	23.06.1999	8,100,000
Italy, flash flood	14.10.2000	8,000,000
People's Republic of China, general flood	23.06.2003	7,890,000

belled as the 'alternative approach' which focuses on how social systems operate to make people vulnerable to disasters. This approach recognizes the fact that natural hazards do occur, but vulnerability is equally important for the outcome of a disaster (Dixit 2003: 166).

Due to asymmetric socio-economic relationships, for instance, those families which have no access to basic resources, such as land, food, and education are particularly vulnerable. "Disasters are the unresolved problems of societies during 'normal' times, and these problems affect the way people are impacted by disasters" (Dixit 2003: 168; Wisner/Blaikie/Cannon/Davis 2004: 206). Lebel, Nikitina and Manuta (2006: 3) pointed out that viewing disaster solely as a technical problem ignores the importance of participation and transparency, and conceals the politics of shifting risk to already vulnerable groups.

Yet, public participation in flood mitigation has not been widely practised; instead the public are treated as irrelevant to the technical exercise of assessing and managing risk and designing institutional responses. Despite the knowledge and promotion of community-based flood disaster management by international agencies, national agencies remain sceptical about its implementation. Reason for this scepticism lies in the fact that this approach requires "addressing fundamental issues of governance and social justice that may undermine positions of authority" (Lebel/Nikitina/Manuta 2006: 3–4).

Whilst public participation in river basin management is strongly advocated by the scientific community[1], case studies in many Asian areas such as Nepal, Vietnam, and Thailand among others show that the dominant response to flood mitigation has been hierarchical and guided by the motivation to control both water and people through states. Consequently, flood mitigation is translated into structural measures which have been proven to be insufficient (Dixit 2003: 174; Lebel/Nikitina/Manuta 2006: 4). Dixit concludes: "that the appropriate response to flooding lies in providing unhindered drainage is an intellectual blind spot because of the political-economic incentives of structural flood control measure" (Dixit 2003: 174).

Lebel, Nikitina and Manuta often observed in their case studies 'risk redistribution' instead of risk mitigation. The interventions reduce risks for one group while increasing them for another. The study describes a common phenomenon of risk redistribution in order to protect major cities. For instance, the protection of the central business district of Bangkok frequently put the surrounding suburbs and upstream districts or farmlands at risk. Due to a lack of prior involvement of the farmers and compensation mechanism serious conflict was provoked (Lebel/Bach/Garden/Bui/Subsin/Le/Nguyen 2008: 3). At the same time, the information made available to the urban population emphasizes structural measures which protect the interests of local elites in urban areas. The social and environmental impacts of such measures on affected areas are not mentioned (Lebel/Bach/Garden/Bui/Subsin/Le/Nguyen 2008: 4).

In addition, the reliance on structural measures leads to crisis driven management, since engineering measures could fail. Simultaneously, more building and investments behind the dykes are generated due to the structural protection, in return, more people

1 See: Jansky (2002: 58); Wisner/Blaikie/Cannon/Davis (2004: 239); Lebel/Nikitina/Manuta (2006: 4); Dixit (2003: 169); Bradbury (1989: 394); Tierney/Lindell/Perry (2001: 201); and Krasovskaia/Gottschalk/Berg/Mcerlain/Ngu/Geissler (2006: 9).

Table 36.4: Overview of the five freshwater flood events with most people killed. **Source:** Jonkman (2005: 158).

Country	Year	Month	Day	Killed	Total affected	Description
Venezuela	1999	12	19	30,000	483,635	flash and river floods and landslides around Caracas and other areas
Afghanistan	1988	6		6,345	166,831	floods in Badakhshan, Baghlan, Heart, Kabul, Jouzjan, Samangan, Takhar provinces
China	1980	6		6,200	67,000	floods in Sichuan, Anhui, Hubei
India	1978	7		3,800	32,000,000	floods in north and northeast India
China	1998	8	6	3,656	238,973,000	river floods combined with storms and landslides in Hubei, Hunan, Sichuan, Jiangxi, Fujian, Guanxi Prov.

and assets are at risk (Lebel/Bach/Garden/Bui/Subsin/Le/Nguyen 2008: 5).

The flood events in the past decade have triggered a rethinking process about mitigation strategies. Especially those flood events in the developed world such as the Elbe flood in 2002 in Germany led to the collapse of confidence in engineered flood prevention in these countries (Wisner/Blaikie/Cannon/Davis 2004: 201). Cutter believes that the ideology of conquering and taming nature, rather than living in harmony with it, was and still is the driving force in the production of the physical vulnerability of the metropolitan area.[2] As a result of the rethinking of the past flood mitigation strategies, the thought of enabling rivers to flow freely and the approach of 'living with floods' arose in the last decades (Wisner/Blaikie/Cannon/Davis 2004: 201–203).

However, this 'new' approach is not completely new. During the Chinese Western Han Dynasty (206 BC–24 AC) flood disasters occurred frequently in the Huanghe River Basin. From 39 BC to 11 AC there was a flood disaster every seven years due to dyke breaches. The most affected area at that time was Jizhou (today's Heibei Province and the south-west of Shandong Province) which was back then already densely populated. The economy in the area was prosperous and the density of townships was the highest in China. Yet, the economy was often severely affected by flood disasters. Thus, the Emperor called for flood mitigation strategies among the officials and scholars (Tan/Wang/Zhou 2005: 49).

One of the most famous strategies was recommended by one of the government officials, Jia Rang. He proposed three different approaches which he categorized into best, moderate, and worst practices. He considered the first approach as the best approach whose core dictates that human being "should not compete with water for land". He suggested relocating the people living between the Taihang Mountain and the dyke along the northern river bank of the Yellow River so that the river could flow freely. The worst practice would be to build dykes and fight against floods. He argued that it was not feasible only to renovate and build dykes, but that, on the contrary, structural measures were not only costly but also detrimental to flood management. Thus, he considered this approach to be the most unfeasible one. The moderate approach which combines dyke building and the creation of retention areas was considered to be the most practicable approach (Tan/Wang/Zhou 2005: 49).

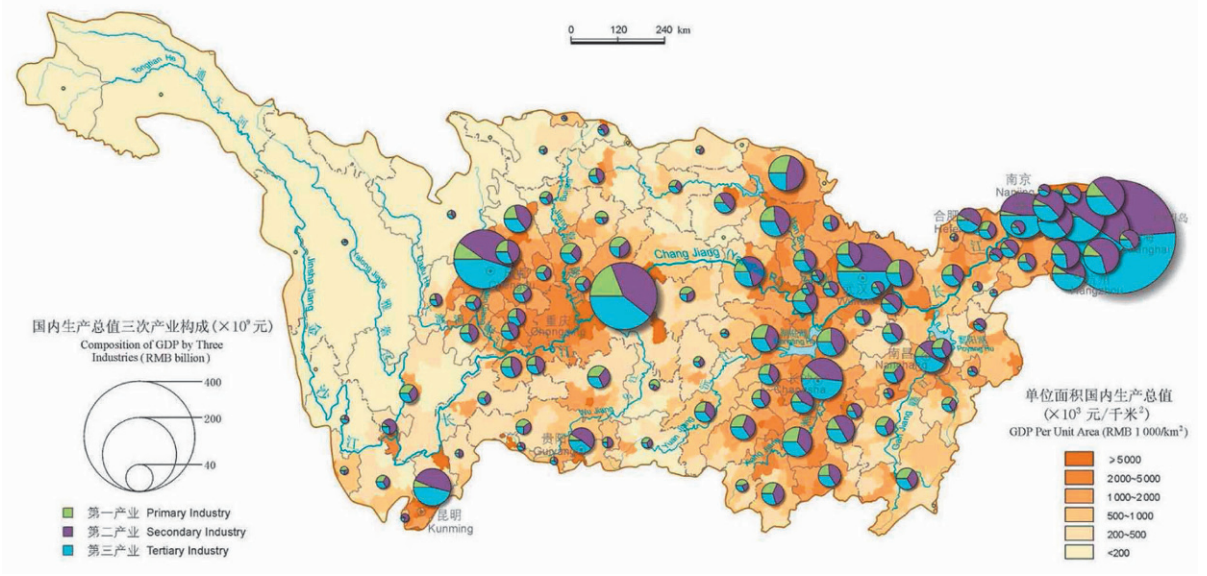
Although Jia Rang's flood mitigation strategy of allowing rivers to flow freely has become a canonical work in the Chinese flood management history, neither his best practice nor his moderate approach have ever been seriously undertaken (Tan/Wang/Zhou 2005: 49). Already in early China of the Western Han period, Jia Rang's opponents argued that his best policy was not applicable due to the advanced economic development and population density.

Today, two thousand years later, Western academics and flood managers have reinvented Jia Rang's thought. At the same time, the Chinese water management authority at the national level has also started to advocate the 'new' idea of 'leaving flood space to flow'. Still, despite the growing understanding of disasters, loss of life and property from flood disasters remains unacceptably high and is increasing in affected countries, including China (table 36.3).

Thus, to investigate how Chinese institutions manage flood risk and how they shape their mitigation strategies according to their conception of risk seems to be a feasible start for understanding the challenges in flood mitigation in China. The next section will elaborate the case study design for researching the

2 See: Susan Cutter: "The Geography of Social Vulnerability: Race, Class, and Catastrophe" (11 June 2006); at: <http://understandingkatrina.ssrc.org/Cutter/> (30 January 2008): 2 of 4.

Figure 36.1: Gross domestic product of the Changjiang River Basin (2000), **Source:** Shi (2003: 108).



risk perception of flood managers and their current flood mitigation strategies in Wuhan, China.

36.3 Research Method

36.3.1 Field Site

The study was conducted in the city of Wuhan in China. Wuhan is located in the middle reach of the Yangtze River. Sub-tropical monsoon dominates the climate. Yearly rainfall is 1,205 mm. As the provincial capital, Wuhan is the political, economic, and cultural centre of Hubei Province as well as the intersection of water, air, and land transportation. Wuhan is one of the most important economic zones in the Yangtze River Basin (figure 36.1). The GDP of the city of Wuhan was 259 billion Yuan in 2006 and per capita GDP was about US$ 3,790[3].

Altogether Wuhan was flooded more than 50 times in the last 800 years. The magnitude of the flood events in 1996, 1998, and 1999 are comparable to the most severe flood event in 1954 (Xu/Rao/Mao/Zhao 2003: 1). According to Fan (2000: 3) 1,183 firms had to interrupt their production during the Great Flood of 1998 and direct economic loss mounted to ca. 4.4 billion Euros, which was 4.8 per cent of the total GDP in the year 1997 in China (Fan 2000: 3).

36.3.2 Research Design

The qualitative social research methods applied in this research include semi-structural interviewing, informal interviewing, field observation, and documentary analysis. Semi-structural expert interviewing was the principal method of data collection in this study. The structured approach systematically asks each informant the same or thematically similar questions (Bernard 2006: 385). This enables comparison between cases and makes coding and analysis of data easier. This approach is especially applicable to research which involves high-level bureaucrats and elite members of a community who have time constraints (Bernard 2006: 212; Kelle 1999: 63). Since this research focuses on how flood experts and managers construe their risk conception and shape coping strategies accordingly, this specific qualitative method is applied.

Informal interviewing and field observation serve to provide additional information to triangulate with the data collected through more formal structured interviews. Documentary analysis includes newspaper articles, official websites, and governmental documents which provide information on how flood risk is perceived by flood experts and managers to complement and triangulate with the other data sources.

During the field work data collection was carried out in 2 phases. The first field phase took place between the end of August and the middle of October

3 See: "Wuhan Tongji Shuju", in: <http://www.whtj.gov.cn/documents/whsq2007/index.htm> (25 October 2007): 1–2 of 5.

2005. In this field phase a bottom-up strategy was applied, since the researcher mainly interviewed the river basin and local flood managers in Wuhan. After analysing the data collected, a second field phase was carried out between November and December 2006 in order to generate additional data to fill 'data gaps'. Here, further interviews were conducted with interviewees at river basin and national level, as well as NGOs. Altogether 35 semi-structured expert interviews were conducted.

The research subjects cover government officials of different agencies such as the flood protection and related agencies, environmental agency, representatives of NGOs such as conservationists' union, as well as the military. Interviewees at different management levels for flood protection were invited to attend the discussion with the researcher, since flood protection in China is arranged in a hierarchical way and all management levels from the central to the local government are involved in flood protection. This includes the national, river basin, and local levels.

36.4 Research Results and Analysis

The research results of the case study in Wuhan have revealed distinctive features of the hazard-led technical approach of the flood risk mitigation strategies which were elaborated above (36.2). These features are mainly shown through the perception of flood risk as an objectively calculable fact, the consequently rationalistic approach and risk distribution without public participation in the decision-making process.

According to the interviewees (in 2005/2006) flooding is a calculable and controllable natural event which requires technical solutions such as technical forecast and probability modelling. One interviewee stated: "Flood management is simple. Namely, we better hydrologically forecast and build more and better dykes. Don't you know the Chinese saying, 'once water comes, one stops it with earth'" (Interview, 2005)?

Dyke construction as a major coping strategy is based on the ideology of altering nature for the benefit of man – a typical Maoist ideology evolved during the Chinese Cultural Revolution. Especially at the local level many interviewees cited Mao's idea of conquering nature and fighting the flood: "We can not allow the flood to do whatever it wants. Like Mao said, we have to build dams and dykes and fight against the flood" (Interview, 2005).

In addition, risk managers believe that the dykes and reservoirs would guarantee them a bright political career like Yu (also Dayu, meaning the Great Yu), the famous King of the old once had. Dayu is a household name in China and the myth about how he coped with flood disasters has left its imprint in China's flood management approach. The official website of the Chinese Ministry of Water Resources published a series of articles on China's water management history to celebrate the World Water Day. One article states, "The Great Yu is the symbol of the spirit of the Chinese nation. The significance of Great Yu's water management is a part and parcel of the long Chinese history and it is also the peak of our civilization"[4]. Dayu was the first successful flood manager in recorded history for water management. Yu's method is to channel water to the sea following the 'way of water'. Mencius elaborates the 'way of water' as taking advantage of its natural tendency to flow downward and yield to obstacles. Thus, Yu controlled water by following water's natural inclination (Allan 1997: 40).

However, today this myth is conferred with different meanings: "The management approach of the Great Yu reveals a vivid picture of how our ancestors *fought* against floods. It also reflects the *unyielding fighting* spirit of our people in the course of *conquering* nature. His fearless spirit of *fighting* floods and his great achievement of water governance has been praised and handed down over generations. This spirit provides people with courage to *fight* flood disasters".[5]

Coupled with the belief that man can shape nature and control nature as well as the meaning of flood management for a political career, the eagerness of engineered flood measures among the flood managers seems to be a logical consequence. The dyke is not only a functional protection measure, but has also monumental symbolic for the politicians: "The Great Wall running thousands of miles and built on water has been constructed based on the 'concept of harmony between man and water'; it has become a monument in the heart of the people living along the river."[6]

This fighting spirit and the western rationalistic ideology, which was brought to China during the New Cultural Movement at the beginning of the 20th cen-

4 See at: http://www.cws.net.cn/zt/06waterday/newsview.asp?CWSN, 30 January 2008, p. 1–5 of 7.

5 See at: <http://www.cws.net.cn/zt/06waterday/newsview.asp?CWSN> (30 January 2008): 1–5 of 7.

6 See: <http://news.xinhuanet.com/newscenter/2007-08/29/content_6626051.htm> (30 January 2008): 1 of 3.

tury (Hu/Aer/Qiong 2005), seem to reinforce each other, thus, *scientism* has assumed an unshakable position in flood mitigation strategies. Baum observed that one of the characteristics of modern Chinese culture is the propensity to idealize science, to reify and universalize its precepts, thereby elevating it from a method of inquiry to the status of canonical dogma (Baum 1982: 1172). Scientific evidence is instrumentalized to justify reductionist engineered flood mitigation strategies as one interview states: "The most important thing in flood protection is to base our measures on solid scientific calculation" (Interview, 2005). Another interviewee even understands science as an instrument to create harmony between man and nature: "Science shall deepen the harmony between man and nature in relation to flood protection" (Interview, 2006).

As Beck states, the discussion in the western world on environmental destruction is only or at least dominantly based on a natural science paradigm. It is largely misconceived that all problems also have a social, cultural, and political meaning. Beck calls it the "*technocratic and naturalistic*" approach. However, this approach is blind to power and distribution structures, bureaucracy, current valid norms, and rationalities (Beck 1986: 33). This description of the technocratic approach in the western world coincides with the statement of Chinese water management officials. Decision-making based on 'scientific evidence' is a strong feature of decision-making in Wuhan and among other management levels.

Rayner contends that a hierarchical culture formalizes risk like all the other themes (Rayner 1992). This behaviour pattern is eminent among the interviewees in water management. When asked about what could be done to reduce flood risk in Wuhan, flood managers often have a very similar response as follows: "Flood risk reduction is just to relocate flood water in different retention areas; decide which reservoir will be used for what purposes; to implement the emergency plans for flood management; consultation to the higher leaders; to collect information of dangerous situations and respond to it..." (Interview, 2006)

Science seems to be entirely neutral to assess risks and therefore free from any moral judgement. At the same time science becomes also a strong instrument to justify the government's behaviour in assessing, managing risk, and their decision-making. Furthermore, science is also an instrument to stabilize authority, because experts always know better and it is the expert who has access to science and acts accordingly.

While many western scholars strongly advocate the approach of 'taking the naturalness out of natural disaster', Chinese water authorities still emphasize the 'naturalness' of a natural disaster and therefore support their risk management strategy using a 'pure' scientific paradigm.

Engineered flood protection supported and justified by scientism leads to *risk externalization* in urban areas which rank high in terms of population and economic considerations, since risk distribution priority is clearly defined according to criteria of population density and economic status (Li 1999: 34). Flood risk in the city of Wuhan is assigned to the retention areas located close to the city (see figure 36.2).

One of the most frequently used retention areas is Dujiatai with a total population of 256,200 according to the statistics of 2004.[7] The city area of Wuhan is protected by dykes. Dykes, as a result of development of technology, are not only used for the function of protection, but also as an instrument to channel risks. This risk distribution approach is perceived to be the most rational way to distribute risk and whose acceptance of stakeholders is not questioned: "The safety of the city of Wuhan should certainly be guaranteed with all means. The other areas can take more risks. Flooding one or two counties in a rural area is not a big deal. We have to take a certain risk and we can calculate risks and see which region can take which risk" (Interview, 2005).

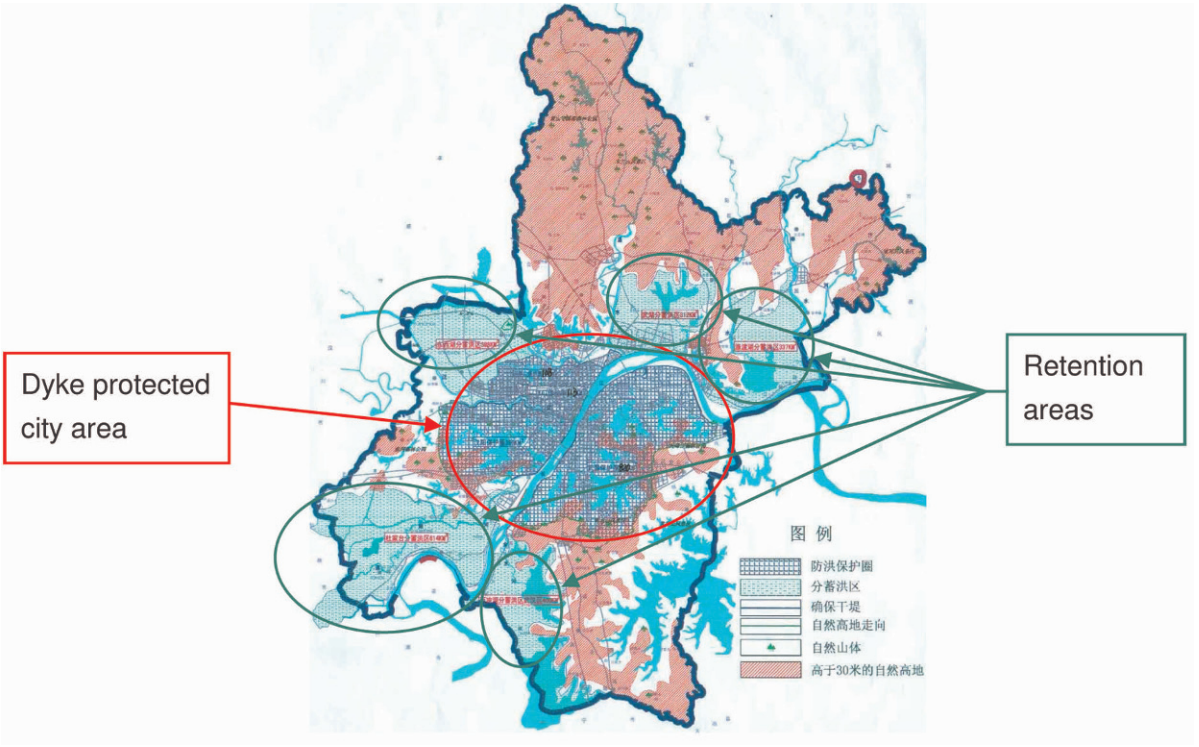
Externalizing risk distribution jeopardizes both the city of Wuhan where inhabitants and local managers completely rely on transporting risk to other areas and the retention areas which are not flooded on a regular basis, for people living in these areas are often not aware of the risks they are facing. Especially in retention areas such as Dongxihu which has never been put into use since its construction in 1957.[8] "Local people living in retention areas are often not aware that they are living within a retention area which can be flooded in case of severe flood events to ensure the safety of more important protection objects" (Interview, 2005). Thus, risk distribution has become an ever challenging and risky undertaking.

However, this externalizing risk distribution is again justified by the cultural tradition. One interviewee argues: "In China it is not like in western countries, that people risk living in flood prone areas in or-

7 See: "Fenxuhongqu Jianshe yu Guanli"; at: <http://www.hbhj.gov.cn/> (29 January 2008): 2. of 10.

8 See: <http://www.chinawater.com.cn/cwrn/cwrn.htm> (30 January 2008): 1–7 of 11.

Figure 36.2: Retention areas in Wuhan. **Source:** Wuhan Chengshi Guihuaju (2003).



der to make more money due to the cheap real estate prices. If they are flooded, they require financial aid paid by all tax payers. In China people have to live in retention areas, otherwise they can not make a living at all. This is like a family with 2 sons: if one son gets a better land protected by dykes, another son has to farm in high risk locations. Once a flood occurs, the son with safer land is obliged to help the son living in a high risk area. The same applies for people in retention areas. Once a disaster occurs and their land has to be flooded, then they will get help from all over the country. This is our culture" (Interview, 2006).

The dilemma here is that this principle functions well if everyone obeys this cultural rule. But in reality the interests of affected people are far from being protected through moral obligation. Without legal enforcement a compensation mechanism solely based on and enforced by a moral code is not ensured. Consensus of affected people on being exposed to urban flood risk is highly hypothetical. Only *public participation* involving affected people into the decision-making process can ensure that their interests are represented properly. However, some local managers seem to be at a loss as to how to respond to public participation when confronted with this topic (field observation, 2005/2006). This shows that public participation is indeed a new concept to many local flood managers. They are more used to the traditional way of coping with flood which focuses on crisis driven top-down management during flooding events.

Other water managers perceive public participation to be a new concept of decision-making which is not completely in line with the traditional Chinese culture. The flood managers in Wuhan who are very sceptical about this approach argue: "We don't have too much public participation in our country. This is due to our thousand-year-old culture. People are willing to be guided and led. The relationship between people and government is a relationship of leading and being led. People don't want to make their own decisions. They have been used to it since thousands of years" (Interview, 2005).

36.5 Discussion and Conclusion

The flood risk management approach in Wuhan is hazard-led and focuses on emergency management. This approach largely ignores the interests of vulnerable social groups in rural areas and the externalization of flood risk from urban agglomeration to rural regions increases the vulnerability of these social groups which affirms the research results of the previous studies in other countries (36.2). Chinese flood man-

agement at the national level has realized this problem, yet, a compensation law to ensure social justice is still embryonic. Moreover, this approach is deeply embedded in the traditional Chinese flood management ideology and justified by the scientist paradigm; thus, a depoliticization of risk becomes a logical consequence of this practice.

Doubtlessly, the integrated flood mitigation approach is widely accepted and advocated by international communities. Yet, the implementation of such an approach depends on fundamental values and beliefs of a society as well as the social relations each society prefers. Especially viewing risk as a social process requires extensive public participation which is one of the most important categories for good governance according to democratic principles. It enhances policy efficiency and legitimacy, when citizens and other institutions have a chance to influence how rules are formulated and implemented (Van Ginkel/Court/Barrett 2001: 18). However, countries such as China have a completely different value system and worldview. It appears that a political and cultural change is needed to adopt the Western democracy-based management approach. Yet, any such change can only take place ideally from within. If the purpose of culture research is to find out features of certain existing cultures and adapt or formulate one's own policy accordingly to work with but not against this culture, it is beneficial to improve hazard management. However, the intention to change or form a new risk culture through a culture study is doomed to fail, for any cultural change takes place during a very long period. And organizational culture particularly is very resistant to change (Johnson 1991).

In addition, the desirability of western modernity in countries like China is questionable. Although western modernity is in the process of successfully projecting its self image upon the rest of the world, it manifests limits in radically different societies (Deuchars 2004: 203). It removes from the story the richness of cultural diversity and space and place specificity (Deuchars 2004: 205). Deuchars contends: "All known societies do order their world to confront the dangers perceived there, however, and so to privilege one form of risk management as being universally superior is a form of conceit" (Deuchars 2004: 203).

Yet, the existence of commonalities across national and cultural borders can serve as the key to transferability of different practice and thinking. The Chinese Yin-Yang principle as an essential part of the Chinese traditional cultural heritage is based on a pluralistic approach. It encompasses both active and passive approaches which seem to have found an echo in the western rethinking process about flood management. Balance and stability, according to this principle, can only be reached by combining both passive (non-structural) and active (engineered) measures. Jia Rang's flood mitigation strategy followed such a tradition. The link between the ancient Chinese wisdom and the novel western (re)thinking appears to be a key to facilitate this political and cultural change.

37 Preparation for an Earthquake in the Megacity Istanbul

Sıdıka Tekeli Yeşil

37.1 Introduction[1]

This chapter addresses the importance of involving and ensuring the active participation of individuals and communities in disaster mitigation and preparedness activities[2]. The key question of this chapter is: What are the factors affecting action regarding mitigation of damage due to earthquakes and earthquake preparedness at the individual level in Istanbul? The chapter is based on the literature review carried out by the author for a study in Istanbul[3].

After brief information on the process of taking action regarding disaster mitigation and preparedness (37.2), the megacity of Istanbul will be reviewed as an example (37.3), looking at the factors affecting the way its residents practise preparedness and mitigation activities (37.4). In conclusion some recommendations will be put forward (37.5).

The impact of natural hazards has increased in severity in recent decades due to the growing vulnerability[4] of populations through, *inter alia*, rapid population growth, urbanization, environmental degradation, poverty, and social inequalities (Wisner/Adams 2002: 15–17; Arnold 2002: 6–7; Brauch 2005). It is therefore becoming vital that pre-disaster activities should be undertaken at both the community and individual level to mitigate the consequences of disasters and sustain the population's resilience. To be effective and successful, efforts to improve mitigation activities and preparedness at governmental, sectoral, and institutional levels should be supported by corresponding efforts at the community and individual levels. For example, land-use strategies or the application of building codes do not mean much if they are not observed (as often happens), and early warning systems are useless if the people do not know what to do or are unprepared for such situations.

The opposite is also true: governments should support individual and community disaster preparation efforts. For example, first aid training could be provided for volunteers and cheap credits given to house-owners to strengthen the construction of their homes. This is why disaster risk reduction was described in the context of the *International Strategy for Disaster Risk Reduction* (ISDR) as a shared responsibility between governments, communities, and individuals (ISDR 2004: 13). Additionally, in many disasters the victims and local people are the first to respond, especially where search and rescue activities are concerned. They can also be isolated or unreachable in the early phases of disasters and thus have no option but to cope with the situation by themselves. Their involvement and active participation in any kind of mitigation and preparedness activities are therefore essential for coping successfully with natural disasters.

1 The author is grateful to Necati Dedeoğlu, Director of the Public Health Department, Akdeniz University Medical Faculty; Marcel Tanner, Director, Swiss Tropical Institute; and Charlotte Braun-Fahlaender, Director a. i., Institute of Social and Preventive Medicine, University of Basel for their helpful input.

2 Preparedness comprises activities designed to minimize loss of life and damage, to organize the temporary removal of people and property from a threatened location, facilitate timely and effective rescue, relief, and rehabilitation, while mitigation comprises measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and the environment (Wisner/Adams, 2002: 13).

3 PhD project at the University of Basel/Switzerland: "Factors affecting the process of taking action at individual level regarding mitigation and preparedness for an earthquake in Istanbul."

4 The term 'vulnerability' explains "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard" (Wisner/Blaikie/Cannon/Davis 2004: 11); and "a function of susceptibility (the factors that allow a hazard to cause a disaster) and resilience (the ability to withstand the damage caused by emergencies and disasters and then to recover)" (Wisner/Adams 2002: 13).

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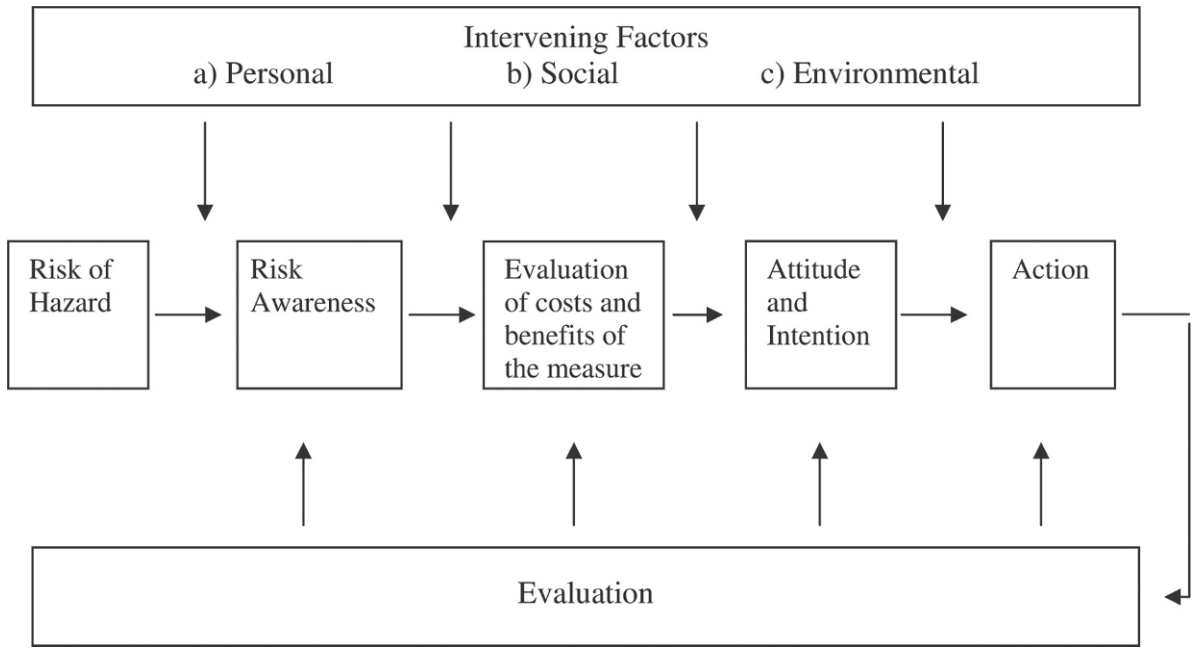
Figure 37.1: Conceptual Framework for the Process of Taking Action on Disaster Mitigation and Preparedness. **Source**: The author.



Getting the cooperation of individuals and communities is not easy. Studies in various countries with different economic and social backgrounds have shown that people tend to be uninterested in and unwilling to take action for preparedness and to reduce their risks.[5] Many social, economic, personal, environmental factors underlie this situation. 'Freedom from hazard impact' can only be achieved when people who are vulnerable to such hazards and disasters (which are often intensified by associated societal threats, challenges, vulnerabilities, and risks) receive better warning of them and are prepared and protected against their impact (Brauch 2005: 41). While many studies focus on understanding the susceptibilities of populations, an equal understanding of the characteristics of resilience in a population is also important in maintaining this freedom and mitigating the consequences of hazards.

37.2 Factors Affecting Individual Preparedness

A conceptual framework on the process of taking precautions at the individual level was developed and applied in the data collection and analysis. This framework is based on theories and models which were used in epidemiological studies to understand risky and protective health behaviour and activities, e.g. on the 'Health Belief Model' (Schwarzer 1991; Becker 1974; Strecher/Rosenstock 1997); on Ajzen and Fishbein's (1980, 1991) 'Theory of Reasoned Action and Theory of Planned Behaviour'; and Rogers' (1975) 'Protection Motivation Theory', and inspired by DeJoy's (1996) model for 'Workplace Self-protective Behaviour'. These models and theories were applied to various preventive and life style behaviours, e.g. to vaccination, smoking, seat belt use, safe sex practices, and exercise (DeJoy, 1996: 62), and all contribute to understanding this behaviour which equals the behaviour on disaster preparedness.

This framework presents a five-step process and shows that where there is a hazard risk, awareness of this risk is the prerequisite of taking action. *Risk of hazard* is the risk of a hazard occurring and involves the type, severity, frequency, and impact of it. *Risk awareness* includes perception and knowledge of the risk, its consequences, and how to cope with it, which

5 See: Tekeli-Yeşil/Tanner/Brauen-Fahrlaender/Dedeoğlu (2007: 102); Dedeoğlu (2005: 273); Inelmen/Işeri Say/Kabasakal (2004: 150); Shaw/Shiwaku/Kobayashi/Kobayashi (2004: 48); Anderson-Berry (2003: 229); Paton (2003: 210); Fişek/Yeniçeri/Müderrisoğlu/Özkarar (2003: 59–60); Kasapoğlu/Ecevit (2001: 15); Kleindorfer/Kunreuther (1999: 727); Larsson/Enander (1997: 11); Hurnen/McClure (1997); Lehman/Taylor (1987: 551–552).

are determined by the availability of reliable and accessible information. These factors have an important influence on the process of taking action to prepare for disasters and mitigate their effects.[6] Although they present high correlations with taking such action, these factors do not, however, automatically guarantee better preparedness at the personal level or mitigation of the effects of disasters (Johnston/Bebbington/Lai/Houghton/Paton 1999: 123; Paton 2003: 210; Chan 1995: 304).

The next step is the *evaluation of costs and benefits*. When deciding whether to prepare for hazards, a person weighs the physical, psychological, and economic costs of taking action against the probable benefits to life and property in the future, and evaluates whether the input can bring greater and/or similar benefits if invested in another area, much as economists do when considering the opportunity cost of an intervention or an investment. According to the results of this evaluation, the sequence might continue with person's *attitudes* towards and *intentions* regarding taking action for mitigation and preparedness, followed by the action taken. Sometimes, as a consequence of a disaster or some other development, the action concerned may be followed by an evaluation applied to all or some of these steps.

The process of *taking action* cannot be considered only in the context of a hazard. A serious of social, personal, and environmental factors is also crucial in this process. This is why intervening factors have been included in the framework. Each step and the transition phases can be positively or negatively influenced by intervening personal, social or environmental factors. Eventual elements of these intervening factors are as follows:

a.) *Personal factors:* previous experience with a disaster (Weinstein 1989: 46, Johston/Bebbington/Lai/Houghton/Paton 1999: 120, Anderson-Berry 2003: 219); availability of resources, such as time, skill, financial and physical resources (Mamun 1996: 71; Chan 1995: 291); demographic characteristics such as age, cohabitation, the presence of a child in the household, type of residence, e.g. ownership or rent (Larsson/Enander, 1997: 17); unrealistic optimism (Weinstein 1989: 44; Burger/Palmer 1992: 42); denial (Lehman/Taylor 1987: 551; personal beliefs such as outcome expectancy, such as perceptions of whether individual action will effectively mitigate or reduce a problem (Lindell/Whitney 2000: 18–19; Rohrmann 2000), and perception of hazards as controllable or uncontrollable (Slovic/Fischof/Lichtenstein 2001: 117; Rohrmann 2000); fatalism, helplessness (Mamun 1996: 69) of the hazard (Renn/Wiliams/Kasperson/Kasperson/Slovic 1992: 156); transfer of responsibility to others, e.g. to the state, government or local authorities (Inelmen/Işeri Say/Kabasakal 2004: 149; Paton 2003: 214; Johnston/Benton 1998); world views (Slovic 2001: 402–403).

b.) *Social factors:* socio-economic status, social class (Burningham/Field/Trush 2008: 220); social network (Anderson-Berry 2003: 227; Paton/Millar/Johnston 2001: 163); sense of community (Paton 2003: 213; social support and interaction (Mileti/Fitzpatrick 1992: 399); cultural phenomena (Kasapoğlu/Ecevit 2004, Bontempo/Bottom/Weber 1997: 480, 486); lack of trust (Inelmen/Işeri Say/Kabasakal 2004: 146) media coverage (Renn/Wiliams/Kasperson/Kasperson/Slovic 1992: 156).

c.) *Environmental factors* mainly related to the phenomenon: frequency of occurrence; normalization bias (Paton 2003: 211, Becker/Smith/Johnston/Munro 2001); imaginably and potential for catastrophe (Slovic/Fischof/Lichtenstein 2001: 107, 117); characteristics and impact of the hazard agent, such as speed of onset, scope, and duration of the impact (Lindell 1994: 320–321); location (Lindell/Prater 2000: 326).

37.3 Megacities and Vulnerabilities of their Residents in Relation to Natural Disasters

The global urban population was 46.7 per cent of the total world population in 2000 and is estimated to rise to 59.9 per cent in 2030 (UN 2006, 2007). Nowadays, urban areas are at the highest risk of disaster since they are places where nearly all factors that make populations more vulnerable are seen or experienced. These factors include high population concentration and densities, in some cases uncontrolled spatial expansion and severe infrastructural deficits, high concentration of industrial production, insufficient housing provision, ecological degradation, and in some cases extreme socio-economic disparities and high immigration rates (Kraas 2003/4: 9). Furthermore, the most crowded cities of the world are lo-

6 See: Johnston/Bebbington/Lai/Houghton/Paton (1999: 1229); Lindell/Whitney (2000: 23); Mileti/Fitzpatrick (1992: 394); Weinstein/Sandman (1992: 73); Mamun (1996: 69); Ronan/Johnston/Daly/Fairley, (2001); Dedeoğlu (2005: 273); Kasapoğlu/Ecevit (2001: 92).

cated in areas that are at extremely high risk of natural disasters (ISDR 2004: 59). As more people move each year to urban areas, it is clear that special attention should be given to the development of projects on urban preparedness.

Disasters in urban settlements can also have positive consequences for awareness. Özerdem and Barakat (2000: 433) mentioned the urban-rural dichotomy when pointing out that even though there have been many earthquakes in Turkey[7], it was only after the 1999 earthquake that earthquake safety and disaster management began to be taken seriously due to the large number of urban areas affected, and as victims were mainly urban dwellers.

An investigation into earthquake preparedness in Istanbul would benefit other cities, even for other types of disasters, since megacities have more in common with each other than with their own hinterlands (Kraas 2003/4: 9) In addition, although all hazard events are unique and their consequences may differ depending on many factors, the similarities in the human response to hazards means that the results could also have general relevance for other hazards. The suggestion is that the methods and findings are not applicable to all cities and all types of natural hazards, but the common aspects in human response and the living circumstances are noteworthy.

37.4 The Case of Istanbul

The social, demographic, and economic characteristics of Istanbul can be summarized briefly as follows. The 2007 general census showed that 12,573,836 people were living in Istanbul; the population density was 2,420 people per km^2; 89 per cent of the people were living in urban areas, 70 per cent of the population was between 15 and 64 years of age.[8] The annual population growth rate was 3.3 per cent and the unemployment rate was 12.7 per cent (IBB 2001). The high population growth rate in Istanbul is mostly due to migration of low-income groups from other parts of Turkey for employment opportunities. This situation produces many problems which increase the vulnerability of the population, such as overcrowding, inadequate infrastructure and services, environmental degradation, and informal settlements (the *gecekondu,* which are makeshift one story houses built illegally on government land, on the outskirts of the city). Since *gecekondus* are constructed without regard to building codes and regulations, the structures are weak and susceptible to hazards. Unfortunately one fifth of the Istanbul population lives in the *gecekondu* (Keleş/Geray, 1995: 141). There are approximately 2,714,462 buildings in Istanbul, of which only 32 per cent are insured against earthquake risk[9] even though insurance has been compulsory since the end of 1999.

On 17 August and 12 November 1999, the Marmara region, where Istanbul is located, was shaken by two severe earthquakes with magnitudes of 7.4 and 7.2 respectively on the Richter scale, which cost nearly 18,000 lives and did severe damage to buildings, economic life, and infrastructure (Sayıştay Bakanlığı 2002/3: 13). Some authors have estimated that there is a 62 per cent probability (± 15 per cent) of an earthquake of a magnitude of approximately 7 on the Richter scale before 2030 in the vicinity of Istanbul (Parsons/Toda/Stein/Barka/Dietrich 2000: 661). During the 1999 earthquakes Istanbul, except for the Avcılar district, was not affected as badly as other cities in the Marmara region, mainly due to the distance from the epicentre of the earthquakes.

The province of Istanbul consists of 1 metropolitan municipality and 32 district municipalities; 13 of the latter are located on the first degree (highest) earthquake risk zone, 17 are located on the second degree earthquake risk zone, 2 located on the third degree earthquake risk zone, and only 2 sub-districts (non-urban) on the fourth degree earthquake risk zone (Istanbul Valiliği Afet Yönetim Merkezi 2005).

37.4.1 Individual Preparedness in Istanbul

Fortunately, increasing numbers of studies about human responses to hazards and individual and community preparedness are being undertaken as more scientists and institutions in different disciplines have begun to deal with these issues. There is still, however, a limited number of studies at national and international levels. Below, findings are offered from a few studies on individual and community preparedness in Istanbul.

7 Between 1902 to 1998 and the two earthquakes in 1999, 129 earthquakes in Turkey caused damages, such as the loss of housing stock, and of these 92 resulted in fatalities ranging from 1 to 3,959 deaths; at: <http://angora.deprem.gov.tr/raporen.htm> (7 February 2008).

8 TUIK [Türkiye İstatistik Kurumu: Turkish Statistical Institute], at: http://www.turkstat.gov.tr (7 February 2008).

9 DASK [Doğal Afet Sigorta Kurumu: Turkish Catastrophe Insurance Pool], at: <http://www.dask. gov.tr/ istatistik21.html> (29 October 2008).

The consequences of a predicted earthquake in Istanbul would be severe, as well as its socio-economic consequences. One scenario projects between 30,000–40,000 casualties and more than 120,000 injured people needing hospitalization (BU 2003: 81). The 1999 earthquake in Turkey and the experience in the rest of the world have shown that most minor and medium injuries are caused by non-structural elements and building contents, e.g. by glass and furniture (Petal 2000: 2–3; Noji 1997: 157) Furthermore, almost all victims were either rescued by local people (neighbours, family members) or saved themselves (Dedeoğlu/Erengin/Pala 2000: 365; WHO 1999: 11). These two findings clearly highlight that individual preparedness plays a critical role and that there are many things that individuals and the community can do to prevent or mitigate the consequences of earthquakes, even with small-scale investments. Although there are many promising mitigation and preparedness programmes which have been conducted since the 1999 earthquakes, the situation in Istanbul on earthquake preparedness at the individual and community level is inadequate.

The level of awareness of the predicted earthquake among the inhabitants of Istanbul is quite high. In the study of Fişek/Yeniçeri/Müderrisoğlu/Özkarar (2003: 25) respondents gave a realistic appraisal of the risk they face in terms of the security of their zones.[10] In the same study, 75 per cent of the respondents gave relevant answers to the question what an earthquake is and 62 per cent saw the construction as the real source of danger. Many inhabitants of Istanbul had experienced earthquakes before (Bay Aytekin 2006: 26; IBB 2002: 126) and had a high perception of the risk of a predicted earthquake. According to studies conducted in different districts of Istanbul, over 50 per cent of the respondents perceived a high risk about a predicted earthquake: 68.8 per cent (Kalaça/Bay Aytekin/Çalı 2007: 405); 52.5 per cent (Işeri Say/Inelmen/Kabasakal 2005: 12); 58.3 per cent (IBB 2002: 46); 58.1 per cent (T.C.[11] Başbakanlık PUB 2005: 16). However, risk perception declines when the question is referred from the city to the individual level. (Işeri Say/Inelmen/Kabasakal 2005: 12).

In the study of Bay Aytekin (2006: 34) 26 per cent of the respondents thought that there is nothing to be done individually against earthquakes. Structural safety was the most commonly mentioned measure (67 per cent) as a way to mitigate the damage from an earthquake among the respondents of the study of Fişek/Yeniçeri/Müderrisoğlu/Özkarar (2003: 53). Despite the people's high perception of risk, very few mitigation or preparedness activities were undertaken (Inelmen/Işeri Say/Kabasakal 2004: 150; Kalaça/Bay Aytekin/Çalı 2007: 405; Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 60; IBB 2002: 33–43). More than 10 per cent of the respondents had not taken any such measures. According to Kalaça, Bay Aytekin and Çalı (2007: 405) and Işeri Say, Inelmen and Kabasakal (2005: 13) 12.9 per cent and 16.7 per cent, respectively, of the respondents had taken no measures for earthquake preparedness, even though earthquakes had been often a theme of daily conversation (IBB 2002: 10–11; T.C. Başbakanlık PUB 2005: 17).

The most common mitigation and preparedness activities undertaken were learning how to behave during an earthquake; having an earthquake bag/kit; fixing high furniture and equipment; obtaining an earthquake insurance (Kalaça/Bay Aytekin/Çalı 2007: 405; Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 60; IBB 2002: 33–43).

37.4.2 Factors Affecting Individuals in Taking Mitigation and Preparedness Actions in Istanbul

The 1999 Marmara earthquakes, which killed over 18,000 people, showed the need for action to prepare for an earthquake in the city of Istanbul. The need to mitigate damage and for preparedness activities was only acknowledged after these deadly earthquakes. (Tekeli-Yeşil/Tanner/Brauen-Fahrlaender/Dedeoğlu 2007: 102; Balamir 2001: 229; Karancı/Akşit 2000: 413). The findings of various studies showed that the

10 High risk districts in earthquake zones or the site dependent intensity distribution of a scenario earthquake provided by related governmental or municipality departments and universities and open to the public knowledge. For detailed information about risk zones or high risk areas see: Afet Işleri Genel Müdürlüğü Deprem Aratrma Dairesi [General Directorate of Disaster Affairs, Earthquake Research Department]; at: <http://www.deprem.gov.tr>; Istanbul Metropolitan Municipality; at: <http://www.ibb.gov.tr/trTR/SubSites/IstanbulVeDeprem/> and BU: Earthquake Risk Assessment for the Istanbul Metropolitan Area Final Report (2003).

11 Risk perception for a destructive earthquake in Istanbul in 2–5 years or later was 58.1 per cent; and within the coming three months or in a year was 13.5 per cent.

following are important factors in undertaking mitigation and preparedness activities in Istanbul.

1. *Higher socio-economic level* (Kalaça/Bay Aytekin/Çalı 2007: 405; Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 62–66). In both studies respondents with a high income or a high socio-economic level had a significantly higher completed prevention score or had taken more precautions than other groups.
2. *Educational level*: According to Bay Aytekin (2006: 34) a higher education level of the respondents influenced significantly their positive attitudes towards preparedness, as well as on taking more precautions.
3. Istanbul citizens living in a district with *relatively high risk*[10] (Kalaça/Bay Aytekin/Çalı 2007: 405) gave a realistic appraisal of the risk they face on the security of their zones. Respondents living in higher risk areas had taken more precautions.
4. *High perception of risk*, where the risk is perceived as a threat to the person or the family (Kalaça/Bay Aytekin/Çalı 2007: 405). However, high risk perception was not followed by action (Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 57, 66).
5. *Trust*: Two studies (T.C. Başbakanlık PUB 2005: 33–37; Öncüler 2002: 6–7) of people's decisions on retrofitting buildings against earthquakes showed that trust (in the institutions that plan, apply, and control retrofitting projects) was an important determinant for decision-making for mitigation of damage. Green (2008: 363–368) discussed distrust of a construction process especially among residents of *gecekondu* districts. She argued that additional to the root causes of unauthorized housing – poverty, macro-economic instability, urban migration, and hierarchical social relation – distrust promotes self-built, unauthorized construction. Because these people perceived self-built houses as being more, rather than less earthquake resistant, as they are constructed by themselves and not by someone interested in profit. Inelmen, Işeri, Say and Kabasakal (2004: 146) discussed the lack of trust in various information sources. Their study and other studies (IBB 2002: 119) showed that scientists and university institutions were the most trusted sources of information on earthquakes.
6. *Experience with an earthquake*: Previous experience with a major earthquake, losing a close relative or friend and participating in solidarity activities during the 1999 earthquakes, were found as significant factors by Kalaça/Bay Aytekin/Çalı (2007: 405).
7. *Fatalism*: Almost all studies noted the existence of fatalism that was no significant factor for taking precautions. However, the study by Inelmen, Işeri Say and Kabasakal (2004: 144) claimed that it was a key factor for not joining disaster preparedness organizations.

In multi-storey buildings with many apartments, group dynamics (T.C. Başbakanlık PUB, 2005: 27) and home-ownership (Kalaça/Bay Aytekin/and 2007: 405; Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 63) were important factors for implementing mitigation and preparedness measures. Öncüler's (2002: 6–7) research showed that the average willingness to pay for earthquake mitigation measures increased when a building nearby was improved. The reduction in damage due to mitigation was another factor. The respondents were more likely to pay for a mitigation activity that offered 'zero damage'. But positive attitudes towards mitigation and preparedness did not necessarily result in such measures being taken (Fişek/Yeniçeri/Müderrisoğlu/Özkarar 2003: 25).

37.5 Conclusion

The impacts of hazards are not just geological, meteorological or hydrological events, they do not only leave economic damage or casualties behind them, and disaster management is not just a technical matter. There are human and social issues around hazards which must also be well understood. Disasters cannot be managed only with technical measures such as an increase in the number of search and rescue personal and ambulances. A wise and effective measure is to educate the communities and individuals for the pre- and post-disaster stages, and maintain their active participation in mitigation and preparedness activities (Tekeli-Yeşil 2007: 192–193). As megacities are seen as hotspots of risk,[12] special attention should be paid to them. By understanding their vulnerable aspects, it is important to determine and use the opportunities they provide.

As noted above (37.4, 37.4.1), in the near future an earthquake is expected in Istanbul with effects beyond those of the earthquakes in 1999. According to

12 See the press release on "Megacities – Mega Hot Spots", by the Institute for Environment and Human Security of the United Nations University in Bonn; at: <http://www.ehs.unu.edu/article:365>.

the conceptual framework (37.2), based on the cited studies, the risk of an earthquake in Istanbul is quite well known by the inhabitants and leads to a high risk perception and moderate awareness. If individuals personalize their actual risk, their high perception of risk can lead them to undertake activities to prepare better for this hazard; otherwise it is no guarantee for critical earthquake awareness or for further activities. But despite an increase in awareness, there is little progress towards taking action.

The studies presented above have shown that there is some awareness within the community but not enough to trigger protective practices. Even if there is little information on evaluation of costs and benefits of physical, and economic aspects of taking individual action; home-owners see more benefit in taking measures on mitigating damage. The expected amount of reduction in damage due to mitigation is also an important factor in this step. Even if the attitudes for mitigation and preparedness measures are optimistic; studies show that they do not necessarily lead to action. According to the framework, possible factors for the disruption between awareness and the following steps are the intervening personal, social, and environmental factors.

Findings from the studies mentioned above and from other studies conducted in other parts of Turkey (Dedeoğlu 2005: 273; Kasapoğlu/Ecevit 2001: 61–62) as well as studies from around the world (Larsson/Enander, 1997: 17; Chan 1995: 292; Lindell/Prater 2000: 327) indicate that socio-economic and educational levels play a significant role in individual preparedness, and are influencing almost all steps of the process.

Living in a high-risk area and experience with a high magnitude earthquake seem to be motivating intervening factors. Past experience of disasters can be a starting point for many people, especially when they have had direct experience, such as participating in rescue or solidarity activities after the event. The lack of trust in the construction sector and information sources is acting as a constraining factor in undertaking precautions. Due to the higher trust people have in scientists and university institutions, they can be seen as potential actors to transmit the appropriate messages of mitigation and preparedness programmes. Findings about group dynamics and positive effects of a building nearby that had been strengthened, indicate the role of social interaction, which can also be helpful in persuading people to adopt precautions. Fatalism does not seem to play as important a role in disaster preparation as might be expected, however, this issue needs further explanation (Tekeli Yeşil/Dedeoğlu/Tanner/Braun-Fahrlaender/Obrist 2008: 12).

Based on the reviewed literature (37.2), it can be assumed that there should be additional key factors instrumental for the gap between awareness and action among citizens of Istanbul. Except the location (living in a high-risk area) there is no information on environmental factors, such as suddenness of onset, normalization bias, poor predictability, etc. Personal beliefs and perceptions on the probable outcome, on counter measures and where the hazard is seen as controllable or not, are also important factors that influence the process of taking action. But there is limited information on such personal factors. Furthermore, there may be additional social factors, due to the specific characteristics of Istanbul or cultural phenomena in the community. These points need further investigation.

In conclusion, the involvement and active participation of individuals in any kind of mitigation and preparedness activities is vital for coping successfully with natural disasters. Preparations for reducing damage from hazards are extremely important for a better disaster management. Individual preparedness for earthquakes and hazards are, however, complex processes, which are determined by many social, economic, environmental, and personal factors. Therefore it is important for disaster managers to identify barriers and motivations particular to their communities in order to communicate the risk successfully.

Finally, risk reduction is a community-based activity which involves the participation, power sharing, legislation, organization, and development planning. These factors mean that not much preparation can be expected in poor, powerless, marginal societies (Dedeoğlu 2006: 129). Preparing for disasters cannot be left with individuals alone: it is the duty of governments to increase the resilience and coping mechanisms of the population. Thus, for cities to become safer, individual activities regarding earthquake preparedness or other hazards should be supported by and integrated into governmental, institutional, and communal preparedness. In this context, disaster risk reduction has to be seen as a political, economic, and social issue, since disasters can only be coped with effectively if disaster management is successfully integrated into social and economic development.

38 Risk Management Strategies for the Predicted Earthquake Hazard in Istanbul

Ebru A. Gencer

38.1 Introduction

Istanbul, the largest and the most populated city in Turkey, lies at the crossroad between Europe and Asia. This natural setting that has created the potency of Istanbul's urban environment is, however, also a characteristic that threatens it. Located in an active earthquake zone, Istanbul's history has been interrupted many times by earthquakes; and today, history may repeat itself as scientists predict that in the near future the city will experience a major earthquake.

This chapter examines risk management[1] strategies for coping with the predicted earthquake hazard[2] in the metropolitan city of Istanbul. The chapter starts by explaining research questions and methods (38.2), and examines Istanbul's current earthquake hazard exposure and risk[3] (38.3). The chapter then continues by exploring the city's earthquake risk coping strategies (38.4), in addition to bringing in the results of the author's empirical research in Istanbul's local municipalities, depicting disparities and vulnerabilities[4] in this metropolitan city (38.5).

38.2 Research Questions and Methodology

This chapter is based on the author's doctoral dissertation, which examines the interplay between natural disasters, vulnerability, and sustainable development (Gencer 2007). As part of a larger framework, this chapter builds on to investigate how the sustainability of an urban environment shapes its vulnerability and disaster risk management. This chapter is primarily concerned with understanding how much impact natural disasters have on disaster risk management, as well as investigating factors that influence the adoption and the implementation of disaster risk reduction strategies in urban areas.

This study is based on a combination of secondary data gathering, field, and survey research. Local data collection and consultations included research at the Istanbul Governorship Disaster Management Center, the Geotechnical and Earthquake Investigation Department of the Istanbul Metropolitan Municipality, at the Master Planning Office of the Istanbul Metropolitan Municipality, the Department of Earthquake Engineering at Boğaziçi University Kandilli Observatory, at the Center for Disaster Management at Boğaziçi University, the Istanbul Branch of the Turkish Chamber of City Planners, the Istanbul Branch of

1 This chapter uses definitions given by the UN/ISDR (2004: 2) on the terms of disaster risk management, hazard, risk and vulnerability. It refers to the contemporary framework of disaster risk management, which gives emphasis to the proactive strategies of disaster risk reduction defined by the UN/ISDR (2004: 2–3) as "the conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks through a society, to avoid (by prevention), or to limit (by mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development."

2 *Hazard* is an event, a condition, or a human activity, with a potential of causing a threat to people and to the physical environment, and that may result in a disaster. In most cases, its origin defines the hazard, such as natural or technological hazards (UN/ISDR (2004: 4–5).

3 *Risk* is the possibility of harmful consequences or expected losses resulting from interactions between natural or human-induced hazards and vulnerable conditions. In the field of hazard and disaster research, risk is commonly expressed as the product of hazard and vulnerability (UN/ISDR (2004: 6).

4 *Vulnerability* is the potential for loss (human, physical, economic, natural, or social) due to a hazardous event. It encompasses the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (UN/ISDR (2004: 7).

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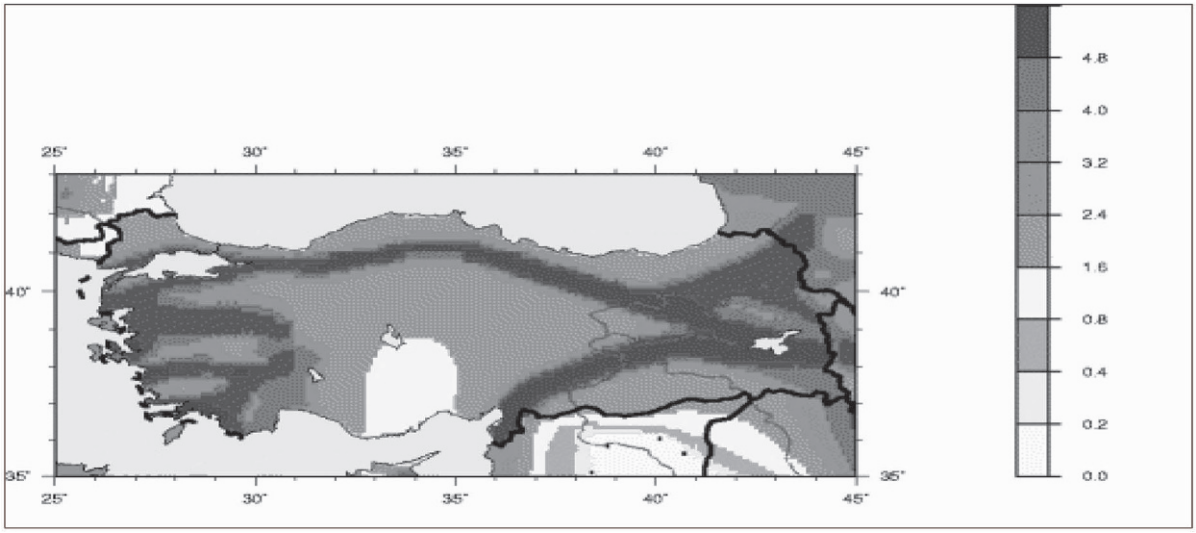
Figure 38.1: Seismic Hazard Map of Turkey: Peak Ground Acceleration (m/s^2) with 10 per cent Probability of Exceedance in 50 Years. **Source:** USGS, Earthquake Hazard Program; at: <http://earthquake.usgs.gov/regional/world/turkey/gshap.php>.



the State Institute of Statistics, and the Istanbul Branch of the Ministry of Public Works and Settlement.

Field and survey research activities included development of a survey questionnaire to facilitate qualitative interviewing about disaster risk reduction activities carried out at local districts in Istanbul. A field research focused on observation of the urban context, as well as conducting interviews and collecting data in district municipalities in the city.[5] Data collection and interviews at this stage included research at Kadıköy, Zeytinburnu, and Avcılar Municipality.

38.3 Earthquake Hazard and Risk in the Istanbul Metropolitan Area

Turkey's unique location between two continents and three major plates – African, Eurasian, and Arabian – has caused major seismic events over the centuries. As the African and the Arabian plates move north towards the Eurasian Plate, the minor Anatolian plate is caused to move westward, resulting in a *strike-slip fault,*[6] known as *The North Anatolian Fault*, which is similar in length and movement to the San Andreas Fault in California (BU 2002: 87). The North Anatolian Fault extends from the Eastern Anatolian Region of Turkey to the western edge of the country, passing through the Sea of Marmara. Istanbul's seismic risk results from its location along this sea, under which tectonic plates move on one of the most active geologic boundaries in the world.

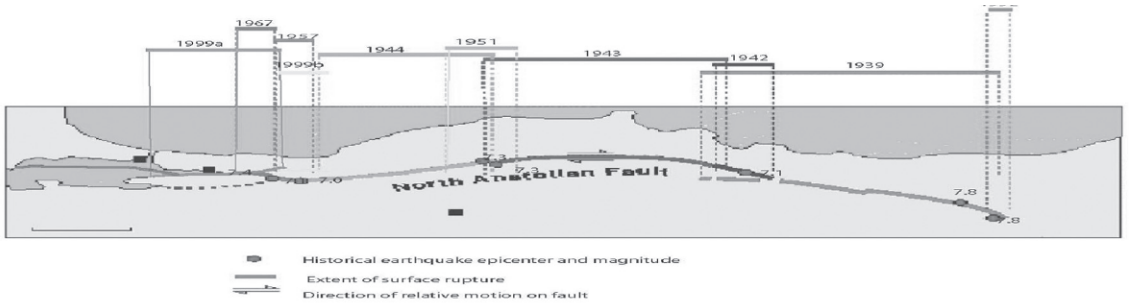
In recent years, an east-to-west progression of earthquakes along the North Anatolian Fault has increased Istanbul's earthquake risk. The first of the most recent major earthquakes, which are referred to as the Marmara earthquakes, occurred on 17 August 1999. The epicentre of the magnitude 7.4 earthquake was at Gölcük, south of Izmit, an industrial city that is located east of Istanbul. On 12 November 1999, a second earthquake with a magnitude 7.2 occurred in the region, near the town of Düzce.

The Marmara earthquakes were among the strongest earthquakes in Turkey, and they are considered to be the worst natural disaster in the Mediterranean region between 1975 and 2001 (Brauch 2003c). The losses from the two earthquakes were devastating: around 18,000 people lost their lives and 50,000 people were injured. In the two earthquakes, more than

5 Prior to the start of research, the author passed Columbia University's Human Subjects Protections Test and received a certificate for research. All interviews were conducted in a manner that respected federal regulations and responsibilities.

6 In strike-strip faults relative displacement of rocks is purely horizontal" (Bolt 2004: 357). In these faults, plates moving past each other horizontally lock together until tension builds to a release point. In the process, stress is released and placed on the neighbouring segments of the fault. These neighbouring segments are then more likely to rupture, resulting in progressive earthquakes along the fault (CU 2002: 123–124).

Figure 38.2: Historic Progression of Earthquakes on North Anatolian Fault. **Source:** Location of August 17, 1999 Turkish Earthquake; at: <http://www.usgs.gov>.



300,000 housing units and 46,000 business premises were damaged, and 320,000 people lost their jobs (Bibbee/Gonenc/Jacobs/Konvitz/Price 2000: 35). The extensive geographical area affected by the earthquake is considered "the industrial heartland of Turkey," with the most severely affected four cities (Kocaeli, Sakarya, Bolu and Yalova) contributing over 7 per cent of the country's GDP and 14 per cent of industrial value added at the time (Bibbee/Gonenc/Jacobs/Konvitz/Price 2000: 1). With the immediately surrounding cities of Bursa, Eskişehir, and Istanbul, the affected region had a share of 35 per cent of Turkey's GDP, stressing the risk of economic losses and significance of earthquake risk to Turkey's development. Direct and indirect economic losses from these two earthquakes were reported to be between five and twelve billion US dollars,[7] resulting in the world's highest relief cost between 1992 and 2003 (EQE 1999: 37). The immense damage of the Izmit earthquake pointed to the vulnerability of structures in Turkey. Post-earthquake inspections revealed that fault rupture, ground shaking, and soil liquefaction had caused structural damage that was intensified by poor construction quality.

Following the Marmara earthquake disasters and the heightened possibility of an earthquake in the Marmara Sea (due to the transfer of stress released by the Izmit earthquake), governmental, international, and academic organizations started working on depicting risk in the Istanbul metropolitan area. As an initial step, earthquake probability[8] calculations were performed for the Marmara fault. In 2000, Tom Parsons and his colleagues announced their calculations, and predicted the probability[9] of an earthquake of M. 7 or greater occurring near Istanbul within the next decade to be 32 +/-12 per cent, and in the next thirty years 62 +/-15 per cent (Parsons/ Toda/Stein/Barka/ Dieterich 2000: 1). Following this forecast, deterministic earthquake hazard assessments were undertaken in joint studies of the *Japan International Cooperation Agency* (JICA) and the *Istanbul Metropolitan Municipality* (IMM) (JICA/IMM/PCI/OYO 2002); and of the *American Red Cross* (ARC) and *Boğaziçi University* (BU 2002: 75). These studies concluded that the occurrence of a worst-case scenario earthquake with M 7.5 is considered "highly probable in the next 70 years" (Erdik/Siyahi/Şeşetyan/Demircioğlu/Akman 2003: 17). Following this diagnosis and the report of the newly founded National Earthquake Council, the Istanbul Metropolitan Municipality organized a consortium to provide risk assessment and vulnerability studies for an Earthquake Master Plan for Istanbul.

According to the site dependent deterministic intensity distribution maps presented in the *Istanbul Earthquake Master Plan* (BU/ITU/METU/YTU 2003), overall conditions lead to a likelihood of

7 The first number indicates the direct and the indirect losses that have been systematically compiled and reported to date in 2003 World Bank figures. The second numbers by OECD are suggested numbers reported by TUSIAD (Turkish Industrialist's and Businessmen's Association) as well as the numbers from Turkey's State Planning Organization (DPT).

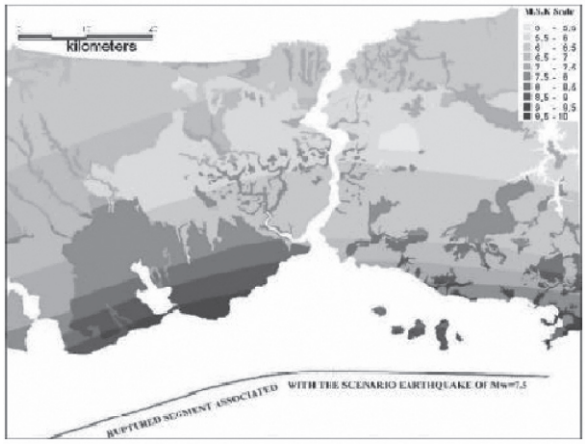
8 There are two main approaches that are used in assessing an earthquake hazard: probabilistic and deterministic methods. Susan Cutter (2001: 24) explains that "[t]he *probabilistic approach* attempts to describe the integrated effects from all possible faults at an individual site." *Deterministic approach*, on the other hand, specifies a magnitude or level of ground shaking mostly for a single fault. This approach commonly represents a "worst case scenario," or the maximum risk the location and its residents are exposed to (Cutter 2001: 24).

9 In 2004, Tom Parsons (2004) of the USGS reassessed the hazard with improved Marmara Sea faulting and a new historical earthquake catalogue and recalculated that the 30-year probability of an earthquake at Istanbul is 41+/- 14 per cent.

Figure 38.3: Collapsed buildings in the August 1999 Izmit earthquake **Source:** EERI; at: <http://www.eeri.org/lfe/turkey_kocaeli.html>.

Figure 38.4: Istanbul Space Image: Istanbul, Turkey: The Crossroads of Europe and Asia, 2004. **Source:** NASA; at: <http://veimages.gsfc.nasa.gov//16812/ISS008-E-21752_lrg.jpg>.

Figure 38.5: Distribution of intensities after a Mw=7.5 Earthquake. **Source**: Erdik, Durukal, Biro, Siyahi and Akman (2001).



strong ground motion on the southern part of Istanbul on the European side, along a portion of the coastline on the Asian side, and the Princes' Islands on the Marmara Sea. The northern areas of the city, due to their relatively large distance from the fault and more stable soils, are expected to have lower site-specific intensities resulting from the occurrence of a scenario earthquake (Erdik/Siyahi/Şeşetyan/Demircioğlu/Akman 2003). Unfortunately, the hazard exposed areas are also the areas where a large portion of Istanbul's development has taken place, which heightens the potential risk in the city.

Indeed, risk calculations performed for the predicted scenario earthquake present a bleak picture for Istanbul. As, due to deficiencies in design, quality of concrete as a construction material, and construction practices, the majority of the reinforced concrete building stock in Istanbul falls into an average vulnerability class C of the 1998 European Macro-Seismic Scale (EMS), intensity based vulnerability calculations for the Istanbul building inventory in 2000 expects more than 40,000 buildings (or about 5.5 per cent of the total building stock) to be damaged beyond repair, 77,000 thousand buildings (10.5 per cent) to be substantially-to-heavily damaged, and about 200,000

buildings (27 per cent) to be moderately damaged in a scenario earthquake (BU 2002: 243). Casualty calculations, based on both night and daytime population, and that were measured using HAZUS99[10] methodology and estimating a direct relationship between the structural damage and the number of casualties (Erdik/Siyahi/Şeşetyan/Demircioğlu/Akman 2003: 19), indicate that based on this building vulnerability, casualty levels in a scenario earthquake may vary between thirty to forty thousand people (BU 2002: 243). In addition to the potency of casualty, expected structural damages will also cause loss of settlement habitability. Analysis predicts about 600,000 households to be in need of shelters following a scenario earthquake in Istanbul, without adding the potential short-term needs of residents in moderately damaged houses (BU 2002: 213, 243).

In addition to buildings, other engineered urban structures, infrastructures, and lifelines are also vulnerable to the effects of earthquakes. Monetary losses from building damages in a worst-case scenario earthquake in Istanbul are estimated to be in the range of twelve billion US dollars (BU 2002: 243, 166). When secondary hazards, indirect economic losses, and social disruption are reflected in the damage assessment, broader dimensions of a scenario earthquake can be anticipated for the largest city in Turkey.

Furthermore, today, Istanbul's earthquake risk is enhanced by the socio-economic vulnerability of its population of over ten million inhabitants. The city is challenged by the volume and rate of internal migration flows. In addition to creating a big income divide, migration leads to illegal housing that is structurally unsafe, lacking in basic services, and located in hazardous areas prone to liquefaction and landslides. Indeed, in the 1990's, the rapidly growing migrant population had reached such levels that only 37 per cent of the population in Istanbul was born in the city (Sönmez 1996: 125). The new incoming populations are either unemployed, or working in temporary or low-skilled jobs and can not gain from Istanbul's economic progress. In fact, according to a survey of the State Institute of Statistics in 1994, in Istanbul, the top 20 per cent of the population with the highest income levels received 64 per cent of the total generated income in the city, whereas the bottom 20 per cent received only 4 per cent of it (Mortan 2000: 46). This polarization adds to the vulnerability of Istanbul's residents and stresses the need for a new risk management strategy.

38.4 Coping with the Hazard: Risk Management after the 1999 Marmara Earthquakes

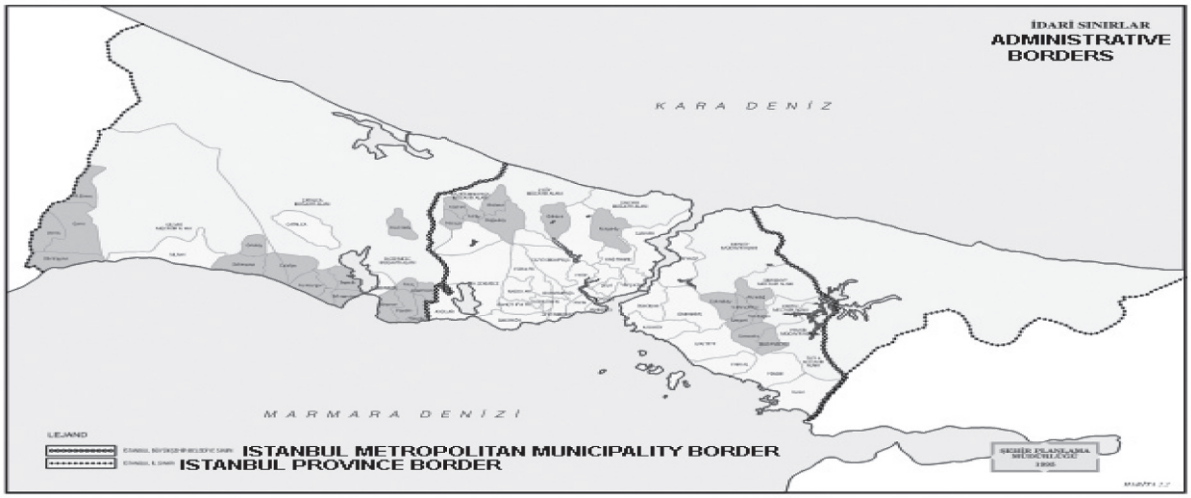
Following the two Marmara earthquakes, and the heightened possibility of a major earthquake in the Istanbul region, there has been a widespread acknowledgment of the significance of disaster preparedness in Turkey. This has been followed by a series of actions from international organizations, central and local governments, academic circles, and the public itself.

After the 1999 earthquakes two significant studies: *A Disaster Mitigation Basic Plan Including Seismic Microzonation* by JICA–IMM, and *Earthquake Risk Assessment of the Istanbul Metropolitan Area* by ARC–BU assessed the potential earthquake risk in Istanbul. Following these studies and the establishment of a *National Earthquake Council* and its *National Earthquake Strategy Report* in 2002, the Istanbul Metropolitan Municipality requested the preparation of the *Istanbul Earthquake Master Plan* (IEMP) by a consortium of four universities. This document laid the basis for identifying activities and responsible authorities, as well as preparing an action plan for disaster risk mitigation and management in Istanbul.

The current disaster management structure in Turkey has an abundance of central governmental agencies with a complicated arrangement of authorities. In addition, most of these organizations, as well as the laws and regulations related to disaster management, are focused on post-disaster actions rather than pre-disaster mitigation and preparedness. At the time of the 1999 earthquakes, the dominating laws on disasters were the 1958 *Law of Civil Defence* (7126 Sayılı Sivil Savunma Kanunu), and the 1959 *Law on Precautions and Aid Regarding all Types of Disasters that Impacts the Community* (7269 Sayılı Umumi Hayata Müessir Afetler Dolayısıyla Alınacak Tedbirlerle

10 HAZUS (Hazard US) is a loss estimation tool, developed by FEMA and the *National Institute for Building Sciences* (NIBS). This GIS-based loss estimation software has the capability of using both deterministic and probabilistic information. It uses four classes of information in order to calculate a probable maximum loss. These are: 1) Map-based analysis (e.g. potential ground shaking intensity); 2) Quantitative estimate of losses (e.g. direct recovery costs, casualties); 3) Functional losses (e.g. reconstruction of critical facilities); and 4) Extent of earthquake induced secondary hazards (e.g. distribution of fires, floods) (Cutter 2001: 29).

Figure 38.6: Istanbul Administration Map. **Source:** Istanbul Büyükşehir Belediyesi (IBB), 1995: *1/50.000 ölçekli İstanbul metropoliten alan alt bölge nazım plan raporu* [1/50,000 scaled Istanbul metropolitan area sub-region master plan report].

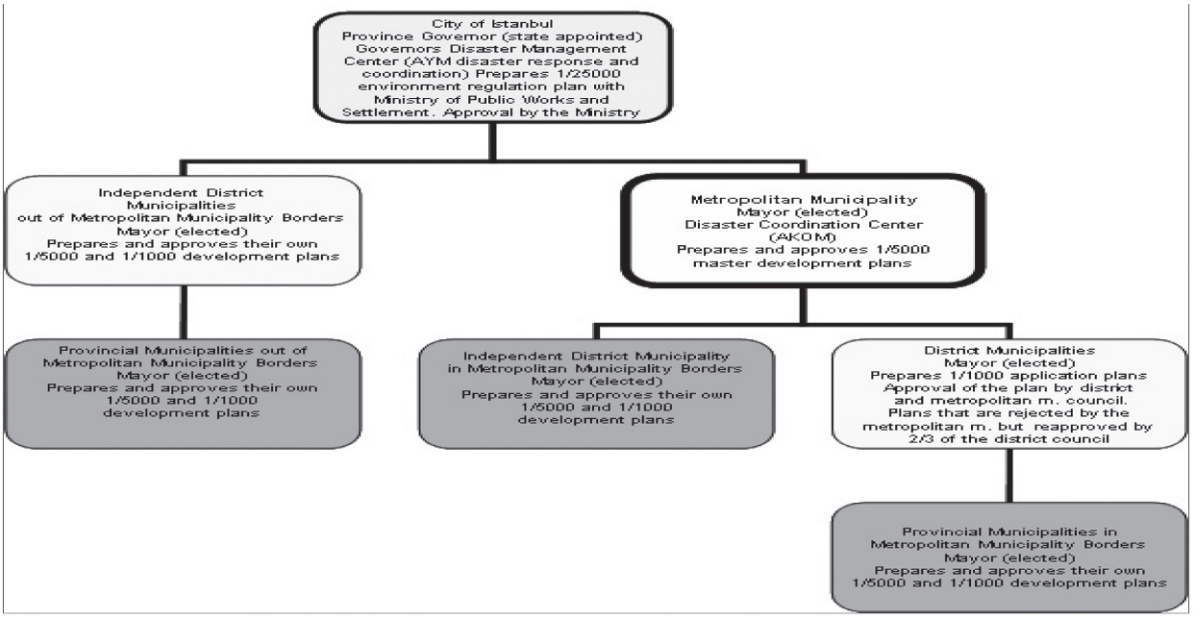


Yapılacak Yardımlara Dair Kanun). According to these laws, after the declaration of a disaster by the Ministry of Public Works and Settlements, authority is transferred to provincial and district governors, providing them with the "sole authority with powers of commanding all public and private and even military resources and means, property, all vehicles and manpower included" (Balamir 2001: 210). However, these laws contain only a few articles related to disaster preparedness and mitigation, such as those related to "dissemination of disaster related information to the general public," or "mandatory relocation of a whole neighbourhood because of eminent danger with the Council of Minister's decisions" (Kabasakal/Say/Inelmen/Yılmaz 2003: 220). The 1959 law and its by-law give authority to prepare and approve disaster area plans in district, provincial, and metropolitan municipalities to the Ministry of Public Works and Settlement, where a *General Directorate of Disaster Works* exists (Sağlam/Ökten/Şengezer/Dinçer/Demir/Koç/Gül/Evren/ Seçkin/Çekiç 2003: 420).

Immediately following the 1999 earthquakes, new revisions and decrees were added to the laws, and new agencies were established to support disaster management in Turkey. One of them is the *Directorate of Civil Defence* (Sivil Savunma Genel Müdürlüğü), under the Ministry of Internal Affairs and the Turkish Emergency Management Directorate (Türkiye Afet Yönetimi – TAY), responsible for organizing, training, and management of civil defence in disaster prone areas. In Istanbul, two disaster management agencies were established after the August 1999 earthquake. These are the *Governorship Disaster Management Centre* (Afet Yönetim Merkezi – AYM), and the *Metropolitan Municipality Disaster Coordination Centre* (Afet Koordinasyon Merkezi – AKOM). The Governorship Disaster Management Centre (AYM) aims to coordinate disaster management activities in the Province of Istanbul, and it is in the process of establishing district offices. Despite the fact that the provincial government has a higher authority in disaster management, it is financially more limited than the Metropolitan Municipality; therefore, it is in need of assistance by the central government, military, and other provinces. The Metropolitan Municipality Disaster Coordination Centre (AKOM) provides internal coordination between the organizations within the Metropolitan Municipality, and it does not have district offices. Both the Istanbul Metropolitan Municipality and the AKOM report to the Governorship on a monthly basis. This complicated disaster management structure of Istanbul is a result of its complicated administrative structure. Figure 38.6 explains the planning and disaster management authorities of the Province of Istanbul, the Metropolitan Municipality, and the District Municipalities, corresponding to Istanbul's administration map.

According to this complex administrative structure, at the time of the 1999 earthquakes, there were twenty-seven district municipalities, seventeen provincial municipalities, and one independent district municipality within the borders of the Istanbul Metropolitan Municipality. This situation created several problems both for the metropolitan municipality and

Figure 38.7: Istanbul Administration Chart. **Source:** Ebru Gencer, 2004: "Sustainable Planning for Disaster Mitigation in Istanbul", Paper presented at the ProVention Consortium Web Conference, World Bank Web Meetings, 2004.



the district municipalities located along the metropolitan city border, inhibiting the preparation of comprehensive plans, and giving full power to independent municipality districts.

An unprecedented change to this structure came in July 2004, as a special temporary decree was enacted for Istanbul and Izmit, enlarging the borders of the Istanbul Metropolitan Municipality to match that of the Province of Istanbul. With this decree, the four municipalities outside of the metropolitan municipality borders and the one independent district municipality within the borders of the metropolitan municipality were put under the authority of the Metropolitan Municipality (BB 2006).

This change in the administrative structure in Istanbul is one of several changes related to planning, urban administration, and risk mitigation that have been undertaken since 1999. Following the change in the administrative structure of Istanbul, a programme for a local administration reform has been undertaken by the central government, initiated in 2005 and supported by the UNDP and the European Commission. Simultaneous with the start of this programme, the World Bank provided a major loan for the development of the *Istanbul Seismic Risk Mitigation and Emergency Preparedness Project*, with the objective of improving the institutional and the technical capacity of the City of Istanbul for disaster management and emergency response, strengthening critical public facilities for earthquake resistance, and supporting measures for better enforcement of building codes and land use plans (World Bank 2005). Responsibility for the implementation of this project was given to a special unit established under the Governor's Office in Istanbul.

Meanwhile, as part of seismic assessment and rehabilitation projects, the Metropolitan Municipality of Istanbul followed up on micro-zoning projects of JICA, and prepared a 1/5000 scaled geological map of the area within the borders of the metropolitan city. Later, the Municipality initiated a pilot building assessment project in which trained civil engineers assessed buildings in one neighbourhood in Istanbul in order to provide specific measures, such as whether the buildings should be demolished, repaired, or strengthened in order to withstand a potential earthquake. This project was executed after the establishment of new regulations regarding construction practices. These regulations were the *Decree of Supervision of Construction Processes* (Yapı Denetimi Hakkında KHK) in April 2000, and the *Decree of Proficiency in Constructional Professions* (İnşaat Mesleklerinde Ehliyet KHK) in May 2000, both of which were transformed into the *Building Supervision Law* (Yapı Denetimi Kanunu) in July 2001 and the *Regulation on Structures to be Built in the Disaster Region* (Deprem Bölgelerinde Yapılacak Binalar Hakkında Yönetmelik) in March 2006.

According to these new regulations, building permits are to be signed by architects or civil engineers representing building control firms that have received government licenses. In addition, the Ministry of Reconstruction and Resettlement and the Ministry of Industry agreed to standardize building materials, and to 'discipline' those who do not obey the new standards with strong punishments[11].

In addition to regulations on construction practices, a *Decree on Compulsory Building Insurance* (Zorunlu Deprem Sigortası KHK) was introduced in December 1999. With this decree, the *Turkish Catastrophe Insurance Pool* (TCIP) was set up to implement compulsory earthquake insurance in Turkey. According to the 2004 World Bank reports, since the beginning of the programme, "insurance penetration for catastrophic coverage has more than tripled" in Turkey, making TCIP "the largest government insurance programme in the world, providing coverage to about 2 million Turkish homeowners (about 16 per cent of the eligible housing stock)" (Pusch 2004: 75). According to another report, "in Istanbul the programme achieved insurance penetration on the order of 30 per cent" (Gurenko/Lester/Mahul/Gonulal 2006: xiv). However, what these reports lack is the identification of residents who are able to purchase the obligatory insurance, as the author's study on district municipalities reveal, the number of residents purchasing insurance varies greatly depending on their socio-economic conditions.

A measure of the TCIP programme was to prohibit earthquake insurance eligibility of "buildings constructed after 27.12.1999 without any construction licence," in an attempt to support legal housing purchase in Turkey (TCIP: 4). For a similar reason, the government introduced a mortgage system, adding to the new housing credit systems issued by banks.[12] In both systems, the main idea is to provide earthquake-resistant and legal housing. However, the proposed mortgage system has contradictions with the newly issued construction laws, as it permits the eligibility of mortgage for housing at the project and construction level, which conflicts with the requirement of systematic control for building permits. Another consideration of the proposed law is that it does not impose a restriction on the age of buildings eligible for mortgage, even though new earthquake construction ordinances came into place only in 1999.

The mortgage law under discussion also provides funds for retrofitting. However, even though both the Municipality's pilot seismic rehabilitation project and other projects undertaken by academic circles have suggested the cost-effectiveness of retrofitting for the most common type of reinforced-concrete apartment structures in Istanbul (Smyth/Altay/Deodatis/ Erdik/ Franco/Gülkan/Kunreuther/Lu/Mete/Seeber/Yüzügüllü: 2004), there has not been a big interest in retrofitting from private home owners. This is partly because existing flat ownership laws require all residents to agree to building strengthening (Arpacı 2003). In addition, it is widely argued that retrofitting a single building will not be successful on lots with attached houses, or in lots where the required distance between buildings is insufficient, putting the risk of each building on its neighbour (Uyaroğlu 2005: 27). On the other hand, in a field survey measuring Turkish homeowner's willingness-to-pay for earthquake measures, it was found that "the role of group dynamics, trust and fairness" played a significant role in earthquake mitigation investment of Istanbul residents; and that the existence of a prior retrofitting of a neighbourhood building made a significant effect on neighbours (Öncüler 2002). Regardless of this analysis, instead of undergoing a retrofitting process, many Istanbul residents have taken steps either to relocate to newly built housing complexes in lower earthquake risk locations on the city outskirts, or to make arrangements with construction firms to demolish their existing buildings (which are usually not higher than six stories) and to rebuild taller ones, in exchange for new apartments.

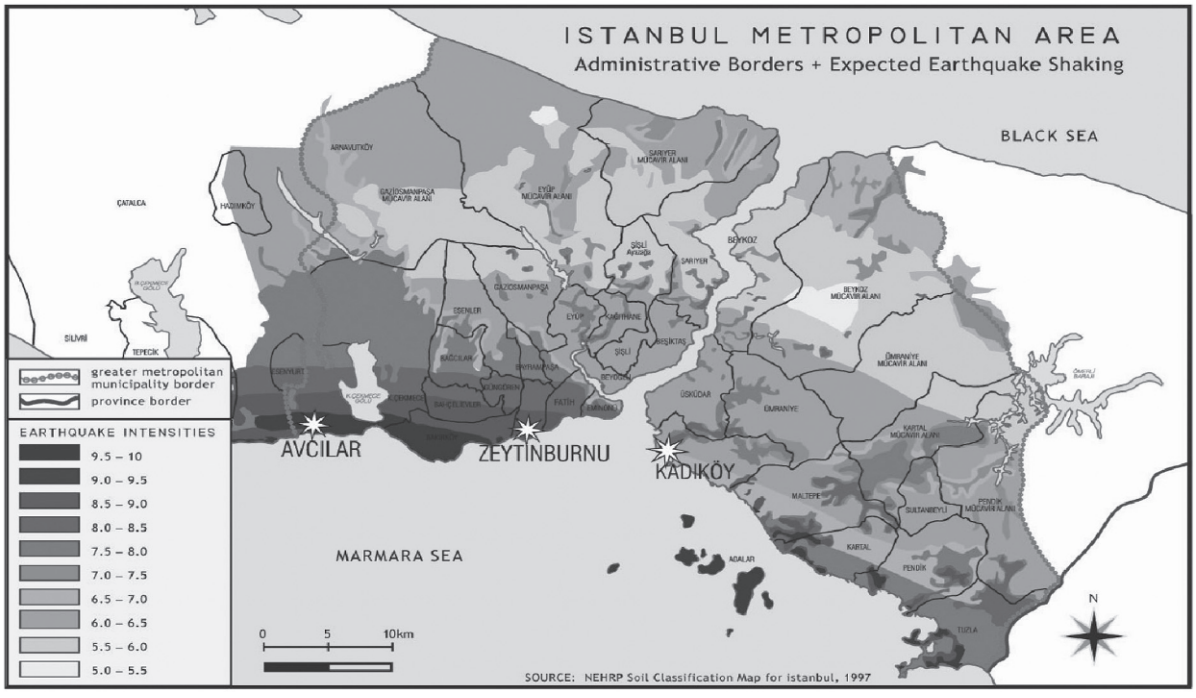
In 2001, another legal coping strategy regarding the predicted earthquake hazard was introduced by the Ministry of Reconstruction and Resettlement with a draft bill on *Development and Urbanization* (İmar ve Şehirleşme Kanun Tasarısı Taslağı). The bill brought a new terminology to the existing planning documents with the introduction of *Disaster Maps* (Afet Haritaları), which were defined as: "Maps that are prepared in different types and scales, and compose a whole with their reports as one of the data groups that lay basis to planning, and identify all disaster dangers that can occur in planning areas, and include preventions and proposals related to the reduction of disaster losses and risks" (TCBB 2005: Article 3). In identifying planning principles, the draft bill explained that "in order to reduce disasters, disaster maps and risk administration reports are to be taken

11 "Yapı sektörüne deprem düzenlemesi" [Earthquake codification to construction sector], in: Yapı (Istanbul), 2006, 294 (May): 17.

12 "Mortgage dosyası" [Mortage file], in: Arkitera; at: <http://www.arkitera.com, 3 November 2005>.

Figure 38.8: A new apartment building in Kalamış, Kadıköy, and a new complex in Beykoz. **Source:** The photos were taken by this author during 2003 and 2005.

Figure 38.9: Selected districts in project. **Source:** Author's adaptation of *Expected Earthquake Shaking Map of the Istanbul Metropolitan Area*, in: *International Urban Planning Studio: Disaster Resistant Istanbul*. Final Report (New York: Columbia University, Graduate School of Architecture, Planning and Preservation, Urban Planning Program). **Source**: NEHRP Soil Classification Map for Istanbul 1997.



as a principle in planning works" (TCBB 2005: Article 7).

However, even though the draft bill tried to incorporate disaster mitigation into the planning agenda, its language and complex definitions brought with it many criticisms by the *Turkish Chamber of Planners* (TMMOB SPO) and the *Istanbul Earthquake Master Plan* (IEMP) report team. Among many other reasons, the draft bill was criticized for not having conferred with the newly issued legislations, and for continuing to create a lack of public participation in the planning process (TMMOB SPO 2005; Sağlam/Öktен/Şengezer/Dinçer/Demir/Koç/Gül/Evren/Sekin/Çekiç 2003: 446–48).

38.5 Study on Risk Management at District Municipalities

This section introduces results of the author's research in district municipalities in Istanbul. The project aim was to investigate how the complex urban administration system in Istanbul influences disaster risk management, and to observe whether there are

Table 38.1: Selected demographic data of Istanbul and of the three project districts. **Sources:** Data from the State Institute of Statistics (SIS) Census Results (TCBDE 2002); IMM Statistics for Istanbul (BB); SIS News Bulletin (TCBDE 1997); Bekar 2002; Yapı 2006[a]; and IEMP (Gülersoy/Eyidoğan/Gülkan/Türkoğlu/Erkut/Tezer, 2003:119; Ökten/ Şengezer/ Dinçer/ Batuk/ Koç/Gül/Evren/Seçkin/Çekiç/Emem, 2003:276).

	Istanbul	Kadıköy	Zeytinburnu	Avcılar
Political Party (2004)	Governing Ak Party (Justice and Development) (Islamist-liberal)	CHP (Social Democrat and Kemalist) (Centre-left)	Ak Party	DSP (Social Democrat-populist left)
Population (2000)	10,000,000	~ 665,000	~ 245,000	~ 235,000
Annual Growth Rate	‰ 33	‰ 2	‰ 40	‰ 61
Population Density (p/km²)	192	16,625	20,416	6025
Rank of District GDP (1996)		3rd	6th	14th
Economy GDP (1996)	US$ 1158	US$ 3332	US$ 1855	US$ 1076
Municipality Budget (2006)	US$ 2,374,256,000	US$ 170,649,650	US$ 72,598,812	US$ 54,209,458
Unemployment Rate	% 12.7	% 6	% 6.8	% 7.4
Higher Education Rate	% 11	% 23	% 4	% 7
Rate of Insurance Purchase (2002)	% 38	% 64	% 31	% 49
Number of Buildings	757,127	38,935	15,416	13,861
Rate of Projected Heavy Damage to Number of Buildings (JICA)	% 7.7	%4.16	% 13.22	% 14.08

a) "İstanbul'un bütçesi 10 katrilyon lira." [Istanbul's budget is 10 quadrillion liras], in: *Yapı* (Istanbul) (January 2006) 290: 9.

disparities in the way the expected earthquake risk is managed in local districts. Three district municipalities – Kadıköy, Zeytinburnu, and Avcılar – within the borders of the Istanbul Metropolitan Municipality were selected for the purpose of this investigation, based on their proximity to the earthquake zone and differences in their socio-economic structures. In the selected municipalities, interviews were made to address an open-ended questionnaire comprised of twenty-six questions related to each municipality's and district residents' actions on disaster risk management.

38.5.1 Kadıköy

> "Even in such a sensitive municipality, we are also a unit under the department of the environment. The institutions do not have any law, and they are not up-to-date about this matter." M. Bilgin (Disaster Management Project) [Author's translation].

Project interviews revealed that Kadıköy[13] municipality was the most departmentalized municipality among the three project locations. Officials from several departments including the Static Bureau, Building Control Office and Planning Office, Ground and Concrete Test Laboratory, Disaster Management Project, Geographic Information Systems Office, Mapping Bureau, and Directorate of Accounting were interviewed for the project.

All interviews in the Kadıköy municipality indicated a clear awareness of the potential earthquake hazard, and significance given to the earthquake, despite the fact that the building stock in Kadıköy is estimated to be one of the least vulnerable in Istanbul. The Kadıköy municipality performed several new activities since the 1999 Izmit earthquake. It executed geological studies for the entire district after the 1999 Marmara earthquakes, according to the notice of the Directorate of Disaster Works in the Ministry of Development that demanded geological studies to prepare or to make changes in development plans in the 19 earthquake-prone cities in Turkey. At the time of the interviews in 2004, the municipality was waiting for the approval of these studies by the central government in order to continue with land-use planning. The Kadıköy Municipality had also prepared a Disaster Emergency Plan in which existing open spaces are proposed to be used for emergency and shelter. After the 1999 earthquake, the municipality established a concrete testing centre and a laboratory. Concrete studies have been performed as requested by Kadıköy's residents, and the highest number of requests was claimed by residents who live in alluvial

13 The district of Kadıköy has the highest GDP per capita of the three locations. It also has the highest education rates and lowest annual growth rate among the three districts.

Figure 38.10: Views from project districts: A 'gecekondu' (squatter housing) in Zeytinburnu, bracing (supporting structures with a wood member) in Kadıköy, and a building in Avcılar. **Source:** The photos were taken by the author in 2004.

soil along the Fenerbahçe canal. In addition to these requests, the Kadıköy Municipality plans to warn building owners, who live in other unsafe locations.

Soil studies are required to receive construction licences for new buildings. In addition, new building codes require the use of higher concrete levels (C20) in first degree earthquake areas**.** The Directorate of Development in the Kadıköy Municipality tracks the number of people who get construction permits; on the other hand they are also aware of those who build without getting permits as well. According to the Directorate of Research, Planning and Coordination, no requests for soil and concrete studies were received from informal settlement areas with low cultural education levels.

By 2002, about three years after the establishment of the compulsory earthquake insurance, 64 per cent of the residences in Kadıköy had joined the programme, accounting for the highest level of insured building stock in Istanbul. According to the office of Disaster Management, insurance purchase levels are low in neighbourhoods with low socio-cultural levels.

The Kadıköy Municipality has initiated a new project with the Chamber of Civil Engineers and Architects to train and give certificates to assistant contractors and foremen, with the future goal of not giving work permits to those without certificates. Another new development in this Municipality was the establishment of a Disaster Management Project Office, which educates volunteers through a project developed by the Kandilli Observatory and UNDP. The Municipality has also established a *Neighbourhood Disaster Volunteers Programme* that created a voluntary organization in twenty-eight neighbourhoods, to train and educate residents. The municipality directors are also sensitive to the education of their own staff, acquiring mostly those with either college or graduate degrees.

38.5.2 Zeytinburnu

> "The problem is that the damaged buildings are without construction licenses and are at odds with development plans. Out of 15,000 buildings, 2,000 of them were built illegally after 1980 amnesty laws. There are an additional 2,000 buildings that were pardoned by amnesty laws."
>
> B. Yıldırım (Civil Engineer) [Author's translation]

Interviews in the Zeytinburnu[14] Municipality revealed a different picture than that of Kadıköy. Zeytinburnu was selected for a pilot reconstruction project by the Metropolitan Municipality of Istanbul. This entailed all buildings in the neighbourhood to be examined at a sidewalk survey by trained engineers, and to be determined whether these buildings should be demolished, retrofitted, or have a change of use. As a result of this project, educational offices were opened in order to provide information to residents. However, the level of mitigation works that were executed prior to this pilot project was inadequate. After the 1999 earthquake, the municipality visited two thousand buildings and presented them with a brochure describing necessary steps to be taken in case of having received damages to their buildings. According to this brochure that was distributed in Zeytinburnu, moderately damaged buildings (with structural damage in beams) were to be strengthened by a specific time; otherwise they would be reconsidered as highly damaged buildings and demolished. However, this period is ex-

14 Zeytinburnu, the first squatter district of Istanbul has the highest density and lowest education rates of the three districts.

tended each year; and at the time of the interviews it was extended to the end of 2004.

According to the director of the building control office, most buildings suffered from steel corrosion and several building owners have implemented strengthening activities on their own. Despite this information, the municipality had no control over these buildings, as most of them were either squatter developments or did not have building permits. In addition, there was strong opposition to the input of the municipality from those who benefited from illegal construction, an opposition that came in the form of attacks to the municipality personnel. Only a small portion of Zeytinburnu residents requested soil studies after the earthquake and only 30 per cent of residences had purchased the compulsory earthquake insurance.

At the time of the 1999 earthquakes, Zeytinburnu Municipality had existing development plans that were prepared without geological studies. After the notice of the Ministry of Development, geological plans were prepared by Istanbul University, due to the lack of technical staff. These plans were superimposed on existing development plans. According to the final approved plans, no relocation was advised, however new zoning rules required the lowering of building heights in earthquake damaged areas. Even though, the Metropolitan Municipality's pilot project aimed at defining the type of transformative work on buildings suggest retrofitting at times, staff at Zeytinburnu Municipality oppose the idea of retrofitting, with the argument that it is expensive and that it can only change building static with 10 per cent improvement. The municipality personnel declare their priority to urban transformation, which can alter the appearance and economics of their district at large.

38.5.3 Avcılar

> There is a confusion of authority. Everybody considers the event from his/her point of view. This view brings distress to the project as well as consumption of time and efforts.
>
> S. Yalçınkaya, Chief Urban Planner [Author's translation]

After experiencing the heaviest destruction in Istanbul from the 1999 earthquake, Avcılar's[15] municipality has made significant changes to its urban planning activities. These changes are generally related to height restriction of buildings and to changes in land use, where settlement is not found suitable after geological studies. In addition, development plans for areas susceptible to landslides are now subject to the approval of the Ministry of Development's Disaster Management Office. Organizational change after the 1999 earthquake took place in the Directorate of Development and Planning, which is in charge of both planning and building control works. Expropriation works could not be easily undertaken due to limited financial resources and long duration of the planning phase. In such instances, planners propose a no-development zone. In upper-scaled plans, there is confusion about authority arising from politics involving the Metropolitan Municipality and the Ministries in charge of environment and development. In addition, the unresolved regional issues due to its location along the borderline of the metropolitan municipality, and neighbouring the independent municipality of Büyükçekmece and the provincial municipality of Esenyurt cause a chaotic situation in planning and earthquake preparedness in Avcılar.

In addition to these problems, Avcılar's municipality suffers from not having an adequate budget for risk management. There was no proper funding for residents that had endured the Izmit earthquake. Financial loans provided by the Ministry of Development were not sufficient enough for retrofitting of damaged buildings. Additionally, as the Ministry of Settlement was not responsible for identifying damages to industrial buildings, many business owners who had suffered from the 1999 earthquake or its indirect losses could not receive financial aid, thus leaving the district in a more vulnerable situation. But despite economic distress, all moderately damaged buildings have been retrofitted under the inspection of the Avcılar Municipality, and 49 per cent of Avcılar residences had purchased compulsory insurance by 2002.

38.5.4 Remark on the Result from Interviews

The interviews that were conducted at only three pilot project locations cannot sufficiently explain whether socio-cultural factors significantly influence the level of risk management activities in these districts in Istanbul. On the other hand, this investigation has exposed differences in levels in actions and strategies. A striking difference seems to arise from the organization of municipalities in these districts, and particularly from their budgetary allocations. In Turkey, the largest part of municipal budgets consists of income from taxes. In this case, it may be expected

15 The district of Avcılar has the highest annual growth rate of the three districts despite its poor soil conditions. It also has the lowest economic level of the three.

that municipalities with low income communities lack adequate income for acquiring experienced and specialized staff, and engage in risk management. In addition, the lacking authority or at times political calculations of local administrations prevent them from opposing and providing sustainable solutions to illegal constructions and settlements arising from migratory practices, leading to vulnerable communities.

38.6 Conclusion

This chapter examined risk management strategies in the earthquake prone city of Istanbul. After examining the hazard and risk profile of Istanbul, this study illustrated post-earthquake risk management in the city after the two Marmara earthquakes in August and November of 1999.

Both the local and the national government have taken many steps after the 1999 earthquake disasters to prepare for and to minimize the impact regarding an expected earthquake in Istanbul. Among them are the preparation of the comprehensive *Istanbul Earthquake Master Plan* (IEMP), the establishment of regulations that increase building construction quality, the imposition of construction control, and required mandatory earthquake insurance. On the other hand, investigations indicate challenges in the implementation of such risk management strategies in the current socio-economic and administrative circumstances of the polarized city, in which most residents neither have the means to upgrade, move, or insure in order to protect themselves. In addition to self-managed coping strategies, low-income groups have also been at a disadvantage from a complex urban administration system which has not provided a common public policy, and in which disparities have been witnessed in actions of risk reduction.

For a sustainable risk management in the metropolitan city of Istanbul, the ongoing legal reforms should provide a better administrative and planning system, where responsibilities are enhanced and clarified, decreasing confusion of authority by multiple agencies. They should be supported with a better financial model for local governments that will improve the current outdated budgetary system and help them with technical capacities to implement planning and development activities. Furthermore, for the success of risk management actions and policies in dynamic urban environments such as Istanbul, there should be a stronger ground for public participation, keeping in mind that there is no one solution to risk management, but that the larger framework should be tailored according to varying socio-economic and physical environments.

39 Urban Vulnerability to Climate Change and Natural Hazards in Nigeria

Adeniyi Sulaiman Gbadegesin, Felix Bayode Olorunfemi and Usman Adebimpe Raheem

39.1 Introduction[1]

Climate change and global warming have attained global dimensions with the recurrent discussions at the *United Nations* (UN) and in other international meetings. Global climate change, driven largely by anthropogenic activities, is a growing threat to human well-being in developing and industrialized nations alike. Significant harm from climate change is already occurring, and further damages are likely (Gwary 2008; Barnett/Adger 2007; CHGE 2005; IPCC 2001a). Extreme weather events resulting in hurricanes, windstorms, tornadoes, droughts, fires, floods and other weather-related hazards account for a large proportion of the increased losses from natural disasters over the last decades. More alarming even than the size of past losses is the trend for losses to increase. More than 1.5 million people died in the past two decades because of extreme climatic events, and more than ninety per cent of those deaths have occurred in developing countries (IFRC-RCS 2002; Munich Re 2003).

The devastating climate change impacts on life and property are most visible in urban centres where complex problems with the frequent breakdowns in services and a general lack of policy, programmes or funding exist. Indeed cities can be seen as crucibles of hazards that, without good management, generate extreme situations of vulnerability[2] and risk[3] for very large populations. In developing nations the problems are commonly associated with rapid growth, social inequalities, volatile flows of corporate investment, demographic change and environmental neglect. Natural disasters simply exacerbate existing social, physical and economic problems (Srinivashari 2007; Clarke/Munasinghe 1995).

The impacts of climate change will vary across cities as well as among households and sectors within cities. In this regard, scholars and practitioners concerned with urban development argue for the need to focus on the poor as they are more vulnerable due to their lack of access to infrastructure and their relative inability to hedge against risks (Mehrotra/Claudia/Natenzon/Omojola/Folorunsho/Rosenzweig/Rosenzweig 2009). UN Habitat (2008a, 2008b), the United Nations' agency for human settlements, as well as the International Institute for Environment and Development (Satterthwaite/Huq/Pelling/Reid/Romero Lankao 2007), among others, have articulated the need to focus attention on developing country cities due to several interrelated factors. Half the world's

1 Keywords: climate change, urban vulnerability, disasters, risk, Nigeria.

2 The term vulnerability has taken on a new and increased importance due to the greater scale of disasters. In general terms, it may be defined as the probability of a community exposed to a natural threat, given the degree of fragility of its elements (infrastructure, housing, productive activities, degree of organization, warning systems, political and institutional development), suffering human and material damages. The magnitude of such damage is, in turn related to the degree of vulnerability. According to Moor (2001: 1) cities as the most complex of human creations are more at great risk from their own multiple vulnerabilities. Points of urban vulnerabilities include their infrastructure systems, factories, telecommunications, transport, energy, food supplies, schools, offices etc.

3 Risk is defined as the probability of harmful consequences (ISDR 2002a), or expected losses (lives lost, persons injured, damage to property and/or the environment, livelihoods lost, disruption of economic activity or social systems) due to the interaction between humans, hazards and vulnerable conditions. Risk is therefore the possibility that a particular hazard might exploit a particular vulnerability (Nierkerk 2002: 4).

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population is urban, and cities, which are the engines of economic growth, are extremely vulnerable to climate change. This is particularly so in developing countries as most coastal mega cities are located there and are home to rapidly growing population centres of the world (UN Habitat 2008a). The challenge posed by climate change for African cities is particularly alarming (UN Habitat 2008b).

According to Hardy and Pandiella (2009), the lack of attention to the risks faced by large sections of the urban population from extreme weather events puts many people at risk from the likely impacts of climate change, including storms, flooding, landslides, heat waves and drought, and overloaded water, drainage and energy supply systems. High levels of risk are particularly evident for those who want to inhabit dangerous sites and lack the resources and options to modify their vulnerability.

Indeed, the existing vulnerability and present and predicted climate change impacts on urban areas are particularly worrisome. According to Satterthwaite, Huq, Pelling, Reid and Romero Lankao (2007), the scale of devastation for urban populations and economies caused by extreme weather events documents these vulnerabilities. Worldwide, the number of people killed or seriously impacted by storms and floods rose rapidly as did the economic damage caused. A significant proportion of these impacts are in urban areas of low- and middle-income nations. Climate change has contributed to these hazards[4] and gives an apt description of the vulnerability of the urban populations to storms and floods whose frequency and intensity is likely to increase. It will cause other less dramatic stresses, such as heat waves and, for many urban areas, reductions in freshwater availability and sea-level rise for all coastal cities. Climate change provides an additional threat that adds to, interacts with, and can reinforce existing risks, placing additional strains on the livelihoods and coping strategies of the urban poor (IPCC 2001a).

The capacity to cope with climate variability and extreme weather events highly depends on the level of economic development. Livelihood sources of the poor are usually more climate-sensitive than those of the non-poor. Henderson (2004) revealed that this level of risk and vulnerability in urban areas of developing countries is attributable to socio-economic stress, aging and inadequate physical infrastructure. Most low-income urban dwellers face serious constraints in any possibility of moving to less dangerous sites, because of their need to be close to income-earning opportunities and due to lacking alternative, well-located, safer places.

A closer analysis of what transforms a natural event into a human and economic disaster[5] reveals that the fundamental problems of development that Nigeria, just as other developing countries, face are the same problems that contribute to its vulnerability to the catastrophic effects of natural hazards. The principal causes of vulnerability in developing countries include rapid and uncontrolled urbanization, widespread urban and rural poverty, degradation of the environment resulting from the mismanagement of natural resources, weak socio-economic infrastructure and inefficient public policies (Olorunfemi/Raheem 2006–2007; Olokesusi 2004).

Nigeria is particularly vulnerable to climate change impacts due to its geography, climate, vegetation, soils, economic structure, population and settlement,

4 A hazard as used in this context can be defined as a potentially damaging physical event, a phenomenon or human activity which may cause the loss or life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include hidden conditions that may represent future threats and can have different origins. These include natural (geological, hydro meteorological and biological) and/or induced by human processes (environmental degradation and technological hazards) (ISDR 2002a: 24).

5 Disaster refers to an emergency caused by natural hazards or human-induced actions and resulting in a significant change in circumstances over a relatively short time period. A broad definition of disasters include *the fact that they are* dramatic, sudden, unscheduled events that are often accompanied by losses of human life, suffering and affliction to a society or a significant part of it, and a temporary breakdown of prevailing lifelines and systems. Such events cause considerable material damages and interrupt the normal functioning of an economy and of society in general (other types of natural events, such as droughts, take a long time to develop into a major disaster and may cause devastating effects in society as well) (Otero/Zapata Marti 1995). The intensity of disaster often represents the intersection of human and natural disaster. Conditions of poverty, poor housing, a lack of information about disaster risk, poor telecommunications, and inadequate physical infrastructures frequently exacerbate natural disasters such as floods. Although every nation is generally aware of their propensity for various kinds of human and natural disaster scenarios, their occurrence and consequences are often sudden, random and not well predicted. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk (ISDR 2002a: 25).

Figure 39.1: Map of Nigeria. **Source:** <http://www.ciaonet.org/atlas/NG/map.html>. Permission to reproduce is needed

energy demands and agricultural activities. The location and size of, and the characteristic relief in Nigeria give rise to a variety of climates ranging from tropical maritime climate characterized by the rainforest along the coastal and southern part to the tropical hinterland climate associated with the Sahel in the north eastern part of the country. Nigeria has a population of about 140 million impacting on the physical environment through their various activities within an area of 923,000 square kilometres. Sixty per cent of the people live directly on the natural resource base as farmers, cattle rearers and fishermen while the informal sector constitutes the bulk of the urban population's economic activities. The technology adopted is rudimentary leading to low output and high levels of poverty.

Successful national economies depend on well-functioning and resilient urban centres. It is therefore crucial to secure the cities of Nigeria against vulnerability to climatic changes for them to become catalytic to national development goals. For most prosperous and well-governed cities, adaptation to the likely risks from climate change for the next few decades does not appear problematic. This has to do with adapting buildings and infrastructure to increasing risks; working with population groups and settlements most at risk to find solutions that serve them; and adequate disaster preparedness. In Nigeria, like other developing countries, one cannot adapt lacking infrastructure because the vulnerability of low-income urban dwellers to climate change is often ascribed to their poverty – but it is far more the result of failures and/or limitations in local governance to ensure that needed infrastructure is in place (figure 39.1).

Using a combination of secondary data gathering, field, and survey research, this chapter examines disaster risks in Nigerian cities, the major causes and patterns of the high vulnerability of these cities and the national framework for disaster management and funding. In line with a similar study by Gencer (2007, chap. 38) in Istanbul, it argues that a combination of urban poverty, unsustainable planning and development practices, and substandard urban management systems work together to add to the risk in these cit-

ies. The discussions in this chapter are based on the existing literature on the functional interrelationships between hazards, vulnerability and risk, and it links and extends the discussion to engage an understanding of disasters in Nigerian cities. It is revealed that the frequent disasters in which lives and livelihoods are destroyed are becoming a source of conflicts especially due to a perceived government inability to effectively address mitigation issues.

The chapter is divided into six sections. The next section (39.2) examines the phenomenal urban growth and development in Nigeria, then major causes of urban vulnerability are discussed (39.3) and the types and patterns of disasters in Nigeria are analysed (39.4). This is followed by a discussion of the institutional framework and funding mechanisms for disaster management (39.5). Finally, issues and challenges in disaster risk and urban management in Nigeria are discussed (39.6) while the last section (39.7) provides major conclusions.

39.2 Urban Growth and Development in Nigeria

Nigeria is a classic case of rapid urban population growth in Africa (table 39.1). Lagos, for example, has one of the fastest growth rates in the third world – between 5 and 8 per cent per annum, and so has become one of the 15 largest agglomerations in the third world. According to UN data (UN Habitat 2003), Lagos is expected to be the third most populous city in the world by 2015. The sheer magnitude of urban problems in Nigerian towns and cities and their seeming intractability have brought to the fore the very important issue of how to plan and manage these cities to make them liveable and sustainable.

As table 39.1 shows, the urban population in Nigeria is high and growing. For instance, the 10.2 per cent urban population in 1950 soared to 42.5 per cent in 2000 and may reach about 50 per cent in 2010. Indeed beginning from 2010, more than half of the Nigerian population will reside in cities of various sizes and the proportion may reach an unprecedented 75.4 per cent by 2050. The inevitable consequence is the fact that while cities were an exception in the ancient world of pre-industrial times, the reverse is rapidly becoming the case particularly since the industrial revolution (Ojo 1990).

Given this phenomenal growth in city size and population, and the attendant environmental management challenges, it is clear that most cities are fast exceeding their carrying capacities. Unfortunately, humanity, as at present, lacks the technology of detecting the critical point when this occurs.

Table 39.1: Total population of Nigeria in 1,000; development and projection of the percentage of urban population in Nigeria; urban population (1950-2050). **Source:** PD, UNDESA [Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat], 2007: *World Population Prospects: The 2006 Revision*; PD, UN DESA, 2008: *World Urbanization Prospects: The 2007 Revision*; at: <http://esa.un.org/unup> (13 August 2009).

Year	Total population	Percentage urban	Urban population
1950	33 960	10.2	3 468
1955	37 850	12.3	4 638
1960	42 356	16.2	6 845
1965	47 611	20.1	9 574
1970	53 764	22.7	12 208
1975	61 163	25.5	15 616
1980	71 065	28.6	20 311
1985	81 598	31.8	25 979
1990	94 454	35.3	33 325
1995	109 010	38.9	42 372
2000	124 773	42.8	53 048
2005	141 356	46.2	65 270
2010	158 313	49.8	78 845
2015	175 715	53.4	93 767
2020	193 099	56.8	109 772
2025	210 129	60.3	126 634
2030	226 855	63.6	144 246
2035	243 274	66.8	162 461
2040	259 233	69.8	181 022
2045	274 462	72.7	199 568
2050	288 696	75.4	217 726

Table 39.2 documents the proportion of cities with a population greater than 750,000 in 2007. The table shows that there are eleven Nigerian cities in this category. Lagos which consistently has the highest population since independence is also the third largest city in the world. It is important to note that its enormous population is located on the Atlantic Coast with attendant slum and informal settlement development. Thus many human homes are constructed on

Table 39.2: Population of the urban agglomerations with 750,000 inhabitants or more in 2007 (thousands) 1950-2025. **Source**: PD, UNDESA (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat), 2007: *World Population Prospects: the 2006 Revision*; PD, UNDESA, 2008: *World Urbanization Prospects: the 2007 Revision*; at: <http://esa.un.org/unup> (13 August 2009).

City	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2007	2010	2015	2020	2025
Abuja	18	21	23	29	48	77	125	204	330	526	832	1 315	1 576	1 994	2 558	2 971	3 358
Benin City	46	62	83	113	163	233	335	480	689	845	975	1 124	1 190	1 302	1 520	1 755	1 991
Ibadan	422	493	570	668	809	980	1 186	1 436	1 739	1 993	2 236	2 509	2 628	2 835	3 270	3 752	4 234
Ilorin	107	143	179	222	268	323	389	457	515	580	653	735	771	835	970	1 123	1 277
Kaduna	33	53	99	173	266	408	628	853	961	1 083	1 220	1 375	1 442	1 560	1 807	2 083	2 360
Kano	115	157	229	343	542	855	1 350	1 861	2 095	2 360	2 658	2 993	3 140	3 393	3 914	4 487	5 056
Lagos	305	468	762	1 135	1 414	1 890	2 572	3 500	4 764	5 966	7 233	8 767	9 466	10 572	12 403	14 134	15 796
Maiduguri	47	68	105	156	216	300	416	531	598	673	758	854	896	969	1 125	1 301	1 479
Ogbomosho	124	169	247	333	378	428	485	549	622	704	798	904	951	1 031	1 199	1 386	1 575
Port Harcourt	56	88	135	198	266	358	482	604	680	766	863	972	1 020	1 104	1 280	1 479	1 680
Zaria	47	70	117	182	241	320	423	525	592	667	752	847	889	963	1 118	1 293	1 470

marginal lands ñ parcels of land that are liable to flooding, erosion or slides. An important feature of Nigerian cities is their spatial distribution. Seven out of the eleven are located in the inland while only four are coastal cities. This is contrary to the notion that urban agglomerations are confined to the coasts of oceans and seas. In Nigeria, a significant proportion of cities are located in the hinterland. Thus, urban disasters are not confined to the coast but a widespread phenomenon with profound impacts on some cities located several kilometres off the Atlantic Coast.

The problems of urbanization in Nigeria are summed up in the prologue to the 2006 *National Urban Development Policy* (NUDP) according to which:

> the problems and challenges posed by the rapid rate of uncontrolled and unplanned urban growth are immense. Nigerian towns are growing without adequate planning. Millions of people live in sub-standard and sub-human environments plagued by slum, squalor and grossly inadequate social amenities. The result is manifested in growing overcrowding in homes and increasing pressure on infrastructural facilities and rapidly deteriorating environment. Low level of awareness on the part of the people, absence of effective advocacy and inappropriate programmes of development has further compounded the problems of urban growth and development (FMHUD 2006).

From the foregoing, rapid and uncontrolled urban growth and its associated problems have continued to overwhelm and outstrip the capacity of successive governments in Nigeria to tackle them, thus resulting in a situation where the supply, expansion and maintenance of services, utilities and physical infrastructure were terribly affected. Today's urban environment in Nigeria is at best described as unsustainable. This situation poses a serious challenge not only to urban administrators and planners, but also other professionals as well as urban residents in Nigeria.

The vast majority of the population in Nigeria, approximately 64 per cent, lived in rural areas, but the urban population is growing rapidly and has increased significantly from 19 per cent in 1963 to 36 per cent in 1991 (NPC 1998) and 46.2 per cent in 2005 (table 39.1). The most urbanized states in Nigeria are Lagos (93.7 per cent), Oyo (69.3 per cent), and Anambra (61.9 per cent) while the least urbanized are Jigawa (6.9 per cent), Taraba (10.4 per cent), Akwa Ibom (12.1 per cent) and Kebbi (12.4 per cent). The Southwest is the most urbanized region (table 39.3), with 20 per cent of Nigeria's 329 urban centres (with populations of over 20,000) located in the region (NPC 1998).

Due to a high rate of rural-urban migration, the overall population growth rate for Nigerian urban centres in 1991 was 4.5 per cent per annum compared to a rural growth rate of 1.70 per cent and a national rate of 2.8 per cent. Lagos, the commercial and industrial capital of Nigeria, with a projected population of 15.8 million, is projected to be the 12th most populous city in the world by 2015 (UN 2008: 10). The implications of these demographic trends for employment, the provision of food, housing and social services as well as the protection of the environment are staggering. As far back as 1981, approximately 58 per cent of the then 4.1 million inhabitants of Lagos were recorded to be residing in slums and informal settlements (Oberai 1993).

As is evident from table 39.4, while Nigeria is estimated to be at 42.5 per cent level of urbanization in 2000 (as compared with about 36 per cent for Ghana, 33.4 per cent for Kenya, 56.9 per cent for South Af-

Table 39.3: Distribution of states by the size of the population of urban settlements. **Source:** National Population Commission (NPC 1998).

Geo-Political Zones	Ranking of States		
	High* (1-10)	Medium** (11-21)	Low*** (22 and above)
North-West	Kaduna (9)	Katsina (18)	Sokoto (27), Kebbi (28)
North-east		Kano (11), Borno (13)	Bauchi (26), Yobe (22), Jigawa (31)
West central	Kwara (7)	Kogi (14), Abuja (19)	Niger (23)
East central		Plateau (21)	Adamawa (24), Benue (25), Taraba (30)
South-west	Lagos (1), Oyo (2), Osun (4), Ogun (6), Ondo (10)		
South-east	Anambra (3), Edo (5), Enugu (8)	Abia (12), Delta (15), Imo (16), Rivers (17), Cross River (20)	Akwa Ibom (29)

* High rank group: At least 40 per cent urban population

** Medium Rank group: At least 25 per cent urban population but less than 40 per cent

*** Low rank group: less than 25 per cent urban population

rica, 57.4 per cent for Malaysia), this figure is expected to rise to 56.8 per cent by 2020 (UN 2008: 10). Lagos, for example, has one of the fastest rates of growth in the world – between 5 and 8 per cent per annum, and has become one of the 15 largest agglomerations in the world (Onibokun 2004).

The characteristics of the urban situation has led to a host of environmental, economic, political and social problems in most major urban centres, all of which have impacted negatively on the development of the nation (Olorunfemi/Raheem 2006–2007; Onibokun 2004).

39.3 Major Causes of Urban Vulnerability in Nigeria

Urbanization has both benefits and problems for humans and the environment. If well planned, urban centres generate economic growth and prosperity for themselves. However, if cities are not properly managed, they may generate major environmental problems that could impact negatively on development. Also, the structure and location of economic activities in and around cities affect the prevalence and severity of particular environmental problems. According to Leitmann (1994), this explains much of the variation in environmental issues between and within cities. The characteristics of the urban situation in Nigeria have led to environmental problems in most major urban centres which have negatively impacted on national development.

Urban environmental impacts stem from the use of resources, including land, water and energy; waste and waste water treatment and disposal practices; and, both industrial and domestic uses of chemicals (UNEP 1999). These problems already exist in Nigeria, and they are being compounded by other problems. According to the *National Urban Development Policy* (FMHUD 2006), the two most important factors determining the quality of the urban environment in Nigeria are the increasing concentration of population in the cities and their pervasive poverty. In general, main urban environmental issues include liquid and solid waste management, unplanned and blighted settlement, air pollution from increasing motor vehicle use (most of which are poorly maintained and use leaded fuel), water pollution, poor urban transportation, urban land degradation, lack of open spaces and poor management of the informal urban sector.

The urban areas of Nigeria are on the pathway of decay (Olorunfemi/Raheem 2008). Air pollution and environmental degradation from the poor refuse disposal are becoming the order of the day in Nigerian cities, while industrial activities which have given little concern to the sustainability of the environmental conditions are resulting in increasing levels of air, water and land pollution. In general, many Nigerian cities are reputed to be among the dirtiest, most unsanitary, least aesthetically pleasing, least safe and secure and most poorly governed cities in the world. Environmental degradation is noticeable everywhere with waste littering the roads (Mabogunje 1996). According to Olokesusi (1999), Nigerian urban settlements are afflicted with a growing list of problems, such as poor environmental quality, traffic congestion, quanti-

Table 39.4: Urbanization trends and growth of the urban population in Nigeria and selected countries by 2020. **Source:** UN-Habitat (2003: 252).

Countries	Level of Urbanization per cent		Estimates and Projections		Annual Growth Rate in per cent	
	2000	2020	2000	2020	2000-2010	2010-2020
Africa	**37.2**	**47.9**	**295,228**	**269,408 (?)**	**3.66**	**3.26**
Algeria	57.1	67.5	17,311	27,301	2.54	2.01
Ghana	36.1	45.3	6,963	13,021	3.15	3.15
Kenya	33.4	50.8	10,234	21,710	4.38	3.14
Nigeria	44.1	58.3	50,175	107,428	4.23	3.39
South Africa	56.9	69.6	24,629	30,624	1.63	0.55
Asia	**37.5**	**48.7**	**1,375,519**	**2,231,108**	**2.6**	2.24
Malaysia	57.4	68.0	12,758	20,325	2.68	1.98
Europe	**73.4**	**77.6**	**534,061**	**539,532**	**0.04**	**0.07**
Germany	87.5	90.5	71,798	72,303	0.11	0.04
Brazil	81.2	88.9	138,287	187,281	1.75	1.28

tatively and qualitatively inadequate housing, uncontrolled growth, inadequate building setback, poverty and encroachment on environmentally sensitive and marginal lands.

Nearly all cities and urban centres in Nigeria manifest glaring qualitative and quantitative deficiencies of housing, roads, municipal services and urban infrastructure. In 2000, access to water supply in urban areas stood at about 78 per cent, while sanitation access was 66 per cent (UN-Habitat 2003). As a result of rural - urban migration drift and rapid natural population increase, the cities and urban centres are congested. Homelessness, overcrowding and unemployment are serious problems contributing to urban poverty due to three reasons: a) the absence of physical development plans to serve as the basis for growth management; b) the weak local management capacity especially in development control and municipal management; and c) the inadequate consideration given to the integration of environmental and equity concerns into municipal management and development control.

Hitherto, local town planning authorities conceived of physical planning in a parochial and environmentally neutral way. Consequently, emphasis is not on growth management with sensitivity to environmental issues, but on the physical layout of human settlements and often an indiscriminate issuance of development permits without a legal basis. The problems of urban floods in Lagos, Ibadan and Benin are partly attributable to poor development control practices and environmental insensitivity. Since physical planning is often perceived by local town planners in terms of ad hoc physical solutions to human settlement problems, it has tended to accentuate the problem it is supposed to ameliorate (Izeogu 1986).

Also, the problem of solid waste disposal has become one of the most intractable environmental problems facing many cities in Nigeria. In recent years, there has been a phenomenal increase in the volume of waste generated daily due to many reasons including population growth, urbanization, industrialization and economic growth.

Most urban areas in Nigeria lack an effective system of refuse collection. As a result, most urban households resort to open dumping of refuse, although a few engage private refuse collectors or burn or bury solid waste. The common arrangement, in the very few urban communities where such a system is in place, is for waste management authorities to collect refuse from households and public containers on a regular basis. Unfortunately, the operation of waste management authorities is inefficient and ineffective as evidenced by mounds of decomposing rubbish that is fast becoming part of the regular landscape in urban areas. The management authorities often lack adequate manpower, equipment and operation funds in relation to the population they are mandated to serve. The reluctance of Nigerians to pay for waste disposal services, as well as relatively low cooperation between the state and *local government areas'* (LGAs) authorities in waste management further reduces the successful waste management agencies. The poor man-

Table 39.5: The ten largest natural hazards in Nigeria (1900-2009) in terms of a) people killed, b) people affected and c) economic damage. **Source**: EM-DAT: The OFDA/CRED International Disaster Database.

People killed			People affected			Economic damage		
Disaster	Date	No of people Killed	Disaster	Date	No of total people Affected	Disaster	Date	Damage (000 US$)
Epidemic	06.05.1991	7,289	Drought	June 1983	3000,000	Drought	June 1983	71,103
Epidemic	Feb. 1996	4,346	Flood	11.09.1994	580,000	Flood	11.09.1994	66,500
Epidemic	Oct. 1969	2,000	Flood	Aug, 1988	300,000	Flood	23.09.1985	8,000
Epidemic	01.01.2009	1,701	Flood	05.09.2003	210,000	Flood	20.09.2000	4,805
Epidemic	19.02.1996	1,193	Flood	10.10.1998	100,000	Flood	27.08.2001	3,000
Epidemic	Nov. 1986	1,000	Flood	15.09.1999	90,000	Flood	05.09.2003	2,570
Epidemic	28.02.2005	561	Flood	27.08.2001	84,065	Flood	15.08.2000	1,900
Epidemic	April 1991	400	Epidemic	Oct. 1969	80,000	Flood	07.08.2005	147
Epidemic	Sept. 1999	350	Flood	04.08.2007	50,000			
Epidemic	March 2001	340	Epidemic	01.01.2009	35,255			

agement of landfill sites is another challenge for waste management agencies.

39.4 Urban Vulnerability to Disasters in Nigeria

Addressing the challenges of evolving 21st century human settlement patterns demands a clear understanding of the vulnerabilities shaping such extreme events and also those factors that 'drive' everyday or 'chronic' environmental stresses. Importantly, there is a growing realization that more needs to be understood about how vulnerabilities – and their impacts – are configured by a range of causal mechanisms and how risks are shifted across the landscape differentially between groups of cities in the global periphery and emerging urban cores, and between rich and poor within individual cities (Bulkeley/Betsill 2003).

A major implication of uncontrolled urban growth in Nigeria is the increasing vulnerability of urban areas to disasters. According to Olokesusi (2004), a closer analysis of what transforms a natural event into a human and economic disaster reveals that the fundamental problems of development that Nigeria faces are the same problems that contribute to its vulnerability to the catastrophic effects of natural hazards. The principal causes of vulnerability in urban areas include rapid and uncontrolled urbanization, widespread urban and rural poverty, and degradation of the environment resulting from a mismanagement of natural resources, weak socio-economic infrastructure and inefficient public policies.

As shown in table 39.5, the *International Disaster Database* (EMDAT) identified 12 episodes of epidemic outbreak, 11 flood events and one drought between 1900 and 2009. These disasters also resulted in high human death tolls in many parts of the country and to say the least, a colossal loss of money and material. It must be noted that the information presented in the table is a modest expression of the disaster situation in Nigeria during the period under review. The data are also a reflection of the scale from which they was obtained. The local reality is such that there are pockets of natural hazards that were of disaster proportion in all parts of the country. A cursory look at tables 39.5 and 39.8 points to a commonality; namely the preponderance of environmental and ecological hazards over and above 'human hazards' like armed banditry and religious conflicts.

The vulnerability of frequent environmental emergencies in Nigeria is largely deter-mined by two variables: (a) the vulnerability of the elements at risk contained within them, that is, the ability of the built physical environment of buildings, site improvements; and infrastructure in them to withstand the stress imposed by natural hazards; (b) the hazards of their locations, or the extent to which they are subjected to environmental emergencies. Furthermore, the roots of urban vulnerability in Nigeria are human beings and their actions. For example, the urban population in the country has been growing at a rate of between 2–5 per cent per year since the 1990's (Olokesusi

Table 39.6: Percentage of people's houses built on various land sites in Bayelsa State. **Source:** Authors' Field Survey

Area	Nature and condition of building site						
	Fragile soil	Safe good soil	Erosion threatened land	Along water course	Polluted land with industrial discharge	Waste dump	Stilt
Brass	15	30	35	15	-	-	5
Ekeremor	22	65	5	2	5	-	-
Nembe	20	20	25	25	-	-	10
Southern Ijaw	40	23	30	-	-	-	7
Yenegoa	44	11	33	-	-	6	6

Figure 39.2: Inappropriate construction of residential buildings on urban wetlands, Bariga, Lagos. **Source:** Photo by D. Simon (2007: 22). The permission to reproduce this photo was granted by the photographer David Simon on 10 October 2009.

2004). The environmental problems associated with uncontrolled expansion and poor management has increased the vulnerability of these cities to major disasters.

Large contingents of low-income migrants have settled on the poorest, most vulnerable land in cheap, dilapidated and over-crowded houses constructed on land subject to floods and landslides (figures 39.2 and 39.3). Poverty and lack of innovative approaches to urban management contribute to acute shortage of social infrastructure services in the urban areas in general, and in the low-income neighbourhoods in particular. The combination of the physical development on unsuitable lands such as wetlands, slopes, flood plains and other environmentally sensitive areas, and over-crowding, all exacerbate environmental degradation and vulnerability to environmental and anthropogenic hazards. Blocked drainage channels in urban areas worsen the externalities associated with flooding. For example, as shown in table 39.6, many residential buildings are built on unsuitable lands in the urban areas.

Nigeria is a disaster-prone country. In 2000/2001, more than 200,000 people were displaced by anthropogenic and environmental emergencies, including more than 1,000 deaths. Several homes, farm crops,

Figure 39.3: Houses in Bariga on stilts over Lagos Lagoon. **Source:** Photo by D. Simon (2007: 26). The permission to reproduce this photo was granted by the photographer David Simon on 10 October 2009.

Table 39.7: Vulnerability situation in selected Nigerian cities. **Source:** Authors' compilation from various sources.

City	Characteristics	Vulnerability	*Severity
Lagos	Coastal city Nigeria's commercial capital Mega city	Flooding Coastal erosion	Very severe
Abuja	Federal Capital	Flooding	Not so severe
Port Harcourt	Coastal City Nigeria's oil capital	Flooding Coastal erosion	Very severe
Ibadan	Largest indigenous African city	Rainstorm Flooding	Very severe
Ilorin	Savannah	Rainstorm, flooding	Very severe
Sokoto	Sudano-Sahelian city	Rainstorm, flooding	Very severe
Onitsha	City with the highest per density population	Rainstorm, flooding	Very severe

* Based on the numbers of death, injured and property destroyed

fishing sites and businesses were destroyed. In the flood disaster events in the Kirfi local government area in Bauchi State, more than 11,000 were displaced while 500 were displaced in Osun State (Orebiyi 2002).

Flooding is a widespread environmental emergency in the country affecting all coastal states especially Lagos (ActionAid International 2006) and even upland states like Bauchi, Sokoto, Niger and Kwara. The situation is worsened by the degradation of the

Table 39.8: Highlights and spatial distribution of major disasters in Nigeria. **Source**: NEMA (2002).

S/NO	State	Types of major disasters	Remark
8.	Abia	Rainstorm: soil erosion and market fires	Soil erosion is prevalence. Market fires frequent
9.	Adamawa	Armed banditry, flood, soil erosion	Soil erosion is a prevailing disaster
10.	Akwa Ibom	Flood, rainstorm and fire	Soil erosion is a prevailing disaster
11.	Anambra	Rainstorm and armed banditry and soil erosion	Soil erosion is a prevailing disaster
12.	Bauchi	Fire and windstorm, religious crisis	Armed banditry is rampant
13.	Bayelsa	Flood and coastal erosion, oil pollution	Oil pollution and youth restiveness are the commonest problem
14.	Benue	Communal clash and bush fire, flooding	Communal clashes and fire disasters are the commonest crises
15.	Borno	Desert encroachment, fire and flood	Desertification is the major problem
16.	Cross River	Fire disaster and oil pollution	Oil pollution is the major problem
17.	Delta	Flood, rainstorm, oil pollution, youth unrest	Oil pollution is the major problem and youth unrest
18.	Ebonyi	Soil erosion, bush fires	Soil erosion and bush fire are the commonest problem
19.	Edo	Flood and rainstorm, oil pollution and youth restiveness	Oil pollution and youth restiveness are the prevailing problems
20.	Enugu	Soil erosion, rainstorm and flood	Rainstorm and soil erosion are common
21.	Ekiti	Rainstorm, flood	Rainstorm and soil erosion are common
22.	Gombe	Desertification	Desertification and rainstorm are common
23.	Imo	Rain and windstorm, soil erosion	Soil erosion is the major problem in the area
24.	Jigawa	Flood, fire, windstorm and flood	Desertification is the major problem
25.	Kaduna	Fire, rainstorm, windstorm and communal clash, flood	Ethnic-religious clashes are the commonest problems in the area
26.	Kano	Flood, fire, windstorm and communal clashes, plane crash	Ethnic-religious clashes are the commonest problems in the area
27.	Katsina	Fire, windstorm and flood	Desertification is the major problem
28.	Kebbi	Fire, windstorm and flood	Desertification is the major problem
29.	Kogi	Flood, fire and rainstorm	Rainstorm and bush fires are the major problem
30.	Kwara	Flood, fire and rainstorm	Rainstorm and bush fires are the major problem
31.	Lagos	Bomb explosion, collapsed buildings, erosion, flooding, plane crash	Flooding is an annual event, armed banditry, communal clashes are very frequent and common in the area
32.	Nasarawa	Communal clashes and bush fires	Ethnic clashes is the major problem in the area
33.	Niger	Rainstorm, flooding	Flooding is common in the area
34.	Ogun	Flooding, ethnic clashes, plane crash	Flooding is common in the area
35.	Ondo	Rainstorm, erosion and communal clashes	Flooding is common in the area
36.	Osun	Rainstorm, communal clashes	Communal clashes are all too frequent
37.	Oyo	Flooding, rainstorm, erosion	Rainstorm and flooding
38.	Plateau	Communal clash, bush fire, erosion	Communal clashes and rainstorm

S/NO	State	Types of major disasters	Remark
39.	Rivers	Erosion, communal clash and oil pollution, flooding and plane crash	Youth restiveness and oil pollution are the main crises and are all too frequent
40.	Sokoto	Flood, quella birds, fire and flood and windstorm	Windstorm, drought
41.	Taraba	Ethno-communal clashes and bush fires	Communal clashes are very frequent
42.	Yobe	Fire, drought, fire and flood	Drought is common
43.	Zamfara	Flooding, religious crises	Occasional flooding is not uncommon
44.	FCT	Windstorm, fire, flooding	Market fires are frequent

Box 39.1: People under siege: "We are Dying". **Source**: TELL Magazine (19 April 2004: 49).

For nearly 10 years, residents of Baruwa, a suburb of Lagos, continue to live with debilitating effects of oil spillage. They could be mistaken for displaced persons from a war-ravaged town. With big jerry cans and large empty buckets, they march daily in search of water. Young men and women, even pregnant women trek kilometres in the heat of the afternoon sun. The scorch is tiring, the destination long. But people seem determined because water is life. Such is the daily lifestyle of inhabitants of Baruwa-Ipaja a Lagos suburb where potable water is scare. Not that Baruwa community is arid. The community is blessed with the where withal. In fact, Tell's investigation revealed that many houses in the community have deep wells where clean water is supposed to be fetched. But the water that flows from Baruwa's earth is polluted and reeks of petroleum products. The houses near the pipeline valve not only smell of petroleum but the product can be seen afloat the water from the well. Scientists have expressed fears that this situation could have a long-term impact on the health of hundreds of people in the community, since many of them still make use of water from the wells as a last resort.

country's environment and natural resources. In the Sudano-Sahelian states of Kano, Niger Bauchi and Sokoto, the situation is precarious due to sparse vegetation; hence, any unusually heavy rainfall results in severe floods and soil erosion. Table 39.7 reveals some of the major environmental problems in selected Nigerian cities. All these problems are projected to get worse due to climate change (Gworgwor 2008; Gwary 2008).

The available literature shows the existence of spatial differences in the nature of disasters in Nigeria. As revealed in table 39.8, while oil and gas pollution is largely a Niger Delta problem, drought and quella birds infestation occur in the Sudano-Sahelian states (e.g. in Kano, Sokoto, Katsina, Borno and Yobe). However, soil erosion, rainstorm and flood disasters are prevalent in virtually all states (NEMA 2002).

Disasters incidence and management in Nigeria are encapsulated in the two scenarios presented in boxes 39.1 and 39.2. While box 39.1 is a classical case of many disasters waiting to happen (creeping disasters) and which there is more or less no concern shown by responsible government agencies to address such, Box 39.2 reveals that many environmental emergencies in Nigeria that often result in major disasters are basically human-induced.

A common trend running through various disaster incidents has been incompetent or inadequate preparation, inadequate or inappropriate response to the disaster event, and an apparent failure to profit from the lessons of previous disasters.

An important dimension to some of the recent disaster incidents has been a wave of protests in some cities after the perceived inability of the government to respond urgently and adequately to the need of the affected and failure to take some mitigation measures to forestall or reduce the impacts of such incidents in the future. A case in point is the riot that broke out in the city of Ilorin after a heavy flooding in which lives were lost and properties destroyed. The riot stem from the fact that the people believed that the government did not provide enough relieve assistance and it did not come on time. Furthermore, the respective municipal authorities were seen as being insensitive to the frequent flooding in the city by not constructing drainages in most neighbourhoods and provide effective waste management services. This type of post disaster conflicts is fast becoming a frequent feature in many disaster prone cities and could threaten peace and stability of such cities and by extension become a threat to human security.

Box 39.2: Panic as Toxic Smoke Covers Lagos. **Source**: Vanguard (13 October 2005: 46).

A dense cloud of mysterious fumes enveloped much of Lagos metropolis, yesterday, triggering panic in many places and health concerns everywhere. The smoke was more noticeable at Ikeja, Oregun, Alausa, Alapere, Onipanu, Bariga, Maryland, Ojota, Ilupeju, Ikorodu and Monde in Ogun State, with residents complaining of eye irritation, difficulty in breathing, and stomach upset, among others. Till late afternoon, the affected area was thrown into a flux.

Governor Bola Tinubu of Lagos State ordered an immediate closure of all public and private schools, and appealed to companies and institutions to allow workers with respiratory infections go home immediately. Those affected by the smoke were also advised to go to designated government hospitals for treatment, while the State Ministry of Health dispatched ambulances and health personnel to the affected areas.

The smog is a type of large-scale pollution caused by chemical reactions between pollutants derived from different sources, primarily automobile exhaust and industrial emissions. The State *Environmental Protection Agency* (LASEPA) first attributed it to "a petroleum pipeline rupture between Mosimi and Atlas Cove Jetty" (Engr Rasheed Adebola, General Manager of Lagos state Environmental Protection Agency in a press statement). Preliminary laboratory analysis showed abnormal levels of sulphur dioxide (So_2) of up to 1,000 ppm.

Thus, anxiety, intense and almost palpable, swept the area as residents' minds went back to the Lake Nyos in South-Western Cameroon of 1987 when 'an ordinary gas' belched from the Lake killed hundreds of thousands in their sleep overnight.

39.5 Institutional Framework for Disaster Management and Funding in Nigeria

In response to the upsurge in disasters, the Federal Government of Nigeria through, Decree No. 12 of 1999, established the *National Federal Emergency Management Agency* (FEMA) as the apex public sector agency for emergency management. This legal instrument was fashioned after the *United States Emergency Management Agency* (U.S. NEMA) law. The enabling legislation contains concepts like co-ordinate, liaise, monitor and collect, etc. which presupposes that NEMA is a coordinating agency. Yet, the Director-General of the agency in his welcome address to a conference on emergency management noted that the management of any emergency no matter how small is the agency's responsibility (Markarfi 2004). This raises the fundamental question of which other units is NEMA liaising with or coordinating.

Although Nigeria has ratified the *United Nations Framework Convention for Climate Change* (UNFCCC), and is widely recognized to be vulnerable to climate change (Olokesusi 2004), much still needs to be done to develop local awareness, knowledge and expertise. Whereas, NEMA is structurally incapacitated, the situation is worse at the state and local levels. Although the 1999 NEMA Decree directs each state to have a fully equipped emergency management agency, this has not been realized. Furthermore, a National Disaster Response Plan was prepared about three years ago, it has not been put to use. In 2009, the Nigeriasat-1 satellite was gathering data on environmental conditions and resources, but what is of utmost concern is the application of such data for participatory and sustainable environmental emergency management.

Funding of disaster management programmes is presently a major responsibility of the Federal Government. The primary source of the financing of NEMA and its activities is a proportion of the Ecological Fund, a certain proportion of the oil revenue set aside to tackle environmental problems and emergencies. Between 1998 and 2004, about ₦82 billion accrued to this fund from which NEMA received its annual capital and recurrent budgetary allocations (table 39.9). Despite the Supreme Court's judgement on the constitutionality or otherwise of the 'Special Fund', deductions from the Federation Account, other tiers of government have not shown appreciable commitment towards disaster mitigation.

Although, it is true that under the current revenue allocation system, the lion's share goes to the Federal Government, it is an inalienable fact that disasters occur and could re-occur in all states of the federation with their attendant adverse economic, political, environmental and social impacts. Moreover, the entire pool of funds in the federation account and the proportion allocated to each tier of government are all subject to the vagaries of oil pricing in the global market. This is because Nigeria depends largely on oil revenue the price of which is not stable in the international oil market. Therefore, for a country striving strenuously to avoid these negative externalities, a comprehensive disaster mitigation financing policy and programme becomes imperative.

Available evidence further shows that apart from the budgetary releases to the *National Emergency Management Agency* (NEMA), there is little financial resource inflow directly and explicitly earmarked for

Table 39.9: Revenue Allocation to the Ecological Fund (1998–2006). **Sources**: Central Bank of Nigeria Statistical Bulletin (December 2003); CBN Annual Reports and Statement of Accounts for 2003 to 2006.

Year	(₦ billion*)	per cent of Total
1998	4.858	5.97
1999	9.125	11.22
2000	21.021	25.85
2001	25.491	31.35
2002	2.711	3.33
2003	0.000	0.00
2004	18.100	22.28
2005	19.234	20.05
2006	18.428	21.22
2007	19.285	20.56
Total	81.306	100.00

* 1 US$ currently exchanges for 150 Naira

Note: Before the 2003 Supreme Court Judgement, the Ecological Fund was deducted from the 'Special Fund' of the Federation Account, but it is now an item of distribution directly from the Federal Government's share of the Federation Account.

disaster reduction. Often the country bears the largest burden of disaster risks. This is due to a large use of *ex-post* financing strategies that do not transfer risk. The development challenge confronting the nation therefore makes it imperative for a transition away from excessive reliance on *ex-post* financing to disaster reduction through mitigation and risk transfer by using financial instruments. While this approach may be new to Nigeria, some countries have realized this transition through partnership arrangements with *International Financial Institutions* (IFIs) (Olokesusi 2004).

While the agency has succeeded in its advocacy and the coordination of emergency organizations during crises, it is finding it difficult to persuade operators of telecommunications in Nigeria to commence the implementation of 112 as the National Emergency Call numbers for quick access to assistance in distress situations. It has held meeting with the stakeholders but it seems some of the telephone operators are not willing to provide the toll free emergency call services which could link the public and response agencies. Such a service is provided in other countries free which are a link between the public and an emergency organization where distress alert calls can be received, processed and forwarded to the relevant response agencies.

To ensure a decentralized disaster management system, the Agency has made worthwhile efforts in providing some concrete structures to assist in the disaster management effort. Some of the structures include the creation of the following: The Agency establishment of zonal offices in the six geopolitical zones of the country namely (figure 39.4):

1. South West at Lagos,
2. South East at Enugu,
3. South South at Port Harcourt,
4. North East at Maiduguri,
5. North Central at Jos and
6. North West at Kaduna.

These zonal offices serve as focal points for NEMA to reach out easily to states, local government and communities within the zones where they are located.

At the state level, the State Emergency Management Committee (SEMC's) is responsible for coordinating disaster situations in their states and requesting† Federal assistance (NEMA) only when the level surpasses their capability. The efforts of NEMA in pursuing the establishment of SEMC's/Agencies in every state of the Federation and that of Local Governments Emergency Management Committees (LEMCs), have been yielding results, which can be visualized from the increasing number of already established committees in states and local government areas of the Federation. However, it is noteworthy that only 21 out of the 36 states in the country have an emergency management agency. These thus not augur well for emergency response and management in the country.

In addition, the agency has established *Disaster Response Units* (DRUs), a Nigerian Mission Control Centre (Cospas-Sarsat), *Emergency Response Teams* (ERTs), establishment of an Early Warning Unit (the Unit is composed of a *Geographic Information System* (GIS), remote sensing laboratory and a data bank).

39.6 Issues and Challenges in Disaster Risk and Urban Management in Nigeria

The management of urban environmental problems and those that are climate change related is a complicated business. The factors that cause managerial complexity are: (a) the frequently large number of

Figure 39.4: National Emergency Management Zonal Offices. **Source:** National Emergency Management Agency; at: <http://www.nema.gov.ng/zone.htm>.

actors per problem area; (b) cross-jurisdictional conflicts; (c) central-local conflicts; and (d) tension between forces for centralization and devolution of authority. Part of this managerial complexity can be attributed to the fact that there is often little relationship between the spatial scale or the nature of the urban environmental problems and the design of institutions or policies. Thus, the processes of planning and implementation can only address partial aspects of environmental problems; for example, there may be an ability to handle waste collection within municipal borders, but solid waste disposal is often a metro-level authority to plan, co-ordinate and execute a waste disposal programme, conflicts and suboptimal results are likely to occur. Similarly, urban environmental problems can be exacerbated when policies do not account for environmental factors. For example land use policies fail to prevent building in flood or earthquake-prone areas. Different measures taken by the government to improve the urban sector are highlighted in table 39.10.

One of the major goals of the new *National Policy on Urban Development* (FMHUD, 2006) is to improve the environmental situation in the urban areas. Specifically, the goal of the urban policy in the context of the environment is to make the urban environment in Nigeria safe, clean, healthy and aesthetically pleasing for all urban residents. To achieve this, according to the policy, the government will employ these strategies:

1. Encourage local planning and health authorities; as well as the local government environmental agency to exhibit greater vigilance in the discharge of their responsibilities;

Table 39.10: Categories of measures taken by governments in Nigeria on urban sector issues (2004). **Source:** Onibokun (2004) and compilations by the authors.

Legislation and Policy	Institution Building	Direct Action
In 1904, the *Cantonment Proclamations* led to the segregation of European Reservations from the Native Areas	In 1924, *Town Planning Committees* were established for the Northern and Southern Provinces to vet planning schemes and initiate new ones where necessary.	In 1974, the *Federal Government of Nigeria* (FGN) commissioned studies of twenty major urban centres in Nigeria to identify critical areas of urban infrastructure needs.
In 1914, *Ordinance No. 9* was enacted to empower the government to acquire land compulsorily for public reasons.	During the First National Development Plan period, *state-owned Housing Corporations* were created to provide planned residential and industrial estates.	From 1975 to 1980, the World Bank-Assisted Nigerian States Urban Development Programme was initiated.
In 1917, the *Road and Township Ordinance No. 29* provided for different grades of urban settlements, established broad physical layouts of towns and classified Nigerian towns into first, second and third class categories, with Lagos as the only first class town.	In 1992, the Urban Development Bank was established to focus on urban infrastructure and public utilities.	In 1985, the FGN, in collaboration with the World Bank, introduced the *Infrastructure Development Fund* (IDF) to finance urban development projects.
In 1928, *the Lagos Town Planning Act* created the *Lagos Executive Development Board* (LEDB) and the Board was empowered to carry out slum clearance, land reclamation, residential and industrial estates.	In 1979 the Federal Ministry for Housing, Urban Development and the Environment was created (it was scrapped in 1983).	In 1984, the monthly National *Clean-up Exercise* was introduced.
In 1946, *the Nigerian Town and Country Planning Ordinance No. 4* authorized Town Planning Authorities to prepare planning schemes. In 1978, FGN introduced the *Land Use Decree* (1978) as a regulatory tool to control the use of land and ensure equitable access to it by all Nigerians.	In 1992, Decree No. 3 of 1992 was enacted to establish the *National Housing Fund* as a source of funds for housing finance.	Between 1996 and 2002, the FGN, in collaboration with UNCHS and UNICEF, the *Sustainable Cities* Programme, the *Urban Basic Services* programme, *Community Upgrading* Programme, *Safer Cities* Programme and the *Campaign on Good Urban governance* were introduced.
In 1985, A National Housing Policy was adopted.	In the 1970's, the concept of *New Towns* was introduced, as a strategy for deconge-sting the major urban centres and creating new growth poles. This concept, for example, gave birth to the relocation of the Federal Capital from Lagos to Abuja.	From 1972 to 1975, the FGN planned to build 59,000 housing units over the federation. The number was subsequently increased to 202,000 units in 1997. The states also launched their housing programme each planning to build 4,000 between 1977 and 1980.
In 1986, the *Rolling Plan concept* was introduced.	In June 2003, a new Ministry of Housing and Urban Development was re-established.	
In 1988, a *National Policy on Environment* was enacted.		
In 1991, the *National Urban Development Policy* was prepared.		
In 1992, the *Nigerian Urban and Regional Planning Decree No. 88* of 1992 was adopted.		

Legislation and Policy	Institution Building	Direct Action
In 1996, *National Plan of Action* to guide human settlements development in the twenty-first century was prepared as part of the background papers for the Second United Nations Conference on Human Settlements (Habitat II).		
In 1998, the *Federal Environmental Protection Agency (FEPA)* was created under Decree No. 58		
In 1971, *the National Council of Housing was* adopted.		
In 2002, a new *Housing and Urban Development Policy* was scrapped.		

2. The government should protect and enact appropriate legislation to back up the various environmental protection conventions it has signed;
3. The government should promote co-operation among urban households to take interest in the maintenance of a high standard of the environment and to embark on campaigns to alert the public especially the urban poor to the increasing range of health hazards in the urban environment;
4. Ensure participation in promoting high environmental standards in our cities;
5. Enforce Development Control measures in order to reduce environmental hazards such as deforestation, oil spillage, desert encroachment, flooding and erosion;
6. Ensure greater coordination among different agencies involved with the environment at the local level such as the town planning authority, the local health board, the local education authority and the local works department.

On the other hand, the increasing frequency and intensity of disasters in Nigeria that will become more severe due to climate change would worsen the prospects for poverty eradication unless action is taken to become response-capable. This requires a focus on reducing vulnerability, achieving equitable growth and improving the governance and institutional context in which poor people live. Strategies to reduce vulnerability should be rooted in vulnerability analysis and greater understanding of both household-level and macro response options that are available to decrease the poor's exposure to disaster risk. Increasing the response-capability of Nigeria will require information on seasonal forecast to enable the preparedness to climate variability as well as longer-term climate prediction data to ensure that strategies to reduce vulnerability also reflect the underlying longer-term climate trends.

To effectively prepare for, manage and reduce the increasing incidents of disasters in Nigeria, therefore, two issues must be addressed. First, the issues involved in best practices for disaster planning and management. According to Quarantelli (1998) and Freeman, Martin, Linnerooth-Bayer, Warner, Level, Cardona and Kunreuther (2001), it is generally accepted that the best disaster planning and management implies to perceive disasters as different from accidents and minor emergencies, taking into consideration all four time phases of the planning process: mitigation, preparedness, response, and recovery, laying emphasis on the need for coordination both within and between organizations and segments of the community, rather than 'command and control'.

Secondly, there is a need to produce a set of guidelines for disaster management. Some important issues to be taken into consideration in disaster management include; the development of databases on various resources, skills and services required for relief at short notice, logistics, technological needs (i.e. a whole range of technical questions regarding buildings, rescue and relief needs to the resolved), self reliance (the lessons of community self help need to be put together), communication infrastructure, emergency preparedness and forecasting.

Climate change related risks pose even more daunting challenges. At the global level, the IPCC Working Group I identified four major aspects of climate change relevant to cities in its synthesis report (IPCC 2007c).

- First, heat waves are very likely to increase in frequency over most land areas.

- Second, heavy precipitation events are very likely to increase in frequency over most areas; available data suggest that a significant current increase in heavy rainfall events is already occurring in many regions. The resulting risk poses challenges to urban society, physical infrastructure, and water quantity and quality.
- Third, the area affected by drought is likely to increase. There is high confidence that many semi-arid areas will suffer a decrease in water resources due to climate change. Drought affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, including food production, water supply, energy supply and health.
- Fourth, it is likely that intense tropical cyclone activity will increase. It is also likely that there will be an increased incidence of extreme high sea level (excluding tsunamis). It is worth noting that all these four impact categories would have effects on one or more Nigerian cities because of its geography as pointed out in section one. Lagos, a coastal city for instance face many risks with respect to climate change (see box 39.3).

Box 39.3: Climate Change Risks and Response in the megacity of Lagos. **Source**: Mehrotra, Natenzon, Omojola, Folorunsho, Rosenzweig and Rosenzweig (2009).

Climate hazards: Sea level rise and coastal flooding;

Extreme events: Extreme precipitation May 1958, June 1962, July 1968, August 1998, November 1998; extreme temperature March 1988, March 1990, February 1998, March 1988, March 2001, March 2002, February 2003, March 2003, August 2004;

Vulnerability: very large population of slum dwellers living in coastal areas prone to storm surge and flooding; lack of adaptation planning and investment;

Adaptive capacity: lack of dedicated institutional support for climate risk reduction;

Response: Lagos State government is leading actor on climate change, which has been influenced by its membership in C40 Large Cities group; Initial studies of climate change risks but results have yet to inform ongoing and planned investments in infrastructure and slum upgrading.

Even more worrisome is the general sensitivity of the megacity of Lagos to climate change due to its flat topography and low elevation, high population, widespread poverty and weak institutional structures. Many more vulnerabilities stem from these characteristics including the high potential for backing up of water in drainage channels, inundation of roadways, and severe erosion. The barrier lagoon coastline in the western extremity, including the high value real estate at Victoria Island and Lekki in Lagos, could lose well over 584 and 602 square kilometres of land respectively from erosion, while inundation could completely submerge the entire Lekki barrier system (Awosika/French/Nicholls/Ibe 1993a; Awosika/ Ojo/ Ajayi 1993b). Further, the climate change associated risks for cities stem primarily from extreme events – implying that cities need to assess risks for droughts, floods, storms, and heat waves, in order to plan and implement adaptation strategies. However, gradual changes such as rise in mean temperature do affect cities in at least two significant ways: by increasing the frequency and intensity of extreme events and burdening the existing infrastructure (Mehrothra/Claudia/ Natenzon/Omojola/Folorunsho/Rosenzweig/Rosenzweig 2009).

There is therefore a need to study the vulnerability of each city in Nigeria to climate change in order to design appropriate mitigation and adaptation measures. This would reduce the risks currently faced by Nigerian cities to hazards associated with climatic events.

39.7 Conclusion

The Nigerian urban areas exhibit many characteristics associated with urban decay which makes them some of the most highly vulnerable cities in the world with frequent negative impacts of environmental emergencies and extreme weather events. Without major changes in the ways that governments and international agencies work in urban areas these impacts will rise.

Three initial lessons which were summarized in the study by Mehrotra, Claudia, Natenzon, Omojola, Folorunsho, Rosenzweig and Rosenzweig (2009) that included Lagos are very relevant for the Nigerian situation. First, a multidimensional approach to risk assessment is a prerequisite to effective urban development programmes that incorporate climate change responses. Second, mismatches between needs and responses are occurring with regard to who should mitigate, how much to adapt, and why. Cities need climate change risk assessments in order to decide for themselves what the right mix between mitigation and adaptation measures will be. Third, the vertically and

horizontally fragmented structure of urban governance is as much an opportunity as an obstacle for introducing responses to climate change.

The rationale for integrating adaptation into development strategies and practices into urban management in Nigeria is stressed by the fact that many interventions required to increase resilience to climatic changes generally benefit development objectives. Adaptation requires the development of human capital, strengthening of institutional systems, and sound management of public finances and natural resources. Such processes build the resilience of countries, communities, and households to all shocks and stresses, including climate variability and change, and are good development practices in them. Adaptations are successful if they reduce the vulnerability of poor communities and poor people to existing climate variability, while also building in the potential to anticipate and react to further changes in climate in the future. Adaptation to climate change requires local knowledge, competence and capacity within local governments. It needs households and community organizations with the knowledge and capacity to act. It also requires a willingness among local governments to work with lower-income groups. These are seriously lacking in Nigeria (Olorunfemi Felix Bayode, 2009).

All things considered, the long-term effects of disasters seriously affect the country's prospects for development. This calls into question at least two aspects related to a country's development strategy: first, an understanding that resources earmarked for preventing and mitigating the impact of natural phenomena are a very high-yield investment, both in economic, social and political terms in line with long-term growth (Coletta 2004). In a poor, disaster-prone country like Nigeria, cost-effective mitigation is important as well as new sources of funding for loss recovery from natural and other disasters which use recent developments in information technology and the emergence of new financial instruments and partnerships.

In conclusion, while an increasing rate of urbanization is inevitable in Nigeria, the circumstances under which the urban population is growing have wiped out most of the gains that should be associated with it. The context within which urbanization is taking place is creating a host of problems far beyond the managerial and fiscal capacity of the municipal governments. Thus, in resolving the environmental implications of rapid urbanization in Nigeria, there is a need to apply sound principles of environmental management through the integration of environmental planning into development. This is a challenge for urban planners and administrators in Nigeria.

Part V Coping with Global Environmental Change: Climate Change, Soil and Desertification, Water Management, Food and Health

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40 Quantifying Global Environmental Change Impacts: Methods, Criteria and Definitions for Compiling Data on Hydro-meteorological Disasters

Debarati Guha-Sapir and Femke Vos

40.1 Introduction[1]

The world is confronted with the impact of natural disasters on human lives and livelihoods on a tremendous scale. These disasters affected 184 million people globally each year, on average, between 1980 and 2008, with a range of 28 million to 661 million. The annual loss of nearly 74,000 human lives occurred on average during this same period, with a range of 10,000 to 460,000. During 2008, 1 out of 31 persons worldwide was affected by natural disasters. Climate-related disasters caused 45,000 deaths each year and affected 178 million people, on average, between 1980 and 2008.

The risk of natural disasters involves three major elements: the exposure to hazards, frequency or severity of a hazard, and human vulnerability. Hazards are defined as "natural processes or phenomena occurring in the biosphere that may constitute a damaging event on human lives and livelihoods"[2] and are thus the natural events as such without their possible human or societal impact. Human vulnerability is comprised of susceptibility – the weakness of a system – and coping capacities – resources to deal with the negative impacts of hazardous events. A wider concept of vulnerability encompasses physical, social, economic, environmental and institutional features.[3] The approach required for measuring vulnerability depends on the type of hazard and both the socio-economic and cultural contexts.[4]

Natural disaster risk is strongly connected to human development processes, as disasters seriously hinder the development progress. At the same time, development processes and choices in governance can increase the risk of disasters. On one hand, development-linked factors responsible for increasing vulnerability to disasters are: rapid urbanization and migration, economic globalization, and climate change and environmental degradation. Furthermore, economic status, rural livelihoods, population size, social networks, changing epidemiology of diseases and armed conflict situations can all influence vulnerability to disasters. On the other hand, development can decrease disaster risk by reducing poverty and increasing community empowerment and resilience.[5]

Direct outcomes of natural disasters are the destruction or degradation of life, livelihoods and infrastructures. The impacts of disasters do not stop there, affecting social structures and education, economic investments, health systems, water and sanitation as well as the environment.[6]

1 The data upon which this report is based are maintained through the long-term support of the *US Agency for International Development's Office of Foreign Disaster Assistance* (OFDA-USAID). The authors would like to thank: David Hargitt for creating maps and proofreading; Laura Irvine and Ruwan Ratnayake for proofreading: Olivia D'Aoust for analytical design; and Regina Below and José Rodriguez-Llanes for their constructive remarks.

2 UNISDR [United Nations International Strategy for Disaster Reduction], 2009: "UNISDR Terminology on Disaster Risk Reduction"; at: <http://www.unisdr.org/eng/library/lib-terminology-eng.htm> (30 May 2009).

3 See Cannon (1994: 19); Alwang, Siegel, Jørgensen (2001: 20); Blaikie, Cannon, Davis, Wisner (1994: 9); Wisner, Blaikie, Cannon, Davis (2004: 11).

4 See Brooks (2003: 13); Birkmann (2007: 21); Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher, Schiller (2003: 8077).

5 See Dilley, Chen, Deichmann, Lerner-Lam, Arnold, Agwe, Buys, Kjekstad, Lyon, Yetman (2005: 15); Benson, Clay (2004: 18); DFID (2004: 4); Stephenson, DuFrane (2002: 112).

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The Millennium Declaration recognizes the risk to development arising from disasters and calls on the global community to "intensify our collective efforts to reduce the number and effects of natural hazards and man-made disasters" (UN 2000a: 23). Disaster risk reduction can be defined as "action taken to reduce the risk of disasters and the adverse impacts of natural hazards, through systematic efforts to analyze and manage the causes of disasters, including avoidance of hazards, reduced social and economic vulnerability to hazards, and improved preparedness for adverse events." The *Hyogo Framework for Action* (HFA) provides the foundation for the implementation of disaster risk reduction.[7] One of the key activities of the HFA is identified as the development of various systems of indicators for disaster risk and vulnerability at national and sub-national scales. The aim of this activity is to aid decision-makers to assess the impact of disasters on social, economic and environmental conditions and disseminate the results to other decision-makers, the public and the populations at risk (UNISDR 2005: 7).

Much has been written on the above,[8] but a key component of effective policy for disaster risk reduction and disaster response is sound data that measure outcomes and provide quantifiable risk profiles of vulnerable communities. The *Centre for Research on the Epidemiology of Disasters* (CRED; box 40.1) provides standardized global disaster occurrence and loss data in their *Emergency Events Database* (EM-DAT). This is embedded in the overall goal of information dissemination for disaster management in order to enhance regional, national and local capacity to prepare for, respond to, and mitigate disaster events.

Other than CRED's EM-DAT, there are two different global disaster databases: *Munich Reinsurance Company's* (MünichRe) NatCat database[9] and *the Swiss Reinsurance Company's* (SwissRe) Sigma database[10]. EM-DAT is developed for scientific research with a development agenda, and while the overall structures of the three above mentioned databases are similar, their objectives differ, hereby influencing the information present in the databases. NatCat and Sigma are essentially designed to serve internal commercial policy and client insurance companies. Raw disaster data, as well as methodologies and criteria are not accessible to the public. However, their high quality data and sustainable resources allow regular analyses and publications that are available to be purchased by the public. Next to public availability, the main differences between data from the three databases derive from the definitions and thresholds used for the inclusion of disasters and the level of data entry (e.g. if disasters are entered per country or per event). Drought events are included in EM-DAT, while not monitored by NatCat or Sigma. Furthermore, EM-DAT also registers technological disasters (Guha-Sapir/Below 2002: 7).

The aim of this chapter is to display and analyse global disaster data held by CRED's EM-DAT database, the reference source for systematic global disaster data. Following this introduction, the chapter then sets out the methodological parameters that guide the recording of natural disaster events in EM-DAT (40.2). It also discusses challenges related to definitions, inclusion and exclusion criteria, as well as other potential ambiguities in disaster data collection. This is followed by a description of the trends and patterns of natural disasters recorded in EM-DAT (40.3.). It examines the absolute and relative distributions of not only the occurrence of natural disasters, but also the distribution over space (continents and countries) and time (long, medium and short term) of the victims of these disasters.

6 See Lindsay (2003: 295); Guha-Sapir, Lechat (1986): 122; Lindell, Prater (2003: 177); Hoyois, Scheuren, Below, Guha-Sapir (2007: 29); Scheuren, le Polain de Waroux, Below, Guha-Sapir, Ponserre (2008: x); Smith (2004: 21); Rodriguez-Llanes, Vos, Below, Guha-Sapir (2009: 8).

7 UNISDR [United Nations International Strategy for Disaster Reduction], 2009: "UNISDR Terminology on Disaster Risk Reduction"; at: <http://www.unisdr.org/eng/library/lib-terminology-eng.htm> (30 May 2009).

8 See Pielke (2006); Guha-Sapir, Below, Hoyois (2006: 155); O'Brien, O'Keefe, Rose, Wisner (2006); Frampton, Chaffey, Hardwick, McNaught (2000); Ahrens, Rudolph (2006); Alexander (2002); Norwegian Ministry for Foreign Affairs, ProVention Consortium, United Nations Development Programme (2008); Boyce (2000: 256).

9 See at: <www.munichre.com> (30 May 2009).

10 See at: <www.swissre.com> (30 May 2009).

Box 40.1: About CRED. **Source**: CRED; at: <www.cred.be> (29 May 2009).

CRED has been active for over 30 years in the field of international disaster conflict and health studies, with research and training activities linking relief, rehabilitation and development. CRED provides an evidence base for the international community on the burden of disease and related health issues arising from disasters and conflicts. The Centre was established in 1973 in Brussels as a non-profit institution with international status under the Belgian law. It is located at the School of Public Health of the Catholic University of Louvain (*Université Catholique de Louvain* or UCL). CRED collaborates with the *World Health Organization* (WHO), the *United Nations Department of Humanitarian Affairs* (UN-DHA), the *European Union Humanitarian Office* (ECHO), the *International Federation of the Red Cross and Red Crescent Societies* (IFRC), the *Office of Foreign Disaster Assistance - United States Agency for International Development* (OFDA-USAID), and non-governmental agencies such as the *International Committee of the Red Cross* (ICRC).

The Centre works in four main areas: 1) natural disasters and their impact; 2) conflict and health studies; 3) database and information support; and 4) capacity building and training. By multi-partner and multi-country research projects, the health impacts of natural disasters are investigated. Examples are MICRODIS[a)], a 16-member research consortium funded by the European Commission, aiming at developing new methods and tools to measure the integrated health, social and economic impacts of natural disasters.

CRED's conflict and health research programme focuses on the way in which violence drives mortality, malnutrition, disease and disability, and otherwise disrupts human health. Funded by the European Commission, CRED is involved in MICROCON[b)], a micro-level and multidisciplinary approach to conflict, aiming at promoting the understanding of individual and group interactions leading to and resulting from violent mass conflicts.

The Centre provides an evidence base for disaster risk identification outcomes by maintaining an international *Emergency Events Database* (EM-DAT)[c)], funded by OFDA-USAID. In collaboration with the United States Department of State, Bureau of Population, Refugees, and Migration, CRED hosts the *Complex Emergencies database* (CE-DAT)[d)], a global database on complex humanitarian emergencies and conflict situations.

CRED's overall capacity building and training programmes enables individuals, communities and systems to strengthen their capabilities to plan, develop, implement and maintain effective health sector services during disasters, conflicts and other humanitarian emergencies. The *Assessing Public Health in Emergency Situations* (APHES) international summer course[e)], co-organized by CRED, UCL and the *Harvard Humanitarian Initiative* (HHI), focuses on quantitative epidemiological assessment tools and methods in the context of humanitarian emergencies.

a) See MICRODIS standing for *Integrated Health, Social and Economic Impacts of Extreme Events: Evidence, Methods and Tools*; at: <www.microdis-eu.be> (29 May 2009).
b) See MICROCON standing for a *Micro Level Analysis of Violent Conflict*; at: <www.microconflict.eu> (29 May 2009).
c) See EM-DAT prepared by the Catholic University of Louvain (UCL), Brussels – Belgium: "The OFDA/CRED International Disaster Database"; at: <www.emdat.be> (29 May 2009).
d) See CE-DAT (*Complex Emergency Database*); at: <www.cedat.org> (29 May 2009) is prepared by the Centre for Research on the Epidemiology of Disasters (CRED), Catholic University of Louvain (UCL) – Brussels, Belgium.
e) See *Assessing Public Health in Emergency Situation* (APHES); International CRED Course; <www.aphes.be> (29 May 2009).

40.2 EM-DAT: History, Methods and Contents

EM-DAT is a unique international reference database used by a wide variety of scientists, policy makers and operational organizations. This section provides an overview of the definitions, methods and limitations of the data collected in EM-DAT. Droughts are discussed as a particular example of methodological complexities in the compilation of disaster data.

40.2.1 History of EM-DAT

Based on the growing need for a comprehensive understanding of the human, economic and social impact of disasters, CRED has maintained EM-DAT since 1988, with the sponsorship of OFDA-USAID. EM-DAT was created with the initial support of WHO, *United Nations Disaster Relief Organization* (UNDRO) and the Belgian Government. The main objectives of the database are: to assist humanitarian action at both national and international levels, to rationalize decision-making for disaster preparedness, and to provide an objective basis for vulnerability assessment and priority setting. Based on historical dis-

aster data, characteristics of disaster risks can be determined and trends analyzed. EM-DAT contains essential core data on the occurrence and impacts of more than 18,000 natural and technological disasters in the world from 1900 to present. The database is compiled from various sources, including the *United Nations* (UN), governmental and non-governmental organizations, insurance companies, research institutes and press agencies. Table 40.1 shows the reporting sources of EM-DAT disasters. Within EM-DAT, strict methodology and standardization are applied, as well as an intensive validation procedure.

Table 40.1: Data sources for disasters registered in EM-DAT. This list is not exhaustive. **Source**: The authors.

Source Type	Source Information
United Nations	OCHA, IRIN, WFP, UNEP, WMO, WHO, FAO
US Government	FEMA, NOAA, OFDA, Smithsonian, CDC
National Governments	Governments, ADRC, CDERA
NGO & Humanitarian Organizations	IFRC
Reinsurance companies	Lloyd Casualty Week, MünichRe, SwissRe
Inter-Governmental Organizations	World Bank
Press	AFP, Reuters
Others	AirDisaster, Emergency Management
Specialized sources	USGS (earthquakes)
	DFO (floods)
	WHO (epidemics)

40.2.2 Definitions and Criteria

Several definitions are currently used to define a disaster. The World Bank's definition of an emergency, "an extraordinary event of limited duration such as a war, civil disturbance or natural disaster" that "seriously dislocates a country's economy,"[11] focuses on the economic impacts of a disaster. The definition promoted by WHO concentrates on the human aspects, describing a disaster as "any occurrence that causes damage, ecological disruption, loss of human life, or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area" (WHO 2007: 9).

EM-DAT's definition for disasters includes all disaster types defined by the UN definition of disasters, which is "a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected people to cope using their own resources" (UN-DHA/IDNDR 1992: 27). Finally, the following definition is applied in the EM-DAT database: "a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering."

For a disaster to be entered into EM-DAT, at least one of the following criteria must be fulfilled:

- 10 or more people reported killed;
- 100 or more people reported affected;
- A declaration of a state of emergency;
- A call for international assistance.

In EM-DAT, the *number of persons killed* by a disaster is defined as "persons confirmed as dead and persons missing and presumed dead." The *number of persons injured* is defined as "people suffering from physical injuries, trauma or an illness requiring medical treatment as a direct result of a disaster." *Homeless people* are "people needing immediate assistance for shelter." *Affected people* are those who "require immediate assistance during a period of emergency, including displaced or evacuated people." The *total number of affected persons* is the sum of all injured, homeless, and affected people. The economic impact of a disaster usually consists of direct consequences on the local economy along with indirect consequences. In EM-DAT, the registered figures correspond to the value of the immediate damage at the time of the event and usually only to the direct damage, expressed in thousands of US$ (current value). Each disaster entry in EM-DAT consists of a set of fields that is universal for all entries in the database (table 40.2).

A data validation process allows for the comparison and selection of data compiled from different sources. An automatic error system alerts for suspect data (e.g. >10 per cent of the population killed). Economic loss data are cross-checked and completed with data from the MünichRe NatCat database (men-

11 See at: <http://go.worldbank.org/21P88LVQO0> (2 June 2009).

Table 40.2: Overview of main information fields included in the EM-DAT database. **Source**: The authors.

Field name	Content of field
DISNO	8-digit disaster ID composed of year + sequential number (e.g. 2008-0525)
Country	country(ies) of disaster occurrence
Disaster group	natural disasters or technological disasters
Disaster sub-group	geophysical, meteorological, hydrological, climatological and biological disasters
Disaster type and sub-type	description of the disaster according to a pre-defined classification
Date	start and end date of the disaster
People killed	number of people killed, including missing persons (official figures)
People injured	number of people injured
People homeless	number of people homeless
People affected	number of people affected
Total affected	sum of injured, homeless and affected people
Victims	sum of killed and total affected
Estimated damage	estimated economic damage in thousands of US$
Geographical information	location, latitude and longitude
Additional fields	e.g. scale of disaster, international status, aid contribution, affected sectors

tioned earlier). Validated data are uploaded to the EM-DAT website on a three-month interval.

An often used method to take into account the long-term impact of a multi-year disaster is by dividing the impact indicators by the number of years that the disaster persists. Only for the number of people reported affected, is the number repeated for each year during the disaster. The same applies for disasters that overlap at the end and beginning of a calendar year. The number of deaths is registered according to the year of onset of the disaster for sudden onset disasters only. Reported economic damages are attributed to the end year of the disaster.

40.2.3 Disasters: How Are They Classified?

CRED and MünichRe have recently led a collaborative initiative on a Disaster Category Classification for Operational Databases in order to create standardized terminology for global and regional databases on natural disasters for the use of comparing and exchanging disaster data (CRED/MunichRe 2008).[12] The definitions for geophysical, meteorological, hydrological, climatological and biological disasters are presented in table 40.3. In this chapter, the climatological, hydrological and meteorological events are defined as *hydro-meteorological* or *climate-related* disasters. Annex 1 and 2 provide a detailed overview of the natural disaster classification by sub-groups, as well as the definitions of natural disaster types.

Table 40.3: Definitions of the main disaster sub-groups as used in the EM-DAT database. **Source**: The authors.

Disaster Sub-group	Definition
Geophysical	events originating from solid earth
Meteorological	events caused by short-lived/small to meso scale atmospheric processes (in the spectrum from minutes to days)
Hydrological	events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up
Climatological	events caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)
Biological	disaster caused by the exposure of living organisms to germs and toxic substances

40.2.4 Droughts – A Special Case

Droughts have always been among the most pervasive of all natural disasters. This assertion is substantiated by historical data collected and maintained in EM-DAT, which is widely cited in peer-reviewed literature, policy papers and international disaster reduction strategy documents. However, difficulties related to the slow-onset, spatially extensive, prolonged and complex nature of droughts have created inconsistencies concerning the identification of start and end dates. In addition, both the misattribution of drought-related losses, and problems reconciling multi-year and multi-country events within the EM-DAT database structure, have also presented challenges.

In earlier stages, all disasters were entered in EM-DAT by year and country, which meant that a new

12 See at: <http://www.emdat.be/Documents/CredCrunch/Cred%20Crunch%2013.pdf> (2 June 2009).

record and identification number was created for each country affected by a disaster. In cases of disasters involving several countries, multiple country-level disaster events were entered into the database. Similarly, if an event lasted more than one year, then the event had an individual entry for each year and the loss data were cumulative.

In addition to the temporal and spatial information, both multi-year and multi-country events also posed difficulties in documenting economic losses. Much of the available quantitative information about drought impacts is ambiguous as to the location and time period for which it is valid. Some statistics may be cumulative since the beginning of the drought, or may only refer to a specific location within a larger area. In the past, this would lead to over- or underestimation of the actual costs. Unlike other disaster types, no specialized dataset is currently available to cross-check drought statistics.

Drought-related famines pose their own documentation problems. As with droughts, they are often multi-country or multi-year events. A famine is not a hazard, but rather a disaster outcome and often a consequence of multiple natural and non-natural factors (e.g. drought, conflict and economic disruption). It is therefore difficult to identify the dominant causal factors that lead to famine and link them to the natural disasters included in EM-DAT.

Within this context, CRED, in collaboration with the *International Research Institute for Climate and Society* (IRI), which is a cooperative agreement between the *National Oceanic and Atmospheric Administration* (NOAA) Climate Program Office and Columbia University and part of the Earth Institute at Columbia University, undertook a comprehensive review of over 800 drought disasters and 76 famines from 1900–2004 recorded in EM-DAT against 1500 original sources, and assigned adjusted temporal information and loss data (Below/Grover-Kopec/Dilley 2007: 332). The review included the development and application of a standardized methodology designed to address four principal problems: 1) lack of a standard method for establishing attribution of drought-related losses; 2) inconsistencies in recording start and end dates; 3) problems created by multi-year droughts; and 4) the need to improve the handling of droughts that affect multiple countries. The outcome of this revision of the data was a decrease in the number of reported droughts by 56 per cent, an increase in the number of reported deaths by 20 per cent, and an increase in reported economic losses by 35 per cent.

40.2.5 Challenges of Disaster Data

Similar to all global datasets, there are limitations to the disaster data. The intent behind the reporting of disaster data by sources can differ, and data may not be specifically gathered for statistical purposes. Data collection methods are often not transparent, which hinders the evaluation of the data quality. Therefore, disaster statistics depend on the reporting sources to a large extent. There are also ambiguities in definitions or thresholds, as previously mentioned. The definition of people affected by disasters remains broad, which compromises the comparability of the data. The number of deaths due to a disaster may include missing people when not reported clearly, thereby inflating or deflating mortality figures. In certain areas, economic losses are loosely reported or missing, which is notably due to problems related to damage assessment. Although standard methods for assessing economic losses are under development by the *Economic Commission for Latin America and the Caribbean* (ECLAC), for example, there is not yet an internationally accepted method that can be used globally and across all disaster types. However, economic loss data are cross-checked with other specialized sources, like MunichRe. While no database can capture complete information on all events, numbers within EM-DAT provide insight into trends which can be used to appreciate the direction and comparative impact of different disasters. On a positive note, more consensus has been reached on definitions and thresholds in reported statistics in recent years.

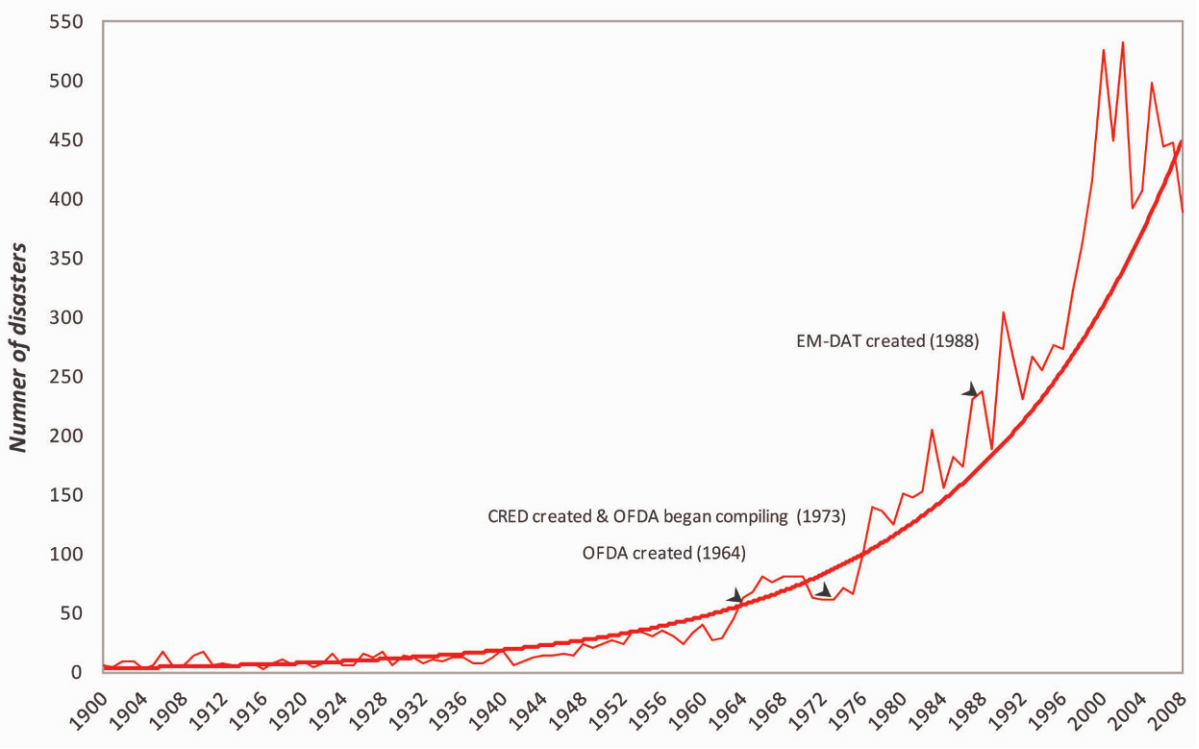
40.3 Patterns and Trends in Natural Disasters

This section describes the patterns and trends of natural disasters from three perspectives: long term trends from 1900 to 2008, an overview from 1980 to 2008 – a period when the reliability of disaster data has vastly improved – and the most recent disaster data in 2008 compared to previous years.

40.3.1 Interpretation of Long Term Trends of Natural Disasters

More than 11,000 natural disasters are registered in EM-DAT dating back to 1900. Of these, about 80 per cent occurred during the last 30 years. One of the main contributors to this apparent increase in natural disasters is related to better reporting due to the

Figure 40.1: Reported natural disaster occurrence in EM-DAT 1900-2008. **Source:** EM-DAT.



launch of both OFDA-USAID in 1964 and CRED in 1973.

Figure 40.1 might lead one to believe that disasters occur more frequently today than in earlier decades. However, reaching such a conclusion based only on this graph would be incorrect. When interpreting disaster data, one has to take into account the inherent complexity of disaster occurrence, human vulnerabilities, and statistical reporting and registering. Furthermore, the development of telecommunications and media, increased humanitarian funds and reinforced international cooperation have all contributed to a better reporting of disasters, particularly of smaller-scale disasters.

40.3.2 Patterns and Trends from 1980 to 2008

From 1980 onwards, data quality and coverage have improved substantially. Media coverage of world events expanded widely, and telecommunication costs decreased. Increased use of internet and email correspondence also made disaster reporting faster and of higher quality. Below, patterns and trends are reviewed using data since 1980.

40.3.2.1 Which Disaster Types Take the Lead? Overview from 1980 to 2008

From 1980 to 2008, hydrological (floods and wet mass movements; 38 per cent) and meteorological disasters (storms; 27 per cent) occurred most often, globally. Together, they represented 65 per cent of the total disaster occurrence during this period (figure 40.2). Floods and wet mass movements accounted for more than half of the total number of victims caused by natural disasters worldwide, whereas a third of the victims were caused by extreme temperatures, droughts and wildfires (figure 40.3). Economic damages were mostly due to meteorological disasters (39 per cent;). From 1980 to 2008, the number of reported natural disasters increased steadily, from more than 150 disasters in 1980 to almost 400 in 2008 (figure 40.5). Likewise, the total number of victims reported worldwide by natural disasters has increased. When looking at the human impact in more detail, it appears that, while the total number of affected persons increased, the number of people reported killed by natural disasters remained relatively stable (figure 40.6). Inherent to global disaster data statistics is the influence of the occurrence of major events and of annual monitoring of disasters, which distort the disaster picture in time. For example, a major peak in the

reported number of people killed occurred in 1983, reflecting the droughts in Ethiopia and Sudan. These droughts were multi-year events that started in 1983 and continued in the next years. The peak in 2004 was due to the Indian Ocean tsunami, the peak in 1991 was due to the Yangtze River floods in China, and the peak in 2008 was the joint consequence of cyclone Nargis in Myanmar and the earthquake in China. These two latter events will be discussed further. In reality, the numbers of people killed by disasters peak on a regular basis and may display an increasing trend once additional years of data can be added for analyses.

Figure 40.2: Average global reported natural disaster occurrence per sub-group from 1980 to 2008. **Source:** CRED, EM-DAT.

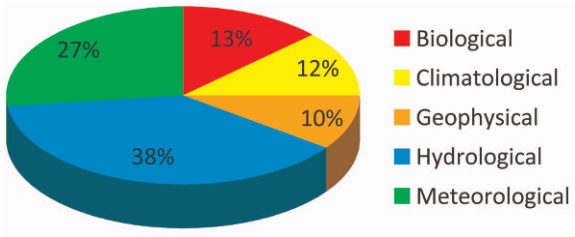


Figure 40.3: Average global reported number of victims per disaster sub-group from 1980 to 2008. **Source:** CRED, EM-DAT.

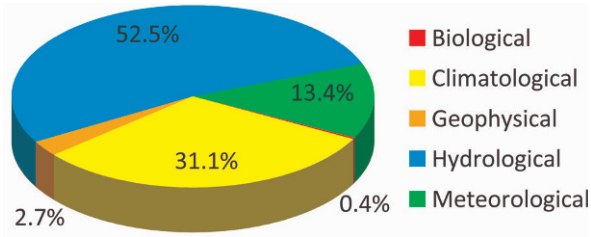
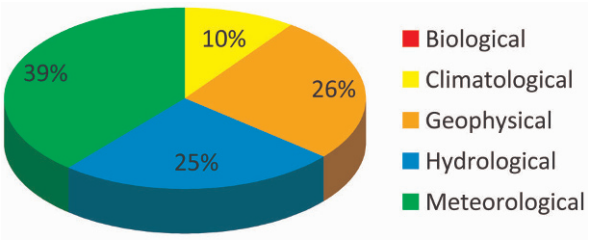


Figure 40.4: Average global reported economic damages per disaster sub-group from 1980 to 2008. **Source:** CRED, EM-DAT.



40.3.2.2 Focus on Climate-related Disasters: 1980 to 2008[13]

Hydro-meteorological disasters, also referred to as climate-related disasters, have had various impacts on human populations, depending on the type of the disaster and its geographical location. In recent years, floods of different types increased significantly all over the world. The industrialized countries saw unprecedented devastation and an increased frequency of floods, as had developing countries. The greatest increase of flooding, both in frequency and in severity, was in the Asian continent[14], ruining harvests and contaminating agricultural soil in large parts of deltaic regions such as the ones surrounding the Mekong River or the Gangetic plains. China also experienced spectacular floods over this period that destroyed millions of hectares of agricultural land and displaced more than a hundred million people. The effects of these floods were not only limited to the destruction and loss of agricultural produce of subsistence-farming families, but they also increasingly caused more direct fatalities than in the past. In addition to the increase in flooding, extreme temperature also affected Europe over the last decade. The largest number of heat and cold waves recorded in the European continent were responsible for nearly 90,000 direct fatalities (table 40.4). This has had a tremendous impact on the public consciousness of European citizens, contributing to the issue of climate extremes becoming a priority on the disaster preparedness agenda.

Figure 40.7 shows the reported economic damage costs of climate-related disasters from 1980 to 2008. Analysing data on the economic costs of climate-related disasters can be a misleading exercise when done on a global scale. This is largely due to the fact that higher property values and insurance penetration in wealthier countries distort damage assessment reports. For example, when economic costs of damage from a storm in Bangladesh are compared to a storm

13 See also the CRED CRUNCH quarterly newsletter on natural disasters in EM-DAT on floods at: <http://www.emdat.be/Documents/CredCrunch/Cred%20Crunch%2011.pdf>; on extreme temperatures at: <http://www.emdat.be/Documents/CredCrunch/Cred%20Crunch%209.pdf>; on droughts at: <http://www.emdat.be/Documents/CredCrunch/Cred%20Crunch%207.pdf>; and on storms at: <http://www.emdat.be/Documents/CredCrunch/Cred%20Crunch%203.pdf>

14 Composition of geographical regions is based on the United Nations Statistics Division's classification <http://unstats.un.org/unsd/methods/m49/m49regin.htm> (2 June 2009).

Figure 40.5: Trend in global reported natural disaster occurrence per sub-group. **Source:** CRED, EM-DAT.

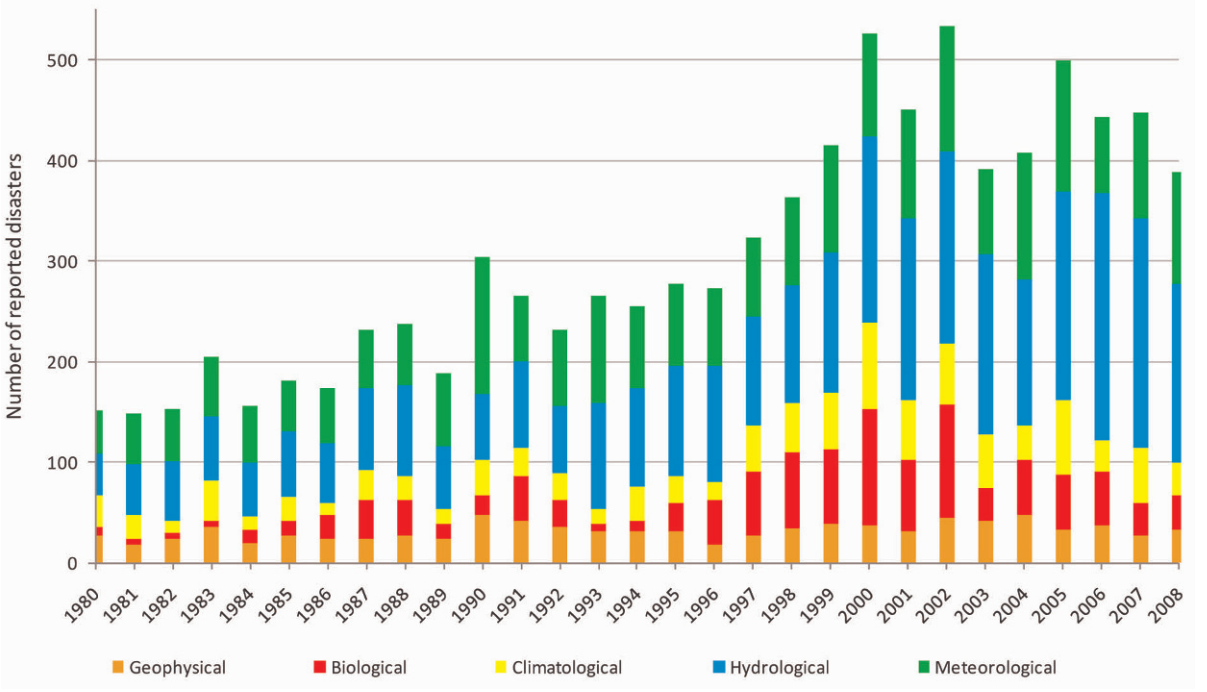
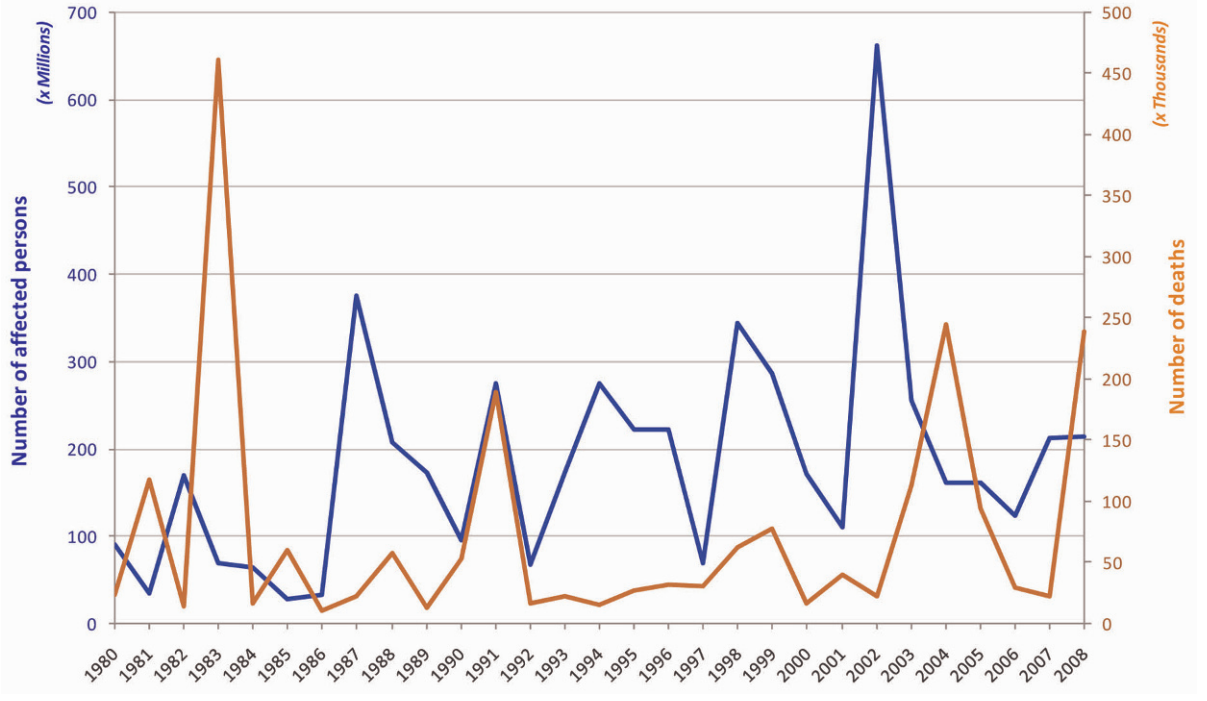


Figure 40.6: Trend in number of persons reported affected and killed by natural disasters. **Source:** CRED, EM-DAT.



in Florida, the relative impact is not adequately captured. In developing countries most of the damages occur in the informal sector. This is not captured by the classic loss assessments. Neither are the costs of human lives lost included in these calculations. From the data that is available, from 1980 to 2008 the major economic impact was in the Americas with the main contribution originating in Northern America. However, Asia also presented high economic losses, mainly due to flooding as the frequency and severity has in-

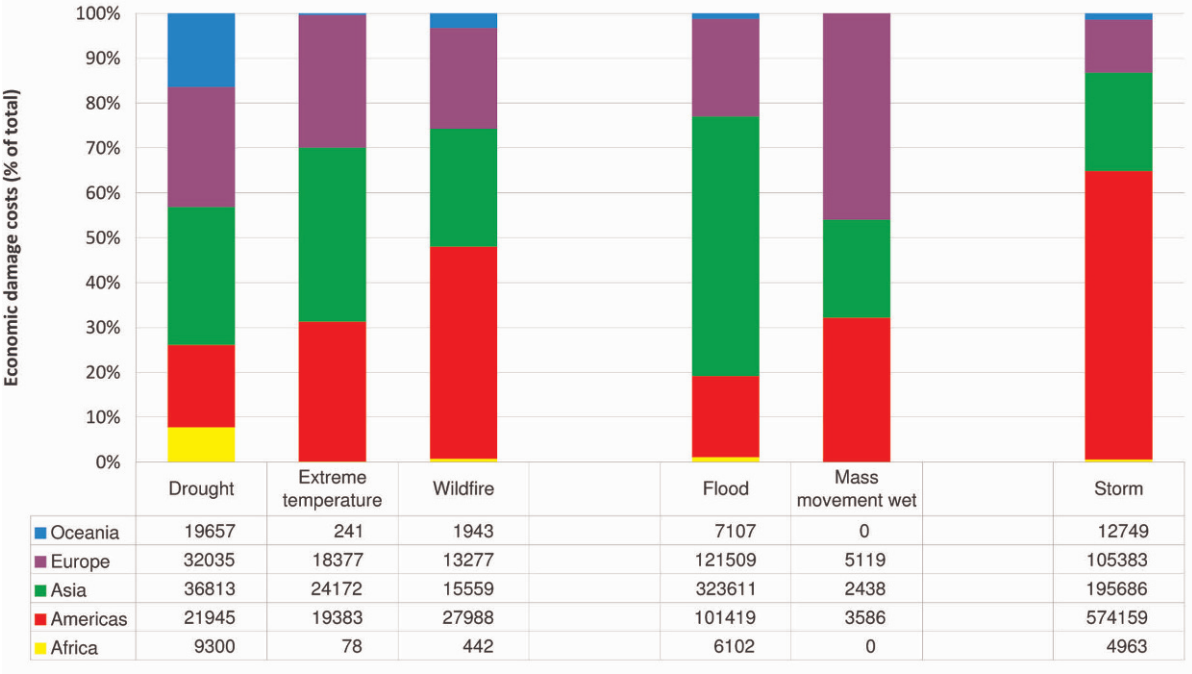
Table 40.4: Hydro-meteorological disaster occurrence and impact per disaster type and per continent from 1980 to 2008. **Source:** CRED, EM-DAT.

Disaster	Disaster type	Continent	N° events	N° killed	N° affected (x1000)
Climatological	**Drought**	Africa	186	553 093	259 289
		Americas	84	73	44 194
		Asia	97	5 308	1 238 805
		Europe	35	2	10 483
		Oceania	14	60	8 028
	Extreme temperature	Africa	10	227	1 000
		Americas	68	4 950	4 974
		Asia	105	15 680	80 137
		Europe	144	82 198	841
		Oceania	5	23	4 601
	Wildfire	Africa	22	264	17
		Americas	106	207	1 216
		Asia	58	690	3 226
		Europe	88	420	1 287
		Oceania	22	119	76
Hydrological	**Flood**	Africa	586	16 220	42 406
		Americas	682	48 021	60 393
		Asia	1 216	130 450	2 683 048
		Europe	393	2 406	8 684
		Oceania	94	255	623
	Mass movement wet	Africa	20	354	23
		Americas	101	5 782	1 417
		Asia	232	13 883	5 587
		Europe	42	1 175	33
		Oceania	13	354	20
Meteorological	**Storm**	Africa	156	3 434	10 795
		Americas	784	38 428	45 732
		Asia	954	383 363	644 016
		Europe	352	2 178	8 418
		Oceania	181	839	5 823
Total			**6 850**	**1 310 456**	**5 175 189**

creased in low-middle income countries such as China. Data on Africa reveal a crucial lack of reporting of natural disasters in general, and more particularly of economic losses due to disasters. Various countries in the African continent are often hit by droughts and floods, which are slow-onset disasters. These types of disasters can have impacts which are typically difficult to measure, since they affect many facets of life, livelihoods and economic structures over long periods of time.

Biological disasters, mainly comprised of epidemics and insect infestations, are another disaster subgroup in EM-DAT. Epidemics are defined as either an unusual increase in the number of cases of an existing infectious disease in the region or population of concern; or the appearance of an infection previously absent within a region (UN-DHA/IDNDR 1992: 35).

Figure 40.7: Average economic damage costs of hydro-meteorological disasters by continent from 1980 to 2008 (in million 2008 US$). **Source:** CRED, EM-DAT.



	Drought	Extreme temperature	Wildfire	Flood	Mass movement wet	Storm
Oceania	19657	241	1943	7107	0	12749
Europe	32035	18377	13277	121509	5119	105383
Asia	36813	24172	15559	323611	2438	195686
Americas	21945	19383	27988	101419	3586	574159
Africa	9300	78	442	6102	0	4963

The compilation of data on epidemics, besides the registration of occurrence, is a complex issue that CRED has not approached with as much thoroughness as other types of natural disasters. Part of the reason for this is the existence of other renowned epidemiological surveillance organizations, such as the WHO's Department of Communicable Disease Surveillance and Response and *Centres for Disease Control and Prevention's* (CDC) Centre for Infectious Diseases. Therefore, the analyses focuses next on the distributions and impacts of geophysical and climate-related disasters.

40.3.2.3 Where Do Natural Disasters Strike? Overview from 1980 to 2008

Figure 40.8 shows the spatial distribution of reported natural disasters by country. From 1980 to 2008, the most affected regions were Southern and South-Eastern Asia followed by Northern and South America. In particular, the United States (U.S.), Mexico, China, India, the Philippines, Indonesia, Bangladesh, Japan, Iran, Vietnam, Russia and Australia were prone to disasters. Figure 40.8 shows natural hazard boundaries, such as the Pacific's volcanic ring of fire, the cyclone and storm paths of Eastern Asia, the Eastern seaboard of Northern America and the tectonic plates.

As disasters are entered in the EM-DAT database by country and the criteria for inclusion are primarily based on the human impact of an event, countries covering large areas with large populations naturally present themselves as those with highest impacts. Below, these variables are accounted for and standardized to display a more realistic view of the effects of natural disasters (see 40.3.2.5).

From 1980 to 2008, Asia was the region most affected by natural disasters. More than 40 per cent of natural disasters occurred in this continent, accounting for almost 90 per cent of the total number of victims (figures 40.9 and 40.10). The Americas and Europe both had a significant share in reported disaster occurrence (26 per cent and 15 per cent respectively), yet together these two continents represented only 3.8 per cent of the total reported number of victims. Economic damage costs from 1980 to 2008 were mostly accounted for by Asia (44 per cent), followed by the Americas (38 per cent). Although the reported number of victims was relatively small, compared to the occurrence of natural disasters, in the Americas and Europe, the reported damage costs were high. On the other end of the scale, Africa accounted for 13 per cent of reported disaster occurrence and less than 1.5 per cent of global reported economic damage costs from natural disasters from 1980 to 2008.

Figure 40.8: Global map of reported natural disasters by country from 1980 to 2008. **Source:** CRED, EM-DAT.

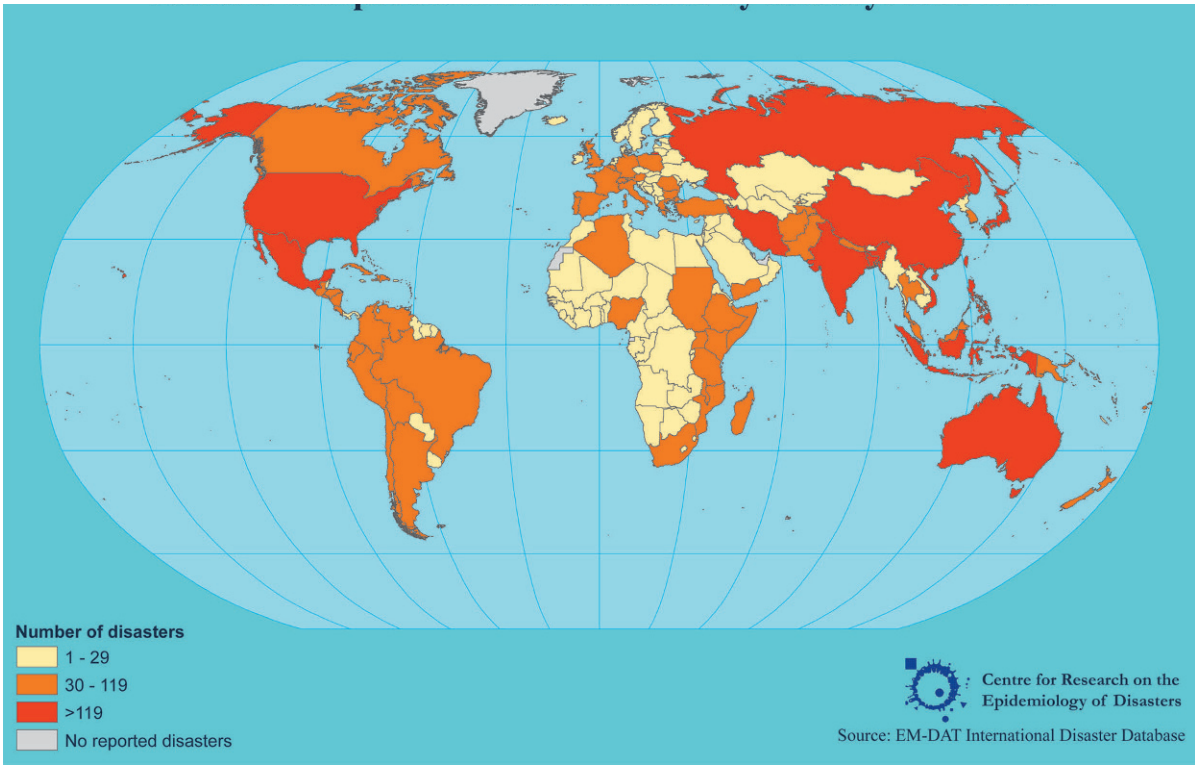


Figure 40.9: Average global reported natural disaster occurrence by region from 1980 to 2008 **Source:** CRED, EM-DAT.

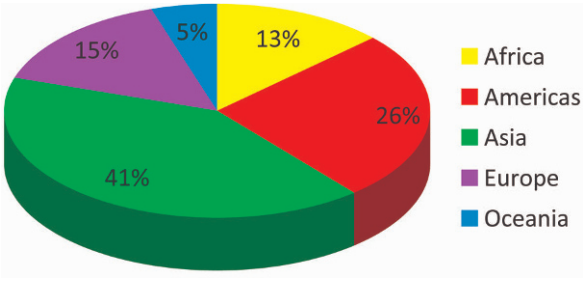


Figure 40.10: Average global reported number of victims by region from 1980 to 2008. **Source:** CRED, EM-DAT.

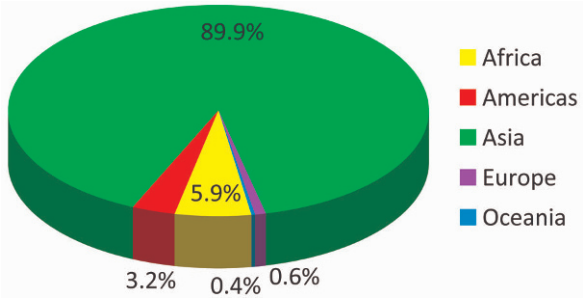
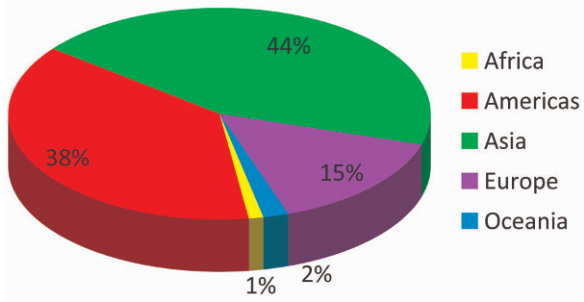


Figure 40.11: Average global reported economic damages by region from 1980 to 2008. **Source:** CRED, EM-DAT.



40.3.2.4 Major Natural Disasters from 1980 to 2008

As table 40.5 and table 40.6 show, the most significant disasters in terms of people killed or affected from 1980 to 2008 have occurred in two continents of the developing world.

The two major droughts that led to famines in all Sahelian countries ranked high on the list with nearly half a million deaths registered due to drought. This is particularly notable as 'deaths due to droughts' are rare. These deaths are often attributed to infectious diseases and diarrhoea, but rarely to malnutrition or

'drought'. These registered figures are probably underestimations of the real mortality rate due to the drought-related famines in these years.

Table 40.5: Top 10 disasters by reported number of people killed from 1980 to 2008. **Source:** CRED, EM-DAT.

Disaster type	Year(s)	Country	N° deaths
Drought	1983-1984	Ethiopia	300 000
Tsunami	Dec 26 2004	Indonesia	165 708
Drought	1983-1985	Sudan	150 000
Storm	Apr-May 1991	Bangladesh	138 866
Storm	May 2/3 2008	Myanmar	138 366
Drought	1981-1985	Mozambique	100 000
Earthquake	May 12 2008	China	87 476
Earthquake	Oct 8 2005	Pakistan	73 338
Earthquake	Jun 21 1990	Iran	40 000
Tsunami	Dec 26 2004	Sri Lanka	35 399

Table 40.6: Top 10 disasters by total reported number of people affected (x1000) from 1980 to 2008. **Source:** CRED, EM-DAT.

Disaster type	Year(s)	Country	N° affected (x1000)
Drought	May-Aug 1987	India	300 000
Drought	Jul 2002	India	300 000
Flood	Jul-Aug 1998	China	238 973
Flood	Jun-Aug 1991	China	210 232
Flood	Jun-Jul 1996	China	154 634
Flood	Jun-Jul 2003	China	150 146
Flood	Jul 8-31 1993	India	128 000
Flood	May-Aug 1995	China	114 470
Flood	Jun-Jul 2007	China	105 004
Flood	Jun-Aug 1999	China	101 024

Tropical cyclone Brendan hit South-Eastern Bangladesh in 1991 with estimated wind speeds of up to 250 kilometres per hour. As often happens with storms, the heavy rainfall and associated flooding rather than wind strength caused most of the deaths and resulted in more than 15 million people affected.

The 2004 Tsunami that mainly affected Asia shows the enormous impact of this event in terms of the number of people killed. Cyclone Nargis, which hit Myanmar in May 2008, claimed over 138,000 lives, and is the third deadliest cyclone ever recorded in EM-DAT. The Sichuan earthquake is the third deadliest disaster in recent Chinese history with more than 87,000 people killed.

Among the top ten affected countries, India ranks first and second, again with droughts. The large and dense population of the country contributes to the high numbers of affected people by any natural event. The same holds true for China. Although the population density is not quite as high in some parts of China, like the Gobi Desert which is practically uninhabitable, a flood in an inhabited area immediately affects many people.

40.3.2.5 Standardizing Disaster Impact

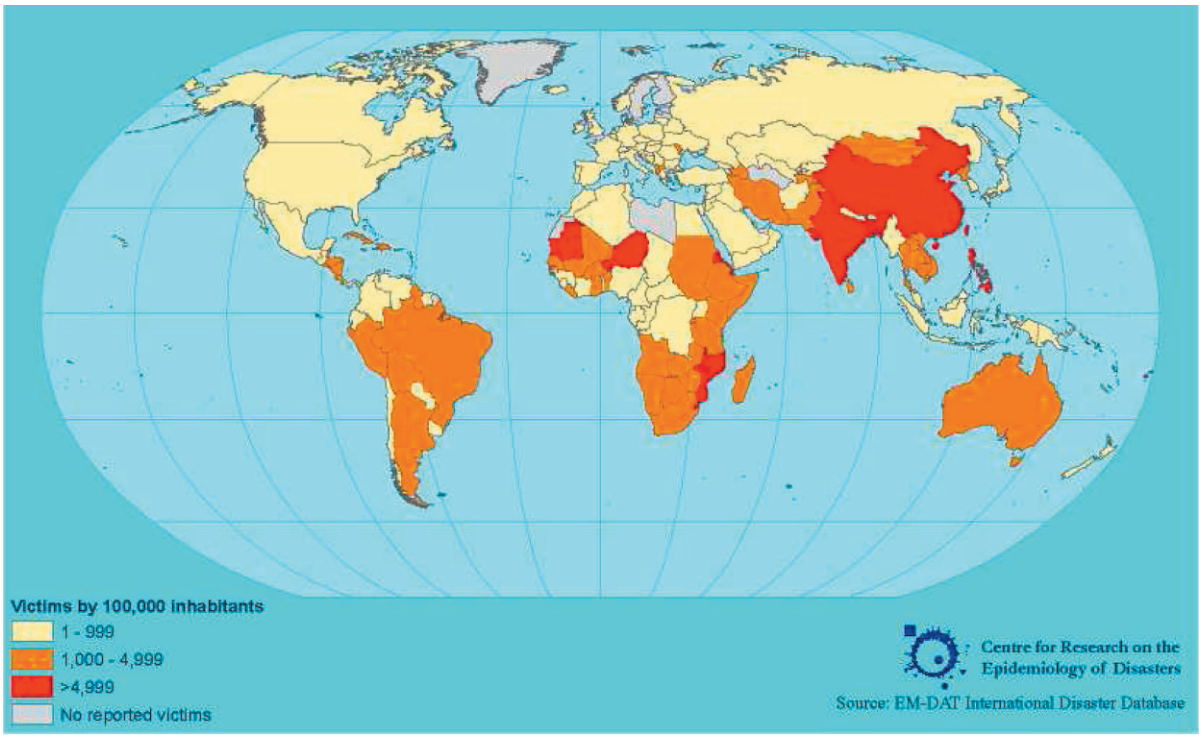
As mentioned before, absolute numbers, while they provide insights, require standardization to control for a variability between units of observation. The two main parameters that vary between countries and have a direct relationship with disasters and their impact are: population size and land surface. We present here the EM-DAT data standardized by these two variables. We are also aware that further refinements, such as excluding land surfaces that are non-inhabited, could also further change the rankings.

Countries in Southern and Eastern Asia, particularly Bangladesh, China and India, remain in the top rankings with a high proportion of the population affected by natural disasters. All have areas of high population density, especially in river basins, and are home to populations whose livelihoods often rely on agriculture. When floods occur, the number of affected communities quickly reach the hundred thousands, and in some cases, millions.

Several countries in Southern and Eastern Africa are added to this list, although they did not show in Figure 40.8 based on the ranking by disaster occurrence. In figure 40.12, Swaziland, Djibouti, Malawi and Mauritania are ranked in the highest category, together with Niger, Eritrea and Mozambique. The development burden of disasters where rates are more than 5,000 victims per 100,000 inhabitants can be crippling for many of these countries, especially those facing difficulties to maintain minimal growth.

The countries with the highest average number of victims per 100,000 inhabitants from 1980 to 2008 are: Swaziland (9,833), Bangladesh (9,434), Djibouti (8,869), China (7,079) and Malawi (6,935). Approximately 1 in every 7 to 10 persons was either reported killed or affected by natural disasters during this period. Inhabitants of certain small island states also had a large number of reported victims in this period, as was the case for Antigua and Barbuda (9,055), Vanuatu (6,221) and Samoa (6,080).

Figure 40.12: Number of reported victims of natural disasters by 100,000 inhabitants: 1980-2008. **Source:** CRED, EM-DAT.



Countries such as the U.S., Indonesia, Russia, or Japan, which in figure 40.8 of global disaster occurrence were placed in the highest category, are now placed in the lowest category in Figure 40.12, with the reported number of victims per hundred thousand inhabitants being 313 (U.S. and Indonesia), 151 (Russia) and 91 (Japan).

Looking at the number of natural disasters per 1,000 km² can also offer some interesting insights into which countries have a high incidence of disaster occurrence. Controlling for land surface, the most vulnerable countries, almost without exception, were the small island states. The top ranking countries in terms of numbers of disasters per 1,000 km² were Tokelau (245), Tuvalu (154), Bermuda (100), Montserrat (69) and Anguilla (56), all are small island states in the Pacific or the Caribbean.

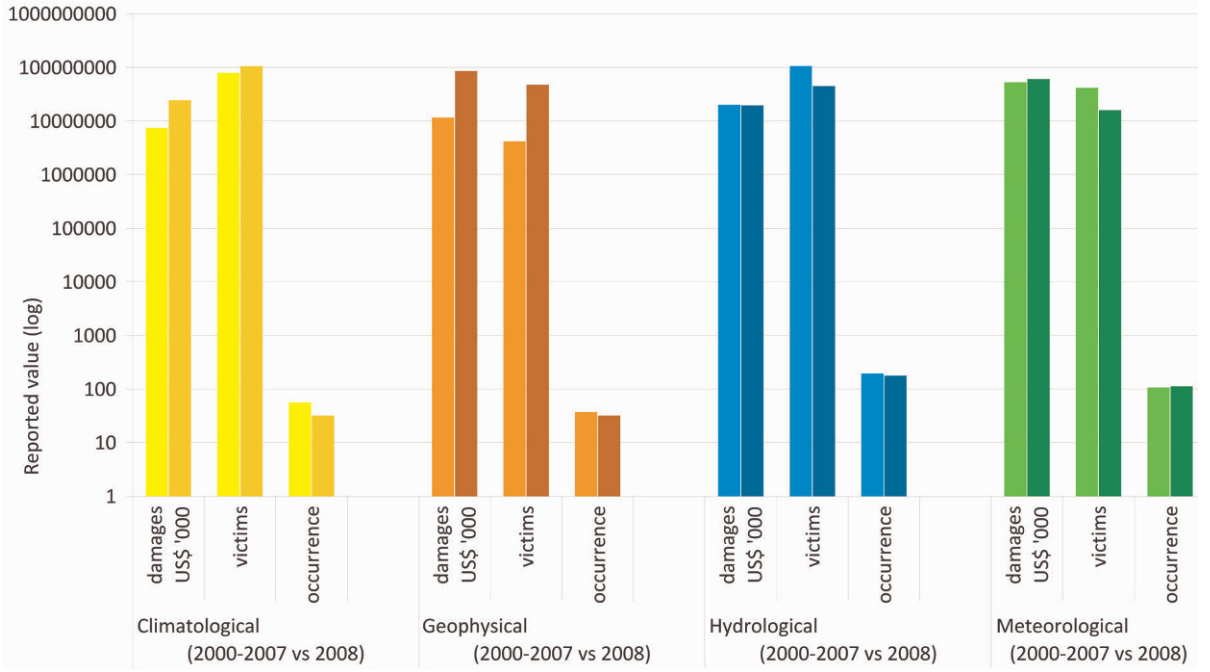
Interestingly, countries such as the U.S., China and India, which ranked high in absolute number of disasters, by this indicator dropped to 0.06 disasters per 1,000 km² in China and the U.S., and 0.10 disasters per 1,000 km² in India.

Finally, table 40.7 lists the 10 most affected countries in terms of economic damage costs from natural disasters relative to country *Gross Domestic Products* (GDP) on average from 1980 to 2008. Here again, either small island states or small poor countries featured at the top 10 of the global ranking. Despite the enormous world attention frequently generated by disasters such as the Indian Ocean Tsunami in Indonesia, Sri Lanka, India and Thailand, or the Bam earthquake in Iran, the effects on the GDP of these countries tend to be relatively less significant. To get

Table 40.7: Top 10 countries average annual total economic damages as proportion of GDP from 1980 to 2008. **Source:** CRED, EM-DAT.

Country	Economic damage by GDP (%)
St. Lucia	29 %
St. Kitts & Nevis	13 %
Vanuata	11 %
Grenada	9 %
Tonga	4 %
EL Salvador	4 %
Honduras	4 %
Nicaragua	4 %
Maldives	3 %
Nepal	3 %

Figure 40.13: Natural disasters impacts by major disaster sub-group: 2008 versus 2000-2007 annual average. **Source:** CRED, EM-DAT.



a useful perspective on the extent to which natural disasters affect a developing country's economy, a comparison relating it to GDP or another appropriate economic indicator is essential. Here we present only a rough idea of what the global ranking could look like if such a comparison was made.

The economic damage costs of natural disasters relative to the country's GDP reveals the economic consequences of disasters on a specific country. The bias in the economic data due to insurance coverage and property values has been mentioned earlier. There is an additional bias of disaster damage costs being reported more frequently for larger disasters, while small and medium disasters often do not provide an adequate loss assessment figure (chap. 31 by Marulanda/Cardona/Barbat). Therefore, these data tend to be underestimated, especially for developing countries (Guha-Sapir/D'Aoust/Vos/Hoyois 2009: i.p.).

40.3.3 Natural Disasters in the Short Term: Recent Trends

In 2008, immense human and economic losses due to natural disasters were reported. More than 235,000 people were killed, 214 million people affected and economic costs were over 190 billion US$. This section summarizes the natural disaster impacts in 2008 and compares the impact of the main disaster types in each continent to the previous years.

40.3.3.1 Natural Disaster Occurrence and Impact: 2008 Compared to 2000-2007

In 2008, 354 natural disasters were recorded in the EM-DAT database, which is less than the 2000–2007 yearly average of 397. The reported death toll in 2008 was over 3-fold the annual average of 2000–2007 (66,800), mainly caused by two major events: Cyclone Nargis in Myanmar and the Sichuan earthquake in China. Disaster costs in 2008 were more than twice the 82 billion US$ annual average of 2000–2007 and were mainly attributed to the Sichuan earthquake in China (85 billion US$) and hurricane Ike in the U.S. (30 billion US$).

In 2008, large populations were affected by few natural disasters. The earthquake and severe winter conditions in China affected a total of 122 million people. Droughts affected 14 million people in Africa and 12 million people in Asia. Severe weather conditions in the U.S. in May and June 2008 affected 11 million people. Figure 40.14 and figure 40.16 show the reported occurrence, total number of affected people and economic costs of global natural disasters in 2008.

Asia remained the most affected continent. Nine of the top 10 countries with the highest number of

Table 40.8: Natural disaster occurrence and impacts: regional statistics. **Source:** CRED, EM-DAT.

No. of Natural Disasters	Africa	Americas	Asia	Europe	Oceania	Global
Climatological 2008	10	4	9	9	0	**32**
Avg. 2000-07	9	14	13	19	2	**57**
Geophysical 2008	3	8	18	2	1	**32**
Avg. 2000-07	3	7	22	3	2	**37**
Hydrological 2008	48	39	73	9	9	**178**
Avg. 2000-07	42	39	82	28	5	**196**
Meteorological 2008	10	44	43	13	2	**112**
Avg. 2000-07	9	34	42	15	7	**107**
Total 2008	**71**	**95**	**143**	**33**	**12**	**354**
Avg. 2000-07	**63**	**94**	**160**	**65**	**16**	**397**
No. of Victims (millions)	**Africa**	**Americas**	**Asia**	**Europe**	**Oceania**	**Global**
Climatological 2008	14.5	0.1	91.1	0.00	0.0	**105.6**
Avg. 2000-07	9.6	1.1	68.4	0.33	0.0	**79.5**
Geophysical 2008	0.0	0.1	47.6	0.01	0.0	**47.8**
Avg. 2000-07	0.1	0.4	3.6	0.01	0.0	**4.2**
Hydrological 2008	1.0	15.9	27.7	0.24	0.1	**44.9**
Avg. 2000-07	2.5	1.3	101.7	0.39	0.0	**105.9**
Meteorological 2008	0.8	3.7	11.4	0.00	0.0	**15.9**
Avg. 2000-07	0.4	2.8	38.0	0.41	0.0	**41.7**
Total 2008	**16.2**	**19.9**	**177.8**	**0.26**	**0.1**	**214.3**
Avg. 2000-07	**12.6**	**5.6**	**211.8**	**1.13**	**0.1**	**231.2**
Damages (2008 US$ bn)	**Africa**	**Americas**	**Asia**	**Europe**	**Oceania**	**Global**
Climatological 2008	0.4	2.0	21.9	0.0	0.0	**24.4**
Avg. 2000-07	0.0	2.4	1.1	3.5	0.4	**7.4**
Geophysical 2008	0.0	0.0	85.8	0.0	0.0	**85.8**
Avg. 2000-07	0.8	1.0	9.5	0.3	0.0	**11.6**
Hydrological 2008	0.3	12.1	3.7	1.3	2.1	**19.5**
Avg. 2000-07	0.4	1.9	9.7	7.7	0.3	**19.9**
Meteorological 2008	0.1	50.0	6.8	3.4	0.5	**60.7**
Avg. 2000-07	0.1	38.6	10.7	3.0	0.3	**52.6**
Total 2008	**0.9**	**64.0**	**118.2**	**4.7**	**2.5**	**190.3**
Avg. 2000-07	**1.3**	**43.8**	**31.0**	**14.5**	**1.0**	**91.6**

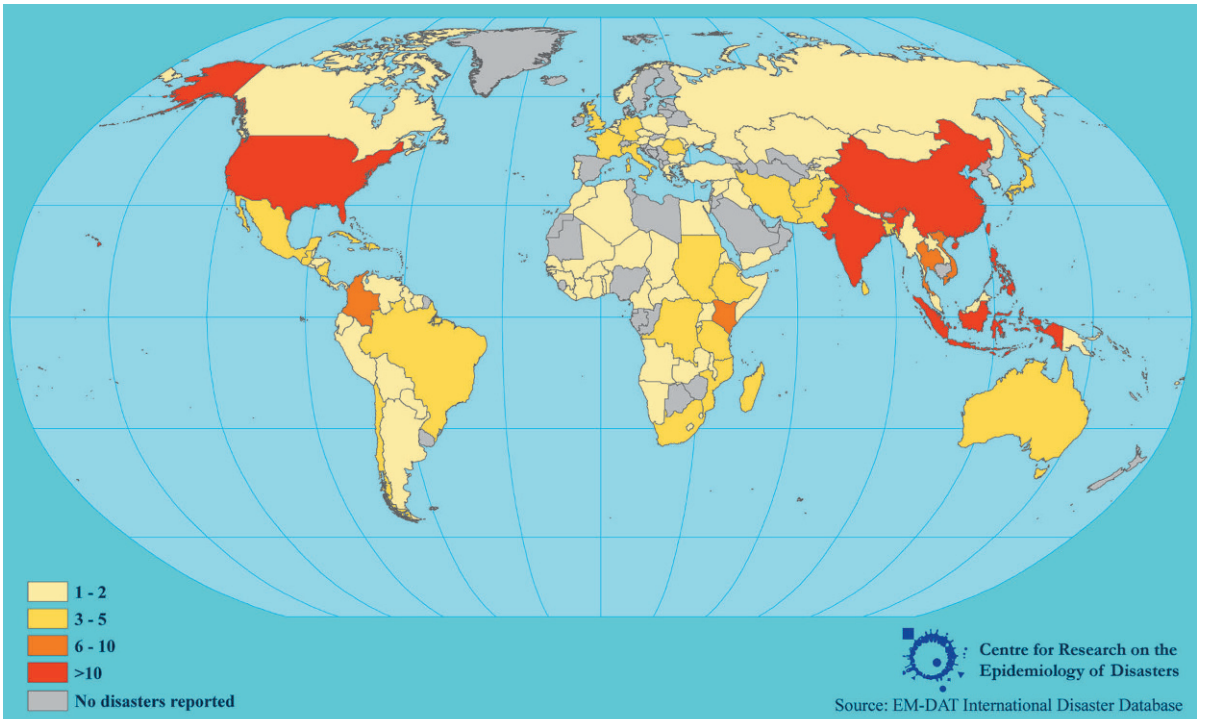
disaster-related deaths were in Asia. While China, the U.S., the Philippines and Indonesia reported the largest number of natural disasters, Djibouti, Tajikistan, Somalia and Eritrea topped the list of number of victims per 100,000 inhabitants.

Although less pronounced than in other years, 2008 continued the upward global trend in natural disaster occurrence observed over the last decade. As in previous years, hydrological and meteorological disasters were the main contributors to this pattern.

40.3.3.2 How are Disaster Types Distributed Today?

In 2008, geophysical disaster occurrence (32) increased compared to 2007 (26), but still remained far below the 2000–2007 annual average of 37 reported

Figure 40.14: Global map of reported number of natural disasters in 2008. **Source:** CRED, EM-DAT.



disasters (figure 40.13, table 40.8). The human impacts of these geophysical disasters in 2008 can be described as enormous, as they were multiplied by a factor 10 compared to the annual average over the last 8 years. This is not a steady increasing trend over the last years; rather it shows the impact of few single geophysical events with a major human impact, in particular the 2008 Sichuan earthquake in China that affected a total of 46 million people. Similar to the human impact, the economic damage costs of geophysical disasters were tremendous in 2008, also mostly due to the earthquake in China.

Meteorological disasters tend to show a cyclical pattern over the years, with major disasters occurring in some years and being absent in other years. Although the number of meteorological events increased slightly in 2008, the reported number of victims decreased when compared to the 2000–2007 annual average. Cyclone Nargis in Myanmar caused the most natural disaster-related deaths in 2008.

Despite the fact that hydrological disasters remained the most common disasters in 2008, their impact was relatively small compared to previous years. The number of hydrological disasters (178) was below the 2000–2007 annual average (196). The number of victims of hydrological disasters also decreased in 2008, whereas economic damage costs remained equal.

Although climatological disasters were less numerous in 2008 compared to the annual average of 2000–2007, the number of victims increased by 30 per cent. The occurrence of unusually costly climatological disasters marked 2008, with extreme winter conditions in China causing 21 billion US$ damages and wildfires in the U.S. causing 2 billion US$ damages.

40.3.3.3 Which Continents are Hit the Hardest?

In 2008, 40 per cent of all reported natural disasters occurred in Asia, which is approximately the same share as seen in the annual average of 2000–2007. More than 80 per cent of the reported victims of natural disasters in 2008 were from Asia, which is 10 per cent less than the average in previous years (table 40.8.). The economic costs in Asia increased greatly in 2008 compared to the annual average of 2000-2007. Asia's contribution to the total economic costs due to natural disasters almost doubled from 34 per cent in the period 2000–2007 to 62 per cent in 2008. The impact of natural disasters on (lower-) middle income countries, such as China, which was the largest contributor to economic losses in 2008, appears to be on the rise. As countries move up the development ladder, their economic vulnerability tends to increase. These countries in particular would benefit

Figure 40.15: Global map of reported number of people affected by natural disasters in 2008. **Source:** CRED EM-DAT.

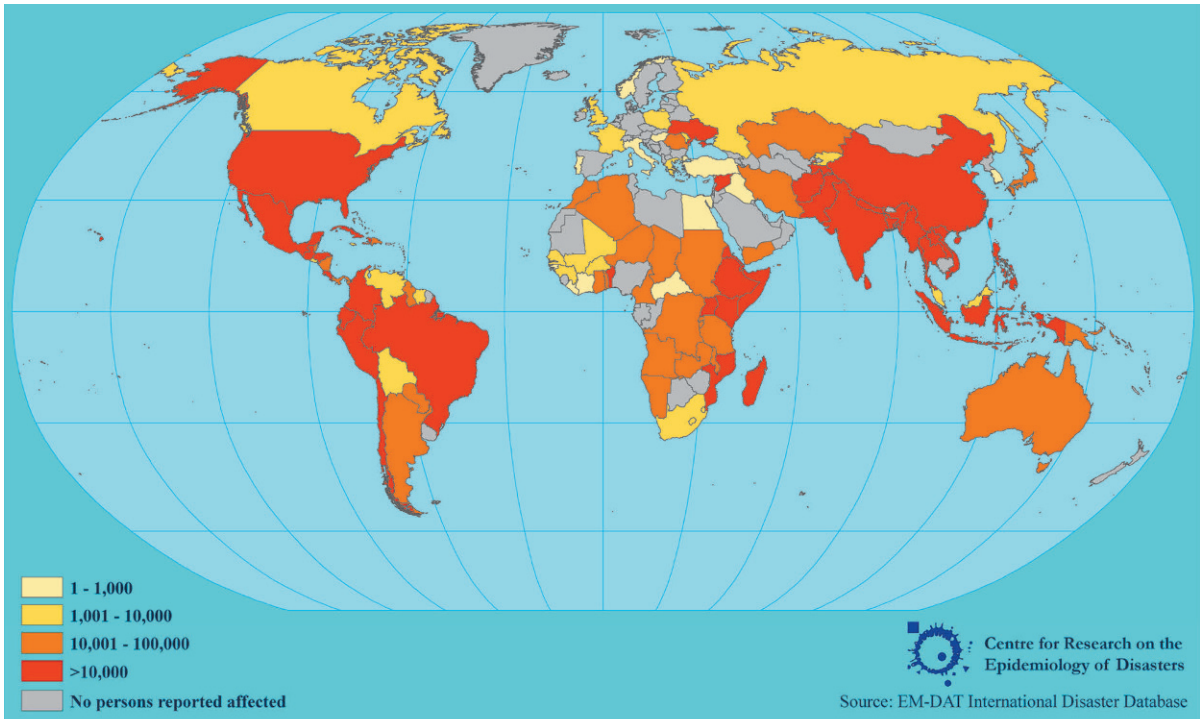
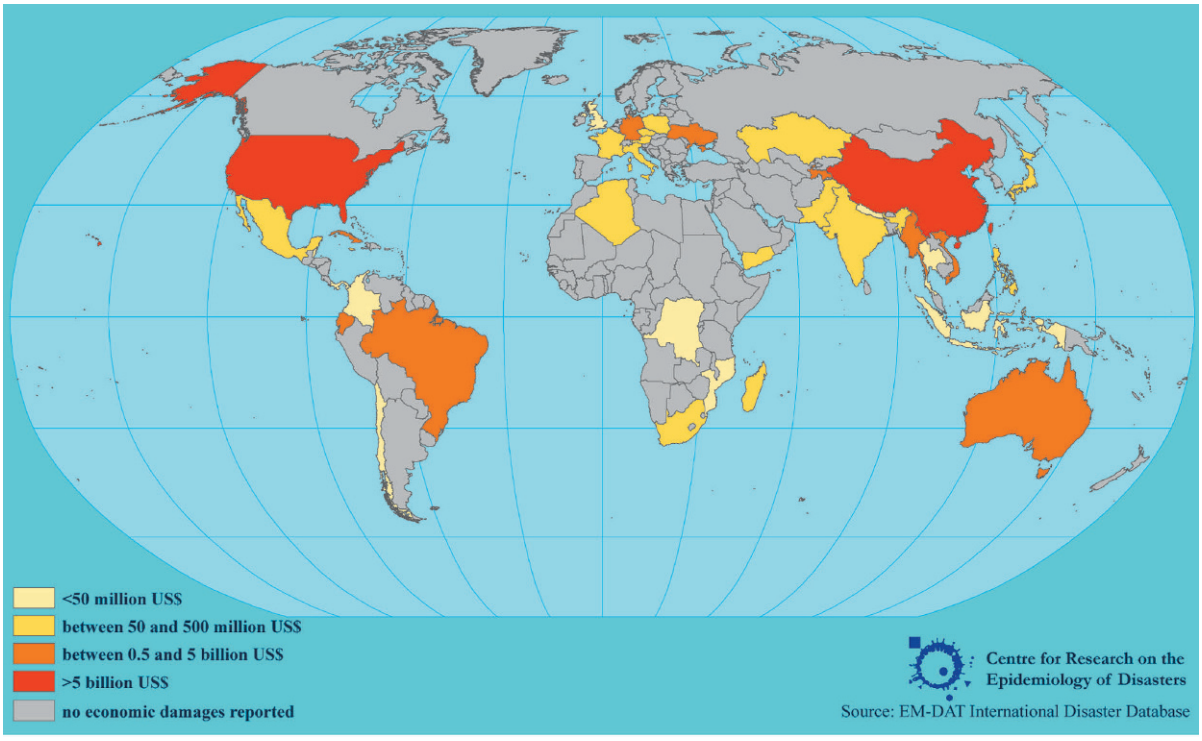


Figure 40.16: Global map of reported economic damage costs from natural disasters in 2008. **Source:** CRED, EM-DAT.



from disaster risk reduction measures in order to better protect development gains.

In the Americas, the number of reported natural disasters remained stable in 2008 compared to the annual average of 2000–2007. The Americas accounted

for more than 25 per cent of global natural disaster occurrence in 2008. A shift in disaster types was seen, as the occurrence of climatological disasters decreased from 15 per cent to 4 per cent and the occurrence of meteorological disasters increased from 36 per cent to 46 per cent of total reported natural disasters in this continent (2000–2007 average versus 2008). The Americas showed a 4-fold increase in the number of victims in 2008 compared to the previous years' average. Hydrological disasters caused the most victims in 2008 for this region (80 per cent), although the total number of hydrological disasters remained the same. These events resulted in increased economic damages in 2008 (4 per cent of total costs in 2000–2007 versus 19 per cent in 2008). Meteorological disasters contributed most to economic damage costs in the Americas in 2008 (78 per cent).

In 2008, Africa accounted for 20 per cent of global natural disaster occurrence. The continent showed a small decrease in reported natural disaster occurrence compared to the 2000–2007 annual average, mostly due to a decline in hydrological disasters. However, the number of victims increased. Climatological disasters were an important contributor to this increase, as Africa was hit by severe droughts. Data on Africa reveal a crucial lack in reporting of natural disasters in general, and more particularly of economic losses due to disasters. Africa accounted for less than 0.5 per cent of global reported economic costs from natural disasters in 2008, a share that is likely to be underestimated.

Compared to previous years, Europe showed the greatest decline in reported natural disaster occurrence among the five continents in 2008. Europe's share in disaster occurrence was 9 per cent in 2008, compared to 16 per cent during 2000–2007. This drop is mostly explained by a decrease in both reported hydrological and climatological disasters. Likewise, Europe experienced a decrease in victims, mostly seen for climatological and meteorological disasters. Europe's decrease in economic damage costs was mainly due to the impacts of hydrological and climatological disasters, which were smaller in 2008 compared to the annual average of 2000–2007. Economic damage costs due to natural disasters in Europe dropped from 16 per cent (2000–2007) to 2.5 per cent (2008) of worldwide damage costs. It is important to note that this does not reflect a decreasing trend in Europe; rather it reflects the impact of mega-disasters that happened in 2008 on other continents.

In 2008, Oceania was, as in previous years, mostly affected by hydrological and meteorological disasters. Hydrological disasters were responsible for over 85 per cent of total reported victims in Oceania in 2008 and also caused the highest economic losses. Because the continent covers many small islands, with the exception of Australia and New Zealand, natural disasters give rise to a relatively large human and economic impact when taking into consideration country surface, number of inhabitants and GDP (adapted from Rodriguez-Llanes/Vos/Below/Guha-Sapir 2009).

40.4 Conclusions and Recommendations

The disaster statistics presented in this chapter describe natural disaster occurrences and impacts in space and across time. By standardizing the data against population size and geographical area, global comparisons are made.

In conclusion, it is emphasized that for policy and preparedness to be effective, it is essential to base decision-making on systematic and scientific data for the occurrence and impacts of natural disasters. While disaster data on a global scale necessarily glosses over particularities and differences at local levels, it does provide an extremely useful view of overall trends and regional comparisons.

Secondly, these data indicate that climate-related disasters (principally floods and storms) constitute the largest proportion of the total disaster count in the past decade or more. Within this group, floods have been increasing in number and intensity in recent years. Furthermore, Southern and South-Eastern Asia display the highest vulnerability to increasing floods and their devastating impact.

Thirdly, while climate-related disasters such as floods, storms, heat and cold waves and droughts are on the rise, the current evidence is not conclusive regarding the main causes for this increase. While climate-related factors such as global warming may be a contributor to this increase, socio-economic vulnerabilities such as urbanization, land use and deforestation cannot be ignored as major potential causes for the rise in some of these climate-related disasters.

In conclusion, two recommendations are offered which are of high priority today, based on the authors' long involvement in natural disaster research and data analysis. Collecting data on a global level, while necessary and useful, is neither enough to change behaviour or policy at national and sub-

national levels, nor does it always provide the key insights necessary for preventing the impact of disasters. Therefore, building a field evidence base for the impact of natural disasters at micro-levels should be strengthened. These evidences should be drawn from well-designed scientific case studies in different parts of the world in different socio-economic settings, or cohort studies that follow vulnerable populations to measure their vulnerabilities in the short and long term. A critical mass of this type of research will build up an evidence base for policies that are drawn from realities rather than common stereotypes or theoretical hypotheses.

The second recommendation is of a more practical nature and relates to the development of operational risk profiles of communities exposed to disasters. Identifying exactly what makes a household or an individual more susceptible to trauma, injury and death when exposed to an acute natural disaster, will improve the quality and effectiveness of the local preparedness programmes.

Annex 1: Natural Disaster Classification

Table 40.9: Grouping of geophysical disasters. **Source:** CRED, EM-DAT.

Generic disaster group	Disaster sub-group	Disaster type	Disaster sub-type	Disaster 2nd sub-type
Natural Disaster	Geophysical	Earthquake	Ground shaking	
			Tsunami	
		Volcano	Volcanic eruption	
		Mass movement (dry)	Rockfall	
			Avalanche	Snow avalanche
				Debris avalanche
			Landslide	Mudslide Lahar Debris flow
			Subsidence	Sudden subsidence
				Long-lasting subsidence

Table 40.10: Grouping of meteorological disasters. **Source:** CRED, EM-DAT.

Generic disaster group	Disaster sub-group	Disaster type	Disaster sub-type	Disaster 2nd sub-type
Natural Disaster		Storm	Tropical Storm	
			Extra-tropical cyclone (Winter storm)	
			Local/Convective-Storm	Thunderstorm/Lightening
				Snowstorm/Blizzard
				Sandstorm/ Dust storm
				Generic (severe) storm
				Tornado
				Orographic storm (Strong winds)

Table 40.11: Grouping of hydrological disasters. **Source:** CRED, EM-DAT.

Generic disaster group	Disaster sub-group	Disaster type	Disaster sub-type	Disaster 2nd sub-type
Natural disaster	Hydrological	Flood	General (river) flood	
			Flash flood	
			Storm surge/ Coastal flood	
		Mass movement (wet)	Rockfall	
			Landslide	Debris flow
			Avalanche	Snow avalanche
				Debris avalanche
			Subsidence	Sudden subsidence
				Long-lasting subsidence

Table 40.12: Grouping of climatological disasters. **Source:** CRED, EM-DAT.

Generic disaster group	Disaster sub-group	Disaster type	Disaster sub-type	Disaster 2nd sub-type
Natural disaster	Climatological	Extreme temperature	Heat wave	
			Cold wave	Frost
			Extreme winter conditions	Snow pressure
				Icing
				Freecing rain
				Debris avalanche
		Drought	Drought	
		Wildfire	Forest fire	
			Land fires (e.g. grass, scrub)	

Table 40.13: Grouping of biological disasters. **Source:** CRED, EM-DAT.

Generic disaster group	Disaster sub-group	Disaster type	Disaster sub-type	Disaster 2nd sub-type
Natural disaster	Biological	Epidemic	Viral infectious diseases	
			Bacterial infectious diseases	
			Parasitic infectious diseases	
			Fungal infectious diseases	
			Prion infectious diseases	
		Insect infestation	Grasshopper/ Locust/Worm	
		Animal stampede		

Annex 2: Natural disaster (sub-)type definitions. **Source**: Compiled by the authors.

Disaster type	Disaster sub-type	Examples/ description	Definition
Earthquake	Ground shaking	Shaking and displacement of ground due to seismic waves; the earthquake itself without secondary effects.	An earthquake is the result of a sudden release of stored energy in the Earth's crust that creates seismic waves. They can be of tectonic or volcanic origin. At the Earth's surface they are felt as a shaking or displacement of the ground. The energy relea-sed in the hypocentre can be measured in different frequency ranges. Therefore there are different scales for measuring the magnitude of a quake according to a certain frequency range: a) surface wave magnitude (Ms); b) body wave magnitude (Mb); c) local magnitude (ML); d) moment magnitude.
	Tsunami	Waves advancing inland.	A tsunami is a series of waves caused by a rapid displacement of a body of water (ocean, lake). The waves are characterized by a very long wavelength and their amplitude is much smaller offshore. The impact on coastal areas can be very destructive as the waves advance inland and can extend over thousands of kilometres. Triggers of a tsunami can be: earthquakes, volcanic eruptions, mass movements, meteorite impacts or underwater explosions.
Volcano	Volcanic eruption	All volcanic activity, such as rock fall, ash fall, lava streams and gases.	Volcanic activity describes the transport of magma and/or gases to the Earth's surface which can be accompanied by tremors and eruptions. Depending on the composition, the magma eruptions can be phreatic, explosive or effusive and result in variations of rock fall, ash fall, lava streams, pyroclastic flow or emission of gases.
Mass movement (dry)	Subsidence	Downward motion of the Earth's surface relative to a datum (e.g. sea level).	Subsidence is the motion of the Earth's surface as it shifts downward relative to a datum. Subsidence (dry) can be the result of: geological faulting, isostatic rebound or human impact (e.g. mining, extraction of natural gas).
	Rockfall	Quantities of rock or stone falling freely from a cliff face.	Rockfall refers to quantities of rock or stone falling freely from a cliff face. It is caused by undercutting, weathering or permafrost degradation.
	Landslide	Any kind of moderate to rapid soil movement including lahar, mudslide and debris flow.	A landslide is the movement of soil or rock controlled by gravity and the speed of the movement usually ranges between slow and rapid. It can be superficial or deep, but the materials have to make up a mass that is a portion of the slope or the slope itself. The movement has to be downward and outward with a free face.
	Unspecified	Other hazards or losses	
Storm	Tropical cyclone	Cyclones in tropical areas, e.g. hurricanes, typhoons, tropical depressions, depending on its location.	A tropical cyclone is a non-frontal storm system that is characterized by a low pressure centre, spiral rain bands and strong winds. Usually it originates over tropical or sub-tropical waters and rotates clockwise in the Southern hemisphere and counter-clockwise in the Northern hemisphere. The system is fuelled by heat released when moist air rises and the water vapour it contains condenses ("warm core" storm system). Therefore the water temperature must be >27 °C. Depending on their location and strength, tropical cyclones are referred to as hurricane (Western Atlantic/Eastern Pacific), typhoon (Western Pacific), cyclone (Southern Pacific/Indian Ocean), tropical storm, and tropical depression (defined by wind speed; see Saffir-Simpson-Scale).

Disaster type	Disaster sub-type	Examples/ description	Definition
	Winter storm (extra-tropical cyclone)	Extra-tropical cyclones in spring, autumn or winter.	A winter storm emerges from an extra-tropical cyclone, a synoptic scale low pressure system that occurs in the middle latitudes of the Earth and is connected to fronts and horizontal gradients in temperature and dew point. A winter storm comes along with high wind speeds, gusts, thunderstorms, rain and often storm surges.
	Severe storm/ Tempest	Convective storm.	A severe storm is the result of convection and condensation in the lower atmosphere and the accompanying formation of a cumulonimbus cloud. A severe storm usually comes along with high winds, heavy precipitation (rain, sleet, hail), thunder and lightning.
	Hail storm	Storm with hailstones as dominant type of precipitation.	A hail storm is a type of storm that is characterized by hail as the dominant part of its precipitation. The size of the hailstones can vary between pea size (6mm) and softball size (112mm) and usually cause considerable damage.
	Lightning	Hazards/ losses caused by lightning stroke.	Lightning is an atmospheric discharge of electricity, which typically occurs during thunderstorms, and sometimes during volcanic eruptions or dust storms.
	Tornado	Other names for this weather phenomenon are twister, waterspout.	A tornado is a rotating column of air (vortex) that emerges out of the base of a cumulonimbus cloud and has contact to the Earth's surface. Typically it forms during a severe convective storm in so-called supercells and is often visible as a funnel-shaped cloud. Tornadoes are usually short-term, lasting on average <10 minutes. They can generate wind speeds above 400 km/h and are considered the most destructive weather phenomenon. The intensity of tornadoes is assessed using the Enhanced Fujita Scale.
	Local windstorm (orographic storm)	E.g. Katabatic winds Foehn, Mistral, Bora.	Local windstorm refers to strong winds caused by regional atmospheric phenomena that are typical for a certain area.
	Sandstorm/ Dust storm	E.g. desert storms.	A sandstorm/dust storm typically occurs in arid or semi-arid regions when high wind speeds causes the transportation of small particles like sand or fine clastic sediment by saltation and/or suspension.
	Snow storm/ Blizzard	Blizzard, ice and snow, often in Northern America.	A snowstorm refers to a storm, usually in the winter season, with large amounts of snow fall. If it is a severe snowstorm that meets certain criteria, such as strong winds, blowing snow or falling temperatures, it is called a blizzard.
Flood	General flood	Gradually rising inland floods (rivers, lakes, ground-water) due to high total depth of rainfall or snowmelt.	A general flood is caused when a body of water (river, lake) overflows its normal confines due to rising water levels. The term general flood additionally comprises the accumulation of water on the surface due to long-lasting rainfall (water logging) and the rise of the groundwater table above surface. Furthermore, inundation by melting snow and ice, backwater effects, and special causes such as the outburst of a glacial lake or the breaching of a dam are subsumed under the term general flood. General floods can be expected at certain locations (e.g. along rivers) with a significantly higher probability than at others.
	Flash flood	Rapid inland floods due to intense rainfall.	A flash flood describes sudden flooding with short duration. In sloped terrains the water flows rapidly with a high destruction potential. In flat terrains the rainwater cannot infiltrate into the ground or run off (due to small slope) as quickly as it falls. Flash floods typically are associated with thunderstorms. A flash flood can occur at virtually any place.

Disaster type	Disaster sub-type	Examples/ description	Definition
	Storm surge	Coastal flood on coasts and lake shores induced by wind.	A storm surge is the rise of the water level in the sea, an estuary or lake as result of strong wind driving the seawater towards the coast. This so-called wind setup is superimposed on the normal astronomical tide. The mean high water level can be exceeded by five and more metres. The areas threatened by storm surges are coastal lowlands.
	Glacier lake outburst flood/ Jökulhlaup	Flooding due to the outburst of a glacier lake.	A glacier lake outburst flood occurs when a lake - dammed by a glacier or a terminal moraine - fails. The outburst can be triggered by erosion, a critical water pressure, a mass movement, an earthquake or cryoseism. A jökulhlaup is a special type of a glacier lake outburst flood related to the outburst of an ice-dammed lake during a volcanic eruption.
Mass movement (wet)	Subsidence	Downward motion of the Earth's surface relative to a datum (e.g. the sea level).	Subsidence is the motion of the Earth's surface as it shifts downward relative to a datum (e.g. the sea level). Subsidence (wet) can be the result of: karst, changes in soil water saturation or permafrost degradation (thermokarst).
	Rockfall	Quantities of rock or stone falling freely from a cliff face.	Rockfall refers to quantities of rock or stone falling freely from a cliff face. It is caused by undercutting, weathering or permafrost degradation.
	Avalanche	Any kind of rapid snow/ice movement.	Avalanche describes a quantity of snow or ice that slides down a mountainside under the force of gravity. It occurs if the load on the upper snow layers exceeds the bonding forces of the entire mass of snow. It often gathers material that is underneath the snowpack like soil or rock (debris avalanche).
	Landslide	Any kind of moderate to rapid soil movement including lahar, mudslide or debris flow.	A landslide is the movement of soil or rock controlled by gravity with a speed of the movement usually ranging between slow and rapid. It can be superficial or deep, but the materials make up a mass that is a portion of the slope or the slope itself. The movement is downward and outward with a free face.
Extreme temperature	Heat wave	Heat waves like in central Europe 2003.	A heat wave is a prolonged period of excessively hot and sometimes also humid weather relative to normal climate patterns of a certain region.
	Cold wave/ frost	Damage caused by low temperatures.	A cold wave can be both a prolonged period of excessively cold weather and the sudden invasion of very cold air over a large area. Along with frost it can cause damage to agriculture, infrastructure or property.
	Winter storm (extreme winter conditions)	Damage caused by snow and ice.	Winter damage refers to damage to buildings, infrastructure, traffic (navigation) inflicted by snow and ice in the form of snow pressure, freezing rain or frozen waterways .
Drought	Drought	Long lasting event; triggered by lack of precipitation.	A drought is an extended period of time characterized by a deficiency in a region's water supply. It's a result of constantly below average precipitation and can lead to losses to agriculture and famine
Wildfire	Wildfire	Fire in forest or bush areas.	Wildfire describes an uncontrolled burning fire, usually in wild lands, which can cause damage to forestry, agriculture, infrastructure or buildings.
Epidemic			Either an unusual increase in the number of cases of an infectious disease, which already exists in the region or population concerned; or the appearance of an infection previously absent from a region.

Disaster type	Disaster sub-type	Examples/ description	Definition
	Viral infectious disease	E.g. Dengue fever, Ebola Hemorrhagic fever, Hepatitis, Lassa fever, Measles, Marburg Hemorrhagic fever, Viral meningitis, Poliomyelitis, West Nile disease, Yellow fever.	
	Bacterial infectious disease	E.g. Anthrax, Bacterial Meningitis, Botulism, Brucellosis, Cholera, Diphtheria, Leptospirosis, Plague, Typhoid fever.	
	Parasitic infectious disease	E.g. Chagas disease, Lalazar, Leishmaniasis, Malaria.	
	Fungal infectious disease	E.g. Candidiasis, Cryptococcodis.	
	Prion infectious disease	E.g. Bovine Spongiform encephalopathy, Creutzfeldt-Jakob.	
Insect infestation		Locust, Grasshopper or Worm	Pervasive influx and development of insects or parasites affecting humans, animals, crops or materials.
Animal stampede			

41 Stormy Weather: International Security in the Shadow of Climate Change

Steffen Bauer

41.1 Introduction[1]

As humankind approaches an increase of 1 °C in the average global temperature compared to the pre-industrialized era, ongoing climate change is already altering the natural systems that support human societies all around the world. Unless effectively mitigated in the near future, an unfettered climate change will drive global dynamics that could transform entire world regions. The radical changes of natural environments that are expected to follow from an unmitigated global warming would be without precedent in human history and it would thus be highly questionable if local authorities, national governments, regional organizations, and international agencies were capable of peacefully steering the resulting social and economic consequences. Indeed, if global average temperatures continue to rise beyond 2 or 3 °C this would imply a historical global experiment with unknown outcomes. The restriction of global warming and its effects should thus be a central concern of forward-looking world politics. As elaborated below, sustainable global development and international stability depend on the successful mitigation of climate change as well as on the effective management of its unavoidable consequences.

Alas, the political world – in its present state – is ill prepared to meet these challenges in a satisfactory manner. Without major breakthroughs in international climate negotiations, global efforts to cut greenhouse gas emissions will remain inadequate. Meaningful efforts to adapt to the already unavoidable consequences of climate change have only just begun to be addressed and may materialize too late, in particular with a view to the world's most vulnerable societies in small island developing states and least developed countries in tropical regions. While starting to take climate change seriously as an issue of 'high politics' the international community remains preoccupied with a bundle of established global issues such as terrorism, economic growth, financial stability, and global trade. Ultimately, the protagonists of world politics – by and large represented by the G-8+5 countries[2] – are concerned more with traditional intergovernmental relations and spheres of influence than with meaningful global governance. While this seems to be in line with short-term concerns for national sovereignty and security, it may prove self-defeating in the long term. In the following, this chapter will discuss why and how so.

To this end, *first* the specific threats will be outlined that ongoing climate change poses to stability and security at local, national, and regional levels and how these may eventually affect international security (41.2). *Second*, it will be discussed why these climate-induced security risks differ substantially from familiar types of conflicts that are driven by environmental degradation as well as how they are interdependent with distinct global trends that threaten international stability in their own right (41.3). *Finally*, it will be argued that current conceptualizations of international security are inadequate to meet the challenges of conflict and cooperation of the 21st century (41.4).

1 The author would like to thank Dirk Messner for substantive contributions to earlier versions of this chapter. Helpful comments by Hans Günter Brauch and three anonymous reviewers as well as editorial support by Michael Eichholz and Ina Gampfer are also gratefully acknowledged.

2 These are the United States, Japan, Germany, United Kingdom, France, Italy, Canada, and Russia (G-8) plus the so-called outreach countries Brazil, India, China, Mexico, and South Africa (G-5).

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41.2 Climate Change as a Security Risk[3]

In November 2006, the then Secretary-General of the United Nations Kofi Annan urged the conference of parties to the United Nations Framework Convention on Climate Change to consider climate change as not merely an environmental issue, but as an all encompassing threat.[4] This was no trivial statement to make. Indeed, outside the environmentalist camp, the seriousness of climate change has been neglected for far too long.

The narrow perspective on one of the greatest global challenges of the 21st century is now gradually being overcome, it seems. Throughout 2007, this emergent paradigmatic shift (Brauch 2009a) was arguably helped by the quick succession of the assessment reports of three working groups of the *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b) in February, March and May 2007,[5] the first ever deliberation of climate change by the United Nations Security Council (17 April 2007), the prioritization of climate change on the agenda of the Heiligendamm G-8 summit (June 2007), the United Nations General Assembly's High-level session on climate change which Annan's successor Ban Ki Moon convened in September, the dedication of the Human Development Report to "fighting climate change" (UNDP 2007) in virtual conjunction with the publication of the IPCC's synthesis report (IPCC 2007c) in November 2007, and not least by the announcement to award the Nobel Peace Prize to the IPCC and to former US Vice President Al Gore for their efforts to raise global awareness for both the causes and the consequences of global warming (October 2007) with the actual award ceremony following suit in December – accidentally in the middle of a dramatic world climate conference which convened in Nua Dusa, Bali (3–14 December 2007).[6]

The true significance of the resulting 'Bali Road Map', by which governments seek to arrive at a comprehensive and internationally binding climate agreement for the post-2012 period, can only be judged in the wake of the outcome of the meeting of the world climate conference which occurred in Copenhagen at the end of 2009.[7] It seems safe to say, however, that 2007 saw the arrival of global climate change at the highest levels of international politics, even as governments got distracted by the international financial crisis in 2008.

Also in 2007, the *German Advisory Council on Global Change* (WBGU) submitted to the federal government of Germany a flagship report which investigates and highlights the interlinkages between global warming, environmental degradation, and international security (WBGU 2007, 2008). It brings together the present state of knowledge and collates research findings on the causes of conflict and war, empirical evidence of conflicts triggered by environmental degradation and the projected consequences of climate change for people and societies. It concludes that emergent forms of large-scale environmental change that are driven by global warming may lead to a destabilization of societies and may overstretch the coping capacity of political and economic systems. Ultimately, climate change may thus generate violence and thereby confront an international system that is already under stress with profound additional challenges.

3 This chapter largely draws on the eponymous report of the German Advisory Council on Global Change (WBGU 2008); see also Bauer/Messner (2007).

4 United Nations Secretary-General Kofi Annan, Nairobi, 15 November 2006: UN Doc. SG/SM/10739; at: <http://www.un.org/News/Press/docs/2006/sgsm10739.doc.htm> (12 January 2009): "Climate change is not just an environmental issue, as too many people still believe. It is an all-encompassing threat. It is a threat to health, since a warmer world is one in which infectious diseases such as malaria and yellow fever will spread further and faster. It could imperil the world's food supply, as rising temperatures and prolonged drought render fertile areas unfit for grazing or crops. It could endanger the very ground on which nearly half the world's population live – coastal cities such as Lagos or Cape Town, which face inundation from sea levels rising as a result of melting icecaps and glaciers. All this and more lies ahead. Billion-dollar weather-related calamities. The destruction of vital ecosystems such as forests and coral reefs. Water supplies disappearing or tainted by saltwater intrusion. Climate change is also a threat to peace and security. Changing patterns of rainfall, for example, can heighten competition for resources, setting in motion potentially destabilizing tensions and migrations, especially in fragile states or volatile regions. There is evidence that some of this is already occurring; more could well be in the offing."

5 The respective reports are on: *The Physical Science Basis* (IPCC 2007); *Impacts, Adaptation and Vulnerability* (IPCC 2007a); and on: *Mitigation of Climate Change* (IPCC 2007b).

6 See IISD (2007); Brauch (2009a); Kinnas (2009) and chap. 42 by Scheffran.

7 On negotiating the Bali Road Map and its significance; see also Müller (2008) and chap. 83 by Egenhofer, Behrens and Georgiev.

This fresh perspective on the environment-security nexus requires both a broadening of the timeframe under analysis and a reconsideration of established concepts of security. Anthropogenic climate change has only just begun and its impacts will cumulate and intensify over coming decades unless global warming is effectively mitigated. Large-scale disruptions pertaining to international security will need to be anticipated with a view to future decades. While familiar patterns of environmental conflicts clearly serve as a vantage point, they must not be expected to represent the challenges lying ahead.

Future conflicts about arable land, food resources, and access to freshwater may follow familiar patterns at local levels, but are likely to reach a new quality by way of magnitude and scale. Storm and flood disasters and drastic increases in environmentally forced migration can be expected to create additional stress and new conflict constellations. Not least, non-linear systemic feedbacks that might be activated once global warming reaches certain tipping points such as a dieback of the Amazon rainforest, a fundamental transformation of monsoon patterns, or a meltdown of continental ice sheets bear the potential to transform entire world regions and with unpredictable consequences for human civilization (IPCC 2007; Lenton/Held/Kriegler/Hall/Lucht/Ramstorf/Schellnhuber 2008; Lynas 2007; Schneider 2004; WBGU 2006, 2008).

The present pace of progress in international climate policy does not bode well for confining average global warming within a margin of 2 °C to 3 °C. Global greenhouse gas emissions are still increasing, despite noteworthy reductions in some countries. Unless the international community very soon reaches an effective global accord that ensures drastic reductions in global *greenhouse gas* (GHG) emissions, it seems all but probable that some of the systemic tipping points will be triggered even within this century.[8]

Even without such radical discontinuities in the Earth system, however, the four categories mentioned above – food security, freshwater availability, storm and flood disasters, and environmental displacement – that must be expected to gain significance in the foreseeable future, are likely to increasingly undermine human security in many regions of the world.[9] Thereby they will heighten susceptibility to social destabilization and, ultimately, violence. Accordingly, the WBGU (2007, 2008) has identified four distinct conflict constellations to explore the causal links between climate change and destabilization and the resulting threats to international security. These are introduced in the following.

41.2.1 Conflict Constellation 1: Climate-induced Fresh Water Scarcity

1.2 billion people are currently without access to safe drinking water, 2.6 billion without access to sanitation (UNDP 2006). The situation could worsen for hundreds of millions of people as climate change alters the variability of precipitation and the quantity of available water (IPCC 2007, 2007a). At the same time, demand for freshwater is increasing due to the world's growing population and its mounting aspirations. This dynamic triggers distributional conflicts and poses major challenges to water management systems in the countries concerned. For example, regions which depend on melt water from mountain glaciers – which are at risk from climate change – will require new water management strategies and infrastructures, as well as political efforts to avert national or even transboundary conflicts over the distribution of increasingly scarce water resources. The core problem generally is a lack of adaptive capacity to absorb changes in water supply and demand. However, the countries which will suffer the greatest water stress are generally those which already lack the political and institutional framework necessary for the adaptation of water and crisis management systems. This could overstretch existing conflict resolution mechanisms and may ultimately lead to destabilization and violence (WBGU 2008). Generally, the risk of violent

8 It is widely perceived that the single most important opportunity to reach a meaningful agreement to succeed the Kyoto Protocol in 2012 has been the 2009 world climate conference in Copenhagen.

9 On the concept of human security see UNDP (1994); Commission on Human Security (2003), see also Brauch (2005, 2005a, 2008a); Dalby (2002); Page/Redclift (2002) for discussions of human security in the context of environmental change. See also in this Hexagon Book Series the chapters by Barnett/Matthew/O'Brien (2008); Pachauri (2009); Steiner (2009); Gnacadja (2009); Zammit Cutajar (2009); Brauch (2009b); Fuentes/Brauch (2009); Abdus Sabur (2009); Werthes/Debiel (2009); Chourou (2009); Othman (2009); Poku/Sandkjær (2009); de Lombaerde/Norton (2009); Black/Swatuck (2009); Shinoda (2009); Schott (2009); Senghaas (2009); Nathan (2009); Wun'Gaeo (2009); Oswald Spring (2009); Truong (2009); Ariyabandu/Fonseka (2009); Tadjbakshsh (2009); Singh (2009); Schnabel/Krummenacher (2009).

conflict over water resources is estimated to be greater at an intrastate or local level than at an interstate level, particularly in weak and fragile states (Wolf/Kramer/Carius/Dabelko 2005).[10] Supply problems contribute to the risk of conflict. But, it is only in conjunction with adverse socio-economic constellations that they trigger violent conflict.

At an international level, a lack of institutional quality and stability of intergovernmental and international water regimes to control the use of shared water resources can be a key driver of transboundary water conflicts (Conca 2006; Scheumann/Neubert/Kipping 2008). Disputes over shared water resources can aggravate already tense relationships and may give rise to violent conflicts. More often, however, cooperative interaction over water use improves the relationship between the states involved (Wolf 2006). Indeed, historically the examples of cooperation between states over water resources have often proven instrumental in initiating cooperation under otherwise difficult circumstances, and have far outnumbered those of conflict escalation.[11]

Cooperative arrangements for the management of shared water resources are more likely to be concluded when economic advantages and other potential benefits of cooperation are foreseeable. This has been especially true for agreements over water infrastructure, e.g. dam building for shared power generation. On the other hand, few agreements have so far been made to promote adaptive responses to increasing regional water scarcity, i.e. agreements with an emphasis on burden-sharing rather than benefit-sharing (Klaphake/Voils 2006). Hence, it remains unclear to what extent benefit-sharing approaches can function to promote cooperation under conditions of increasing climate-induced water scarcity.

Whether or how this might lead to an occurrence of 'water wars' in the future remains debatable. Governments generally seem to be aware that there is little strategic or economic sense in waging wars if the aim is control over water resources outside their own borders. Yet, disputes over water could contribute to interstate violence in combination with other socio-economic factors that also relate to foreign affairs (UNDP 2006). In particular, where conflicts related to the overexploitation of water resources are paralleled by unsustainable land use patterns and soil degradation or where they become a driving force of migration.[12]

41.2.2 Conflict Constellation 2: Climate-induced Decline in Food Production

More than 923 million people worldwide are currently affected by food insecurity (FAO 2006; FAOSTAT 2006). This situation is the result of many interdependent causes.[13] It is likely to worsen in the future as food insecurity in many developing countries will be exacerbated as a result of climate change, even with a global temperature rise of just 2 °C (relative to 1990). If global warming rises beyond 2 °C, a drop in agricultural productivity is to be expected not only in the lower latitudes but worldwide (Battisti/Naylor 2009; IPCC 2007a). At regional levels, the risk of declining food production will be substantially reinforced by desertification, soil salinization, or water scarcity. In South Asia and North Africa, for example, the areas suitable for agriculture are already largely exploited. South of the Sahara changing rainfall patterns may reduce yields by up to 50 per cent by 2020 (Lal/Uphoff/Stewart/Hansen 2005; Dinar/Mendelsohn/Hassan/Benhin 2008). This may well trigger regional food crises and further undermine the economic performance of weak and unstable states, thereby encouraging or exacerbating destabilization, the collapse of social systems, and violent conflicts (Homer-Dixon/Boutwell/Rathjens 1993; de Soysa/Gleditsch/Gibson/Sollenberg/Westing 1999).

The adverse consequences of environmental change for regional food production are at the core of this conflict constellation. They are determined by the regional climate – temperature trends, precipitation patterns, extreme weather events – and the access to available natural resources, notably arable soil and fresh water. The impact of environmental changes on food production depends critically on the configuration of factors of regional agricultural production,

10 See also Flintan/Tamrat (2006); Herrfahrdt-Pähle (2008); Lindemann (2008).

11 See the pertinent chapters in the previous volume of the Hexagon Series by Oswald Spring/Brauch (2009); Allan (2009); Shiva (2009); Affeltranger (2009); Aydin/Ereker (2009); Hayek (2009); Selby (2009); Jageskog (2009); Adly/Ahmed (2009); Kameri-Mbote/Kindiki (2009); Ashton/Turton (2009); Kipping (2009, 2009a); Borghese (2009); Lindemann (2009); Rakel (2009); Wunderer (2009); Martius/Froebrich/Nuppenau (2009); Tignino (2009).

12 See also Bauer (2007); Carius/Tänzler/Winterstein (2006); Molle/Berkhoff 2006; Philips/Daoudy/McCaffrey/ Öjendal/Turton (2006); Sadoff/Grey (2002).

13 See i.a. Brüntrup (2008); Faaij (2008); von Braun (2007); von Koerber/Kretschmer/Prinz (2008).

which is basically a function of local agro-ecological conditions and sustainable land use. The viability of regional agricultural production is further determined by the adaptive capacity of agricultural systems to changing climatic conditions, for instance by crop selection, new breeds and varieties, or other yield-stabilizing techniques.

Competing demands and regional land use needs are also crucial, in particular if there is competition between food production and other land uses forms, notably biofuel crops or timber production (Faaij 2008; von Braun 2007; WBGU 2009). The more profitable these alternatives appear, the greater the danger that food production will be crowded out. This applies particularly to marginal agricultural regions with rising population density and may be exacerbated by increasing global demands for renewable energies. Utilization conflicts between different producer groups harbour the potential for outright conflict and violence. A danger that is evident already in the land-use competition between nomadic pastoralists and settled crop farmers in parts of Africa. The global rise in meat consumption is another factor that compounds land-use competition at regional and local levels (von Koerber/Kretschmer/Prinz 2008).

Of course, declining food production will not necessarily lead to a food crisis. This is largely determined by demographic development and economic factors. The higher a country's economic output and per-capita income, the more readily it can resort to agricultural imports to compensate for drops in production. Generally, high economic output also provides options for adequate transfers to affected groups and to thus mitigate the potential for conflict. Naturally, the impact of a decline in agricultural production will be more severely felt the greater the part played by agriculture in employment and value creation in the economy as a whole. This is typically the case in developing countries in which the export of agricultural products is a major source of foreign currency income. In the event of a noticeable economic downturn, these countries are more vulnerable than countries with a more diversified economy or higher levels of wealth and economic stability. Moreover, the quality of agricultural infrastructure (e.g. distribution of fertilizers and seeds, availability of loans), transport infrastructure, and effective institutions for disaster management are vital to prevent a destabilization in the event of a food crisis. Capacities for agricultural research also help to minimize the risk of food crisis by enabling forward-looking adaptation of the agricultural system (von Braun 2008).

Whether food crises eventually culminate in outbreaks of violence is ultimately determined by overarching societal factors, notably social and political stability, functional governance structures, and a resilient civil society. In this context, a particularly significant aspect regarding the potential for violence arising from food shortages is whether an affected country or region is prone to scapegoating. If, for instance, demagogues convince large social groups that certain ethnic minorities or religious groups are 'enemies within', the likelihood of violence increases dramatically.[14]

External factors, such as the regional and sectoral structures of global agricultural production and trade, need to be considered, too. If climate change gives rise to large-scale production failures, prices on world agricultural markets can easily exceed the financial capacities of highly indebted developing countries (WBGU 2009). In the extreme, worldwide food production could drop to a level that jeopardizes the nourishment of the world population, which would render it increasingly difficult to make up for regional shortfalls with imports even where the cash were available. A growing world population, changing patterns of consumption, and increasing global competition about the use of available land would amplify the problems resulting from any such scenario. Likewise, the interdependency of markets, e.g. for agrochemicals, fuels or machinery, may also have repercussions with global food security, which makes access to other countries' markets another key factor for political and economic decision-makers around the world. Multilateral framework conditions as governed by policies of the *International Monetary Fund* (IMF), the *World Trade Organization* (WTO) or regional development banks can have substantial influence over subsequent developments at regional and national levels (von Braun 2008; WBGU 2008).

41.2.3 Conflict Constellation 3: Climate-induced Increase in Storm and Flood Disasters

Climate change is likely to result in further sea-level rise, and more intensive storms and heavy precipitation. This will greatly increase the risk of natural disasters occurring in many cities and industrial regions in coastal zones. Those risks will be further amplified

14 See i.a. Bigagaza/Abong/Mukarubuga (2002); Diamond (2004); Gasana (2002); Hauge/Ellingsen (1998); Kaplan (1985); Percival/Homer-Dixon (2005).

by deforestation along the upper reaches of rivers, land subsidence in large urban areas, and the ever greater spatial concentration of populations and assets (UNEP 2002). Storm and flood disasters have already contributed to conflict in the past, especially during phases of domestic political tension, e.g. in Central America, India, and China. Conflicts are likely to occur more frequently in the future for two main reasons. Firstly, regions especially at risk from storm and flood disasters, such as Central America and Southern Africa, generally have weak economic and political capacities, which renders adaptation and crisis management much more difficult. Secondly, frequent storm and flood disasters along the densely populated coastal areas of India, Bangladesh, and China could cause major damage and trigger or intensify migration processes that will be hard to control.

Yet, climatic-meteorological mechanisms and rising sea levels are not the only factors that heighten the risks of disaster: deforestation in the upper reaches of rivers and land subsidence in major urban centres also contribute to this development. Moreover, the growing concentration of cities and settlements in coastal regions, the high proportion of economically weak population groups in developing and newly industrializing countries, and the particular vulnerability of the urban and industrial infrastructure are also reasons for concern. In many cities, land subsidence is perceived as a problem primarily because of the damages it inflicts on buildings and infrastructure. However, for coastal cities in particular, subsidence also implies a precarious rise in the relative sea level. The potential repercussions of such a rise in relative sea level were seen when New Orleans, where some districts are up to 3 metres below sea level, was hit by Hurricane Katrina. Although the special vulnerability of New Orleans does not automatically apply to every other coastal city, there are numerous cities, particularly in developing countries, in which major areas lie below or only narrowly above sea level.

The *International Strategy for Disaster Reduction* (ISDR) of the United Nations defines a disaster as "a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources" (UNISDR 2006). From this definition it follows that natural disasters are usually associated with a temporary local collapse of state functions. The devastation of infrastructure blocks external consignments of relief, the water and energy supply is disrupted and the capacities of hospitals and physicians are overstretched. In situations like this, the scope of governments to act is often so heavily impeded that it virtually equals a total collapse of state functions, which can in turn often undermine political stability in several respects. At the same time, a population is never more reliant on public support than in the wake of a disaster. The call for external assistance in dealing with the direct consequences is part and parcel of almost all major natural disasters. Met with failure, this leads to frustration and dissatisfaction with the officials in charge, even more so if damages and casualties are not attributable purely to the physical forces of nature but to poorly implemented or inadequate policies and emergency measures (Drury/Olson 1998).[15] Local and regional security may be particularly at stake if a temporary breakdown of state functions is exploited by non-state actors in the pursuit of their own interests.[16]

Research on disaster impacts and political stability indicates three general mechanisms pertaining to the social and political outcomes of natural disasters:

1. an escalation of pre-existing internal conflicts;
2. conflicts resulting from social tensions that emerge within a power vacuum;
3. de-escalation of conflicts through relief operations and negotiations.[17]

41.2.4 Conflict Constellation 4: Environmentally-induced Migration

Changes in the environment as a consequence of climate change are expected to contribute to increased migration in the future. Migration, in turn, can greatly increase the likelihood of conflict in transit and target regions. It can be assumed that the number of environmentally displaced persons will substantially rise in the future due to the impacts of climate change, particularly in densely populated coastal areas affected by rising sea levels (WBGU 2006a)[18] and in dr-

15 See also Auf der Heide (2004); Fuentes (2003); O'Leary (2004).

16 These or similar issues contributed to political crises in Haiti (1954), East Pakistan (1970), Bangladesh (1974 and 1988), Bihar (1987), Orissa and West Bengal (1999), West Bengal (2000) and New Orleans (2005), see also WBGU (2008: fig. 3.2.4).

17 Examples including cooperation and assistance in spite of political tensions or ongoing conflicts include Turkey/Greece (1999), Iran/USA (2003), Sri Lanka/Tamil rebel movement LTTE (2004), Indonesia/Free Aceh Movement GAM (2004) and India/Pakistan (2005), see WBGU 2008 for details.

yland developing countries where recurring drought, desertification, and water scarcity are already severe (Bauer 2007, Leighton 2006). In combination with high population growth, weak institutions, high levels of poverty or dependency on agriculture further exacerbates the likelihood of environmentally induced migration, most of which typically occurs within national borders. However, transboundary environmental migration seems also likely to increase, mainly in the form of south-south migration. Yet, Europe and North America must also expect substantially increased migratory pressure from neighbouring regions with adverse environmental conditions. According to different estimates, some 150–200 million people might find themselves forced to abandon their homes by 2050 due to environmental changes caused by global warming (Myers 1993, 2002; Brown 2008a). While such estimates have a considerable margin of error and depend on underlying assumptions about population growth, economic development as well as the degree of climate change and subsequent environmental impacts, there is growing consensus regarding the general trend.[19] The consequences of global warming are likely to trigger migratory movements of an unprecedented scale, notably so in Asia and Africa (Biermann/Boas 2008).

At the international level, the questions of how to deal with growing migratory movements and which states will have to bear the costs of environmentally induced migration bears considerable conflict potential in its own right (Biermann/Boas 2008; Morton et al. 2008; WBGU 2008). While the recent past yields little evidence that large migration movements have been the cause of conflicts, there is evidence that migration can sometimes significantly increase the likelihood of conflict and that different types of migration involve different security risks (Goldstone 2002; Lohrmann 2000).

It stands to reason that the likelihood of conflict increases if environmentally displaced persons have to compete with the resident population for scarce resources such as land, water, accommodation, employment and basic social services, or even if immigrants are merely perceived as competitors. A competitive situation of this sort is particularly likely to arise in regions in which population growth is strong (Urdal 2005).[20] Moreover, the likelihood of ethnic conflict may increase if the arrival of migrants upsets the 'ethnic balance' in the region and thereby gives rise to xenophobia and violent confrontation or exacerbates pre-existing tensions (Homer-Dixon 1999; Lohrmann 2000). Recent research also highlights the relevance of a diaspora as a possible cause of conflict (Brauch 2006c). For instance, Collier and Hoeffler (2004) found a strong positive correlation between both susceptibility to repeated conflict and conflict intensity and the size of the diaspora abroad.

The actual impact of either of these factors depends considerably on the responses of the governments in charge, many of which are ill-prepared to cope with migration. This does not only refer to developing countries but has also been demonstrated in the industrialized world, for instance by Spain's periodic problems in dealing with West African boat people or by the difficulties encountered by the US government in catering for 1.3 million internally displaced persons after Hurricane Katrina in August 2005. Yet, the proliferation of environmental migrants mainly occurs in countries and regions with weak governance structures where political stability is easily shaken. Once an inflow of migrants overstretches the coping capacities, the likelihood of conflicts increases, in particular if affected countries are also prone to economic crises (Reuveny 2007; WBGU 2008).

41.2.5 Regional Distribution of Climate-induced Security Risks

While unmitigated climate change will eventually have adverse consequences for people all over the world, the eminent security risks that are expected to result from continued global warming will be unevenly spread. Resilience and vulnerability to changing environmental conditions vary considerably within societies but also across regions. Developing countries in Africa, Asia and South America, that typically have fewer capacities for adaptation at their disposal than developed countries, will be affected earlier and to a much higher degree. Arguably, small island develop-

18 In 1995 some 60 million people lived within the 1-metre elevation zone and 275 million within the 5-metre zone above mean sea level. Projections of population growth indicate that these figures will rise by the end of the 21st century to 130 million in the 1-metre zone and 410 million in the 5-metre zone; WBGU 2006.

19 See inter alia Biermann and Boas 2008; Brown 2008a; Jakobeit and Methmann 2007; Leighton 2006; Reuveny 2007; Stern 2006; WBGU 2006, 2008.

20 Similar competition for resources can also trigger conflict once migrants return to their regions of origin. Particularly if returnees find their land or property to have been overtaken by others during their absence.

ing states in the Pacific and the Caribbean are worst off in a view even of moderate climate change.

Africa, based on its particular sensitivity with regard to climatic variability combined with socio-economic as well as political stress factors and with very low adaptation capacities, is particularly endangered. Until 2020 the IPCC expects an increase of about 75–250 million people suffering from climate-induced water shortages. In individual countries a fall-off in yields of rain-fed agriculture of up to 50 per cent is also expected. In the Nile delta the regional food production is threatened by rising sea levels as even a small rise leads to the salinization of important agricultural farmland. At the same time, the demand for food, farmland, and freshwater will presumably increase due to the continuing population growth and the immigration from the bordering dryland regions. In the Sahel region and in southern Africa, where a lot of people are dependent on subsistence agriculture and rain-fed agriculture, the already precarious living standards will worsen further due to more frequent and intensive extreme weather occurrences. In combination with the prevailing weakness of state institutions in many countries of the region, as well as complex violent conflicts and large streams of refugees, the risk of a gradual regional destabilization furthermore seems to be quite high. The current endeavours in fighting poverty and regional stabilization would be set back.

In Asia the melting of the Himalayan glaciers is a central problem. Apart from flooding and landslides, this means primarily a shortage of freshwater resources which could affect more than one billion people in 2050, according to the assessment of the IPCC. In large parts of the continent flooding and temperature increases will impede the containment of typical tropical diseases and will probably lead to higher mortality. India, Pakistan, and Bangladesh will be especially hard hit by the foreseeable climatic consequences. The destructive storms and floods that already occur nowadays will take place more and more often, and will also unleash a much larger destructive power due to rising sea levels. In addition, salinization of the soil and changing monsoon patterns are likely to affect the regional food production whose yields could decrease by up to 30 per cent by the middle of the century. In the densely populated and notoriously conflict-ridden Gulf of Bengal the social tensions could eventually escalate in a violent manner (BMU 2002). In China the economically significant southeast coast (tropical storms) and large parts of the hinterland (droughts, heat waves, desertification) will be especially severely exposed. It is hard to tell if the adaptive capacities of the state can match at the same time the challenges of modernization, social crises, environmental stress, and the consequences of climate change.

In South America the accelerated glacier melting in the Andes region together with changing precipitation patterns will most likely lead to a reduction in the available freshwater resources. The water resources in the conurbation of Lima, for instance, depend over 80 per cent on the glaciers of the Andes. These have lost a third of their volume between 1970 and 1997 alone and will disappear within the next decades as warming continues. Hence, a highly populated and continually growing urban agglomeration within a desert-like environment must be supplied with a new water system in the foreseeable future. In other South American dryland areas salinization and desertification will intensify and are thus likely to adversely affect regional food production. In addition, rising temperatures and declining soil humidity in the eastern Amazon region will probably lead to the gradual replacement of rainforest with savannah by the middle of the century (figure 41.1).

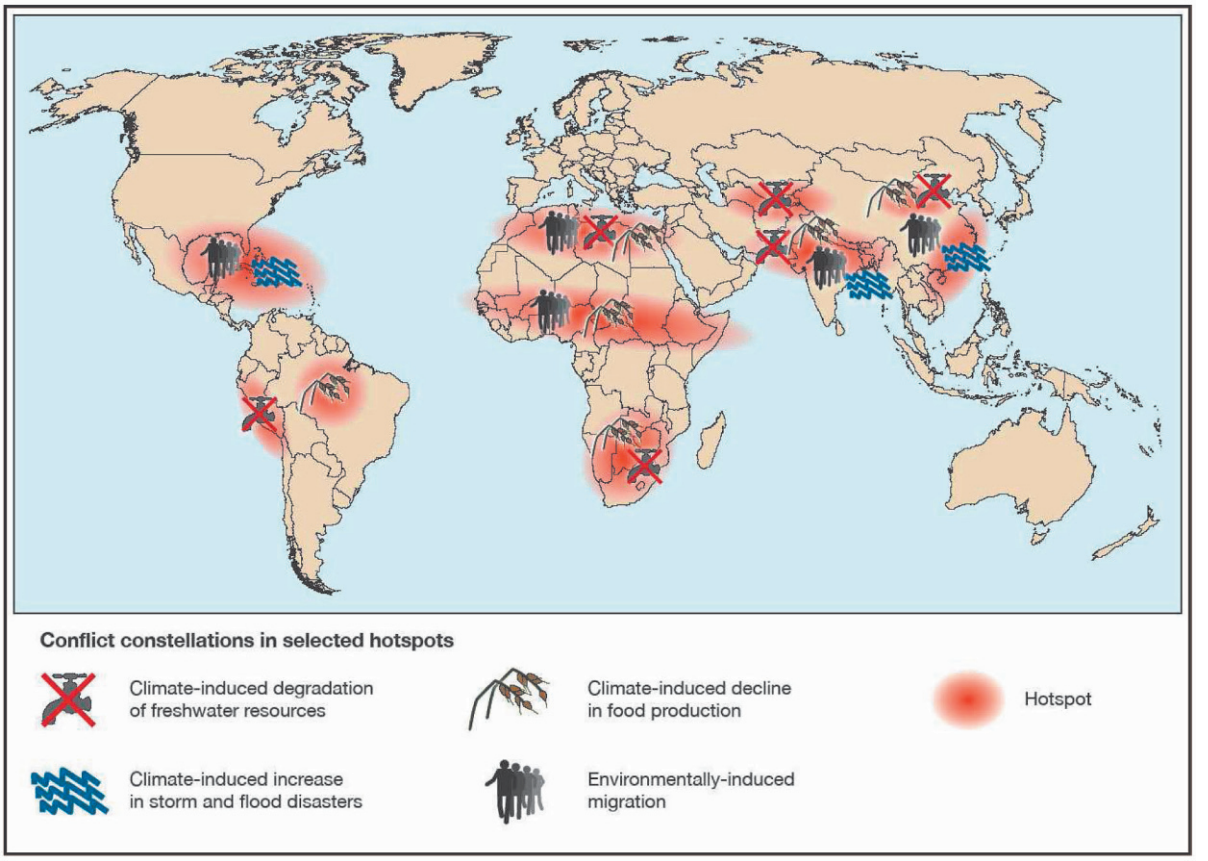
While this selection of examples from the major developing regions is just a scratch at the surface, it should become clear that climate change will intensify the existing development problems in many countries and regions, and will bring forth a multitude of additional constraints for human development and, indeed, human security. Notably, global warming undermines progress towards the Millennium Development Goals even at its current temperature level of less than 1 °C increase in average global temperature.

41.3 New Quality of Threats and Interlinkages

Research on the relationship between changing environmental conditions and violent conflicts began in the 1970's. It was not until the 1990's, however, that scholars entered into systematic inquiry of the causal links between environmental degradation and conflict escalation.[21] Emerging post-Cold War debates on the

21 Seminal pioneering works from this field of research include studies by Homer-Dixon 1990; 1991; 1994; 1999 and by Bächler et al. 1996; 1996a; 1996b; Bächler 1998; for discussions and reviews of the early literature see inter alia Barnett 2000; Brauch 2003, 2005; Brock 1997; Gleditsch 1998, 2003; and Levy 1995.

Figure 41.1: Conflict constellations in selected hotspots. **Source:** WBGU (2008: 163).



concept of human security and about the general 'securitization' (Wæver 1995, 2008, 2008a) of international politics further fuelled this specific research agenda throughout the 1990's. In spite of some fundamental criticism pertaining to the methods and assumptions of this particular research, there is widespread agreement regarding at least three core empirical findings.

- *First*, all approaches to the causality between environmental degradation and conflict emphasize the multi-causality of the conflicts observed. There is thus a strong consensus that environmental degradation is always only one of several complex causes of conflict. Indeed, environmental degradation rarely was considered to be the decisive factor in past conflicts.
- *Second,* there is a consensus regarding the locality of the conflicts with a distinct environmental component. Even when they can be categorized as cross-border conflicts, they are predominantly intrastate conflicts. Generally they do not grow into classical interstate conflicts in the sense of wars between countries but manifest themselves as regionally limited clashes at the sub-national level.
- *Finally*, all approaches emphasize the central role of a state's or society's problem-solving capacity with regard to the emergence and management of conflicts: where political and societal institutions are weak, there is a proportionally higher probability of conflict occurring. Future crisis hotspots in view of environmental degradation intensified by climate change can therefore be assumed to be located in countries and regions with weak capacities for problem-solving.

In the recent past, there has been no evidence that environmental problems are the direct cause of war – that is, there have been no 'environmental wars' manifesting the most extreme form of interstate conflict. However, it can hardly be ruled out that environmental degradation can have destabilizing impacts that may lead to conflict escalation – as can be seen from various conflicts in the recent past, this remains a plausible possibility.

Accordingly, the interconnections between environmental conditions, society, and conflict are ex-

tremely complex due to the diversity of mutual dependencies between political, societal, and economic factors on the one hand and ecosystem factors such as availability of water, soil quality, and climate change on the other. Nonetheless, the key findings of environmental and conflict research suggest that, for the time being, genuine 'environmental conflicts' are unlikely to occur. Yet, environmental degradation may be one significant driver of conflict in combination with predominant socio-economic factors and governance problems. While some of these conflicts may develop a cross-border nature, they generally remain limited to a local area.

However, little can be said about future long-term developments on the basis of these findings. While there is a growing body of scientific evidence about climate change and its potential consequences, knowledge about a resulting tendency towards violent conflicts both within and between countries remains opaque. In order to reach a more accurate assessment of the relevance of climate change and environmental change to security it is necessary to consider that studies on environment and security have thus far focused on environmental changes at local and regional levels, but hardly at large-scale changes as driven by climate change and their potentially destabilizing impact. Moreover, empirical research on environmental conflicts has been concerned with the period from 1980 up to the turn of the millennium (Brauch 2003). Taking a new look through the lens of climate change however requires an extension of the analytical time horizon because the security-relevant disruption that is to be expected as a result of climate change is only likely to occur in the coming decades.

Looking through this lens suggests a need to reconceptualize our current understanding of the environmental conditions of conflict on two counts. First, an intensification of familiar environmental conflict patterns through reciprocal interlinkages; second, a new quality and scale of conflict-relevant environmental changes due to climate change.

41.3.1 Reciprocal Interlinkages between Conflict Constellations

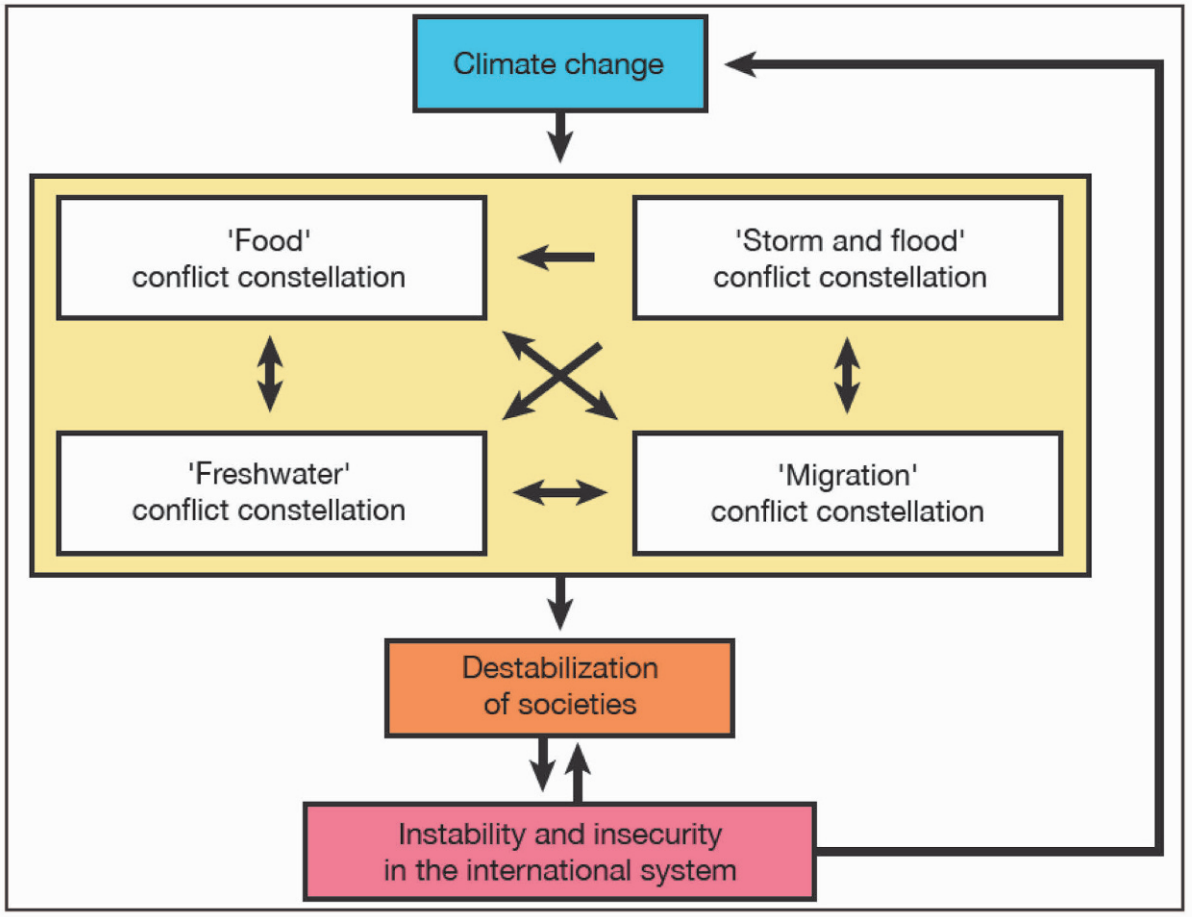
The problems associated with climate change are particularly likely to develop their critical impact when several adverse causal complexes coincide. Societies and regions are particularly vulnerable where unfavourable biogeophysical conditions, such as aridity, converge with poverty, high population density, weak institutions, and political instability. In many cases, the resulting critical constellations can be expected to be amplified by numerous interdependencies and feedback effects among the four constellations described above. Policy challenges to deal with the ensuing security risks would thus grow exponentially.

For instance, there are obvious interlinkages between fresh water scarcity, food production, and migration. With 70 per cent of fresh water being used for farming, it is fundamental to both food security and poverty reduction. Unfavourable climate-related changes in water availability can thus have severe impacts on the conditions for agricultural production and the livelihoods of rural populations. Such trends are again amplified by competition with other forms of resource use such as hydropower, and by pre-existing environmental problems such as soil degradation. In short, where water crises emerge, food crises can be triggered or worsened. Conversely, non-sustainable agricultural practices can contribute to causing water stress and conflict by overexploiting water resources or rendering them unusable through contamination with fertilizers and pesticides. In combination with poverty, weak institutions and political instability, freshwater scarcity and food insecurity can thus concentrate and amplify impacts regionally, thereby overwhelming institutions and causing crises to escalate.

In extreme cases, drought or water stress will force people to leave their homelands and thereby provide a link to migration. Migration, in turn, potentially causes various types of conflicts in transit and target regions. A growth in population and thus in demand for water and food could, for instance, overwhelm local management capacities or lead to further demographic pressure, for instance at risk of storm surges in densely populated coastal conurbations. Poor migration management can then adversely affect water availability and food production as well as disaster risk management structures in the transit and destination regions. In any case, it can be expected that climate change will lead to a considerable increase in the number of migrants, mainly within and between developing countries. An increase of associated conflicts seems therefore likely, in particular as here, too, there exist self-reinforcing feedbacks among the conflict constellations and their concentration in the developing world. They can already be observed today, but will become more frequent and emerge in new regions in the future.

Moreover, the risk for conflict constellations about water, food, and migration to escalate will be driven by the increase and intensification of storm and flood disasters. This will not only inundate and

Figure 41.2: Conflict constellations as drivers of international destabilization. **Source:** WBGU (2008: 160).



erode coasts, destroy settlements and infrastructure and wreak considerable economic damage, for instance in the fisheries and tourism sectors, but it will also force large numbers of people to flee suddenly. This will place major pressures upon disaster risk management systems and upon the coping capacities of the states and regions affected. Moreover, increasing extreme weather events lead not only to sudden disasters. They also trigger gradual processes of environmental degradation, notably through rising sea levels (WBGU 2006). Storm and flood disasters thus have the potential to reduce the availability of fresh water as well as soil quality over the long term, and, in conjunction with other factors, to thus induce water and food crises and to drive large numbers of people to migrate.

41.3.2 Climate Change as a Catalyst of Insecurity

Although conflicts related to environmental degradation have thus far remained relatively uncritical in terms of international security, the phenomena described above suggest, however, that regional risks of destabilization and violence driven by climate change threaten to gain a significantly new dimension. Far-reaching impacts upon national societies, entire continents, and the international system are to be expected unless climate change is effectively mitigated in the near future. It is in this sense that climate change lends a new quality to environmental threats to security, which results from the globality of causation and impacts, the speed and scale of climate-induced environmental effects, the large numbers of people affected, and the reciprocal interlinkages between climate-related conflict constellations about fresh water, food, storm and flood disasters, and migration.

In particular, this new quality is captured by eight distinct characteristics that directly relate to the above described conflict constellations (WBGU 2008):

- *Concentration* of conflict constellations in certain predisposed types of countries. Developing countries and, in particular, those characterized as weak and fragile states will be hit hardest (and often first). The low problem-solving capacities of this group of states makes probable a high potential for violent conflict.
- *Cumulation* of different conflict constellations in one region, which will thus be particularly stressed by resultant feedback effects and interlinkages as described above.
- *Scale* of crisis potential and the number of people affected will both reach unprecedented levels worldwide. Global population amounts to around 6.6 billion people today, and they are exposed in different ways to the consequences of climate change, notably in densely populated coastal communities.
- *Recurrence and a greater frequency* of extreme events can undermine all development efforts and progress in a region. A greater frequency of floods and drought will pose particular risks to people dependent upon subsistence farming (in lower latitudes), i.e. especially in Africa, parts of Asia, and South America (IPCC 2007a).
- *Propagation* of conflict constellations beyond the immediately affected region, with environmentally-induced migration serving as a key mechanism here. It can be assumed that the number of migrants moving away from areas particularly affected by climate change will increase in the future and that this may destabilize neighbouring regions. Moreover, the areas directly affected by severe consequences of climate change can also expand, for instance regarding the occurrence of hurricanes in higher latitudes due to warmer ocean surfaces.
- *Intensification* of crisis situations with problems ultimately resulting from climate change can engender a new dimension of conflict risks resulting from the interplay between increasing frequency and regional propagation of conflict constellations.
- *Disputes* and conflicts of interest between states will become more probable through an altered global balance of power in combination with the new problems driven by climate change. A world characterized by 'power in transition' (Kupchan/Adler/Coicaud/Yuen 2001) is highly likely to be less stable than the unipolar world we know today (see below). Accordingly, the risk of serious confrontation among key players will rise and hamper global governance in areas such as environment, development, and disaster prevention.
- *Time lag* characterizes ongoing climate change and thus poses a particular challenge to efforts to address the problems resulting from it. In order to reduce the risks of major climatic and socio-economic disruption resolute action is required immediately, that is within the next 10–15 years. Political and economic systems, however, are poorly equipped to respond to such global, long-term challenges as posed by climate change. Accordingly, failure to mitigate climate change will lead to considerable further destabilization, crisis, instability, and violence from roughly the mid-century onwards.

41.3.3 Contextual Global Trends and the Cumulative Destabilization of the International System

Of course, none of these developments will occur in isolation but have to be seen in the much bigger picture of world developments and international politics. Here, five macro-trends can be observed, each of which represents a considerable challenge to the current global governance architecture in its own right. Again, climate change will not help to ameliorate the ensuing problems but rather intensify them (Bauer/Messner 2007):

- *A critical impairment of global economics*, that can result, amongst other things, from the necessary adaptation measures which the safeguarding of local and regional production processes and supply structures will require. Thereby the costs for coping with the consequences of climate change will be that much higher, the longer an effective climate policy is procrastinated.
- *An increasing climate-induced threat to existential human rights* (notably access to water, food, security) could undermine the international legitimacy of mainly responsible industrialized nations, but also that of fast-growing anchor countries such as China and India whose emissions are rapidly increasing. Ultimately, this could limit these countries' capacity to act at the global level.
- *An intensification of international distribution conflicts*, especially with a view to the transfer of compensation payments between those mainly

responsible for global warming and those mainly affected by its negative consequences.
- *A drastic increase in migration* both within the regions heavily affected by climate change as well as beyond these regions, for which humanitarian solutions as well as adequate international legal responses must be found in order to cope with these problems.
- *A proliferation of weak and fragile states* that will hardly be able to protect their population from the consequences of climate change and that destabilizes the international order as a result of eroding statehood.

Given the state and capacity of its current multilateral institutional architecture the international community seems ill-prepared to cope with each one of these challenges. If the resulting threats accumulate and intensify each other, which seems probable, it would quickly reach its limits. More than ever, the international community will thus be all but helpless unless governments finally prop up existing multilateral institutions with adequate means. This may require them to venture new ways of international organization altogether and even to transcend persistent notions of national sovereignty that define the present international system.[22]

41.4 Outlook: Reconceptualizing Security for a Hotter World

Security and the question of how it is best conceptualized are among the most controversial issues in international politics. Due to the inherent flexibility of the concept, security can be interpreted in different ways, depending on the interests of security experts, intellectuals, and politicians (Dalby 1992, 2008; Brauch 2008, 2009).[23] In classical terms, security implies the preservation of a nation state's integrity vis-à-vis external threats in an anarchic world of states. In the vein of this paradigm, guaranteeing security is ultimately seen as a military task. In the era of post-Cold War globalization, however, it became ever more obvious that insecurity, instability, and violence are brought about not by military aggression alone, but may have complex political, economic, socio-cultural, and ecological origins, which in turn led to calls for a re-assessment of security and corresponding policy adjustments (Tuchman/Mathews 1989; Lipschutz 1995; UN 2004).

In the particular context of environmental challenges for security policy, proponents of the concept of human security have since stressed that a concept of security which refers to collective actors, such as states and societies, is not capable of encompassing all relevant threats, challenges, vulnerabilities, and risks that can be found on the ground (Brauch 2005, 2009a: 4; Dalby 2002, 2008). Indeed, environmental conflicts do not usually involve longstanding clashes of interest between organized groups, but are rather discrete disputes that occur between people whose intention is to safeguard their means of survival. From the point of view of human security, environmental security would have to be geared not towards the nation state but towards the ecosystem in which humans themselves represent the real threat to security in their role as users and polluters of the environment (Brauch 2005; Dalby/Brauch/Oswald Spring 2009; Oswald Spring/Brauch/Dalby 2009).

However, a range of objections have been raised against the concept of human security. One is that the UNDP approach plays down security risks, such as wars, and the important role of nation states in their significance, and that it blurs the boundary between human security and human development. Clarity can be gained only by restricting the concept of security to 'freedom from direct physical violence'. Even then, there is a danger that the concept of human security, with its positive connotations, could be exploited to construct new sources of legitimacy for military interventions aimed at safeguarding security (from environmental risks, AIDS, migration, etc.). Finally, when the concept of security is watered down in this way, it leads to a loss of analytical clarity from a research perspective as well.

Overall, then, the debates about comprehensive security and its policy implications remain controversial due to the inevitably Janus-faced character of the issues involved. On the one hand, an expanded concept of security could counteract the further militarization of international politics, if the drive to achieve security were increasingly understood to encompass economic, social, and ecological concerns in the context of sustainable development. On the other hand, however, it allows international structural policy to become militarized, as environmental policy and other non-military matters are turned into security concerns.[24] This may lead, among other things, to a situ-

22 See i.a. Newman/Thakur/Tirman (2006); Paolini/Jarvis/Reus-Smit (1998); Kennedy (2006) for general discussions of the state of multilateralism and structural change in the international order.

23 See also Brock (1997); Dalby (2002, 2008); Levy (1995).

ation in which non-civilian actors, such as secret services or police and border protection authorities, are increasingly entrusted with tasks that lie outside their original area of responsibility – as exemplified by the Patriot Act in the USA – or in which resources intended for development cooperation are used to co-finance military operations in the context of humanitarian interventions. Similarly, it is to be feared that the 'colonization' of international environmental policy by the dominant industrialized powers will further reinforce the North-South conflict. Both tendencies – the endeavour to develop non-military supporting measures for security policy and military back-up for global structural policy – are reflected in the more recent debate about development strategies for weak and fragile states (BMZ 2007; Collier 2007; Faust/Messner 2004).

Since the events of 11 September 2001 security discourse in international politics has been dominated by the fight against global terrorism. This is reflected clearly in the new security strategies that have arisen on both sides of the Atlantic (Berenskoetter 2005), with the USA and the European Union setting differing priorities. The National Security Strategy of the USA clearly emphasizes military aspects, even including pre-emptive military action, whereas the European security strategy argues more along political lines and is oriented towards the objective of avoiding conflict. While the strategy of the USA also contains provisions for increasing foreign and development assistance, its overall content and style is oriented towards military offensiveness: 'our best defense is a good offense' (White House 2002).

In contrast to this, the European security strategy, formulated in December 2003 under the supervision of Javier Solana, i.e. the Secretary-General of the Council and High Representative for the Common Foreign and Security Policy of the EU, emphasizes the possibilities of multilateral diplomacy. The strategy calls, above all, for a strengthening of the multilateral world order and of international law; it also calls for conflict prevention measures to be designed for the long term and to be based on both non-military cooperation and political pressure, which in the last resort – as in the case of humanitarian disasters, genocide or acute state failure – is to be complemented by robust military intervention within the framework of the international legal order (EU 2003; Faust/Messner 2004; chap. 6 by Bailes).

The general principles formulated in the European security strategy have been lent greater precision, however, in a European defence paper commissioned by the EU member states and prepared by the Paris *Institute for Security Studies* (ISS 2004). This paper notes that there is an increasing need for expeditionary forces that are flexible and capable of being deployed at short notice, as well as for occupation forces that can be deployed over the long term. The ISS paper bears the unmistakeable trademark of a military policy-based approach, suggesting that the EU's security policy think tank has yet not accommodated the broader, more non-military security approach. Thus the transatlantic differences in approach are no longer quite so pronounced.

In addition to the European defence paper, though, the report commissioned by Solana entitled 'A Human Security Doctrine for Europe' and prepared by the *Study Group on Europe's Security Capabilities* (Study Group 2004) has also become a central component of the debate over European security policy. This report – also known as the 'Kaldor paper' after the group's chairperson Mary Kaldor – makes explicit reference to the concept of human security, which differs markedly from traditional security policy ideas. In particular, the Study Group recommends that foreign and security policy be oriented less towards states and more towards individuals, since territorial defence in the classical sense is no longer effective in the changed global security situation. The Kaldor paper thus calls additionally for a Human Security Response Force that is specialized in humanitarian intervention, to complement the EU Military Rapid Response Force proposed in the ISS paper.

In sum, security risks that could arise as a result of long-term processes of global environmental change are accorded varying degrees of attention in the strategies put forward by the US and other OECD countries; overall, however, they still play a rather subordinate role. Statements about potential linkages between environmental degradation and security often remain vague, unless they are focused on those natural resources whose supply is directly relevant to the interests of the industrialized countries. As another example, the 2005 status report from the Worldwatch Institute, entitled *Redefining Global Security*, stresses the significant role of an oil-based global economy with regard to climate change and calls for a reduction in dependency on crude oil. Yet even the Worldwatch Institute sees the security risks associated with such an economy as being above all a problem of supply shortages and the 'resource curse'; this

24 See, for instance, Brock (1997); Deudney (1991, 1992); Wæver (1995).

means that resource richness can often be associated with negative consequences for the development of a country (Worldwatch Institute 2005).

A similar approach to environmental change also characterizes recent security debates in the United Nations which respond to reports by UN Secretary-General Kofi Annan (UNSG 2005) and by the High-level Panel on Threats, Challenges and Change that was commissioned by Annan (UN 2004). While the high-level panel argues for a more wide-ranging concept of security that regards poverty reduction as an indispensable basis for a new collective security, environmental degradation is mentioned only as a marginal issue in the six categories of global threats to security which the panel defined, namely, as a sub-issue under economic and social deprivation.

Against this background, it is remarkable that, in its security strategy of 2006, which it formulated in the aftermath of Hurricane Katrina, the United States no longer addresses the scarcity of strategically important resources alone, but also explicitly refers to environmental degradation (White House 2006).

Irrespective thereof, the concepts of 'environmental security' and 'ecological security', which relate to environmentally induced security risks, have already been taken on board by important international actors, such as NATO, OECD, and UNEP who have responded to the policy relevance of the issue by setting up working groups and special departments.[25]

The EU, in particular, might be seen as a pioneer in this respect. In March 2008 the EU and the heads of state of the EU member states published an "action plan on climate change and security", emphasizing that the mitigation of global warming should be perceived as a preventive strategy to avoid climate driven conflicts in the future. Furthermore, they emphasize that beyond mitigation initiatives significant adaptation strategies need to be developed in order to avoid destabilizing impacts of climate change in vulnerable countries and regions. Meanwhile, practitioners of international development cooperation, too, have taken up the issue of climate change and security (e.g. GTZ 2008, Smith/Vivekananda 2007; Brauch 2009a; chap. 42 by Scheffran).

A year after the publication of the IPCC's fourth assessment report, it seems, the theoretical and political debates on climate-induced conflicts are actually gaining relevance in international policy-making, as is reflected in the Implementation Paper to the European Security Strategy by the European Council in December 2008 (chap. 6 Bailes; EU 2008, 2008a).

25 See the chapters in the previous volume of the Hexagon Series by Brauch 2009; Dalby/Brauch/Oswald Spring (2009); Matthew/McDonald (2009); Sergunin (2009); Ramakrishnan (2009); Schreurs (2009); Selim (2009); Newman (2009); Twite (2009); Dajani (2009); Ejigu (2009); Moyo (2009); Lopez (2009); Cheterian (2009); Barnett (2009); Hoogensen (2009); Oswald Spring/Brauch/Dalby (2009).

42 Security Risks of Climate Change: Vulnerabilities, Threats, Conflicts and Strategies

Jürgen Scheffran

42.1 The Climate-Security Challenge

With growing indications of climate change, the expected impacts and risks pose a major challenge for society, foreign policy and security (Ott 2001). The issue is complex and covers highly uncertain future developments which preclude simple predictions from previous data. The recent reports by the *Intergovernmental Panel on Climate Change* (IPCC) point to new risks, but do not focus on the linkages between climate change and potential social tensions and conflicts (IPCC 2007a; Nordås/Gleditsch 2009). Worldwide, devastating impacts on food and water availability, flood and storm disasters and large-scale events, such as loss of the monsoon, breakdown of the thermahaline circulation, polar ice melting, or sea-level rise, could affect large populations. It is unclear yet how human beings and their societies will respond to the expected dramatic consequences of climate change and whether the social stress will lead to more security risks and conflicts or to more cooperation.

Since 2007 interest in the climate-security nexus has increased in the international community which contributed to the securitization of climate policy (Scheffran 2008a, 2009; Brzoska 2009; Brauch 2009a). In April 2007, the U.N. Security Council discussed the security risks of climate change for the first time (UNSC 2007), and U.N. Secretary-General Ban Ki-Moon warned that climate change may pose as much of a danger as war (BBC 2007). In June 2009, the UN General Assembly requested a report on climate change and its potential security implications (UNGA 2009). The EU High Representative and the European Commission, in part with a view on the growing tension on Arctic resources, suggested that "climate change acts as a threat multiplier, worsening existing tensions in countries and regions which are already fragile and conflict-prone" (EU 2008).

Several think tanks have published studies that analysed the potential security implications of climate change. A Washington-based panel of experts asserted that climate change "has the potential to be one of the greatest national security challenges that this or any other generation of policy makers is likely to confront" (Campbell/Gulledge/McNeill/Podesta/Ogden/Fuerth/Woolsey/Lennon/Smith/Weitz/Mix 2007). A panel of retired admirals and generals also identified climate change as a 'threat multiplier' that undermines international and human security and aggravates conflict in many parts of the world (CNA 2007). The German Advisory Council on Global Change discussed conflict constellations in climate hot spots and concluded that climate change could overwhelm adaptive capacities of many societies, possibly leading to instability and conflict (WBGU 2008; chap. 41 by Bauer).

Before the year 2000 the research literature sporadically discussed (Brown 1989; Swart 1996; van Ireland/Klaassen/Nierop/van der Wusten 1996; Scheffran 1997; Edwards 1999; Rahman 1999). More recently a number of studies have analysed potential security implications of climate change on the local, regional and global levels (Brauch 2002, 2007f, 2009a; Brown 2007; Maas/Tänzler 2009), without providing sufficient evidence to support a clear causal relationship. A critical analysis raises doubts about over-simplifications (Barnett 2003; Barnett/Adger 2005, 2007; Nordås/Gleditsch 2007) and warns against over-selling the argument before the links are better understood (Dabelko 2009). A systematic and integrated analysis of the climate-security link is still missing, and there is a need to design interdisciplinary and integrated assessment approaches to improve the understanding of how actors are responding to climate change and how potential security implications can be avoided. In particular, indicators are missing that measure key impact dimensions, such as vulnerability, risk, threat, insecurity, instability and conflict that could guide strategies for addressing these problems.

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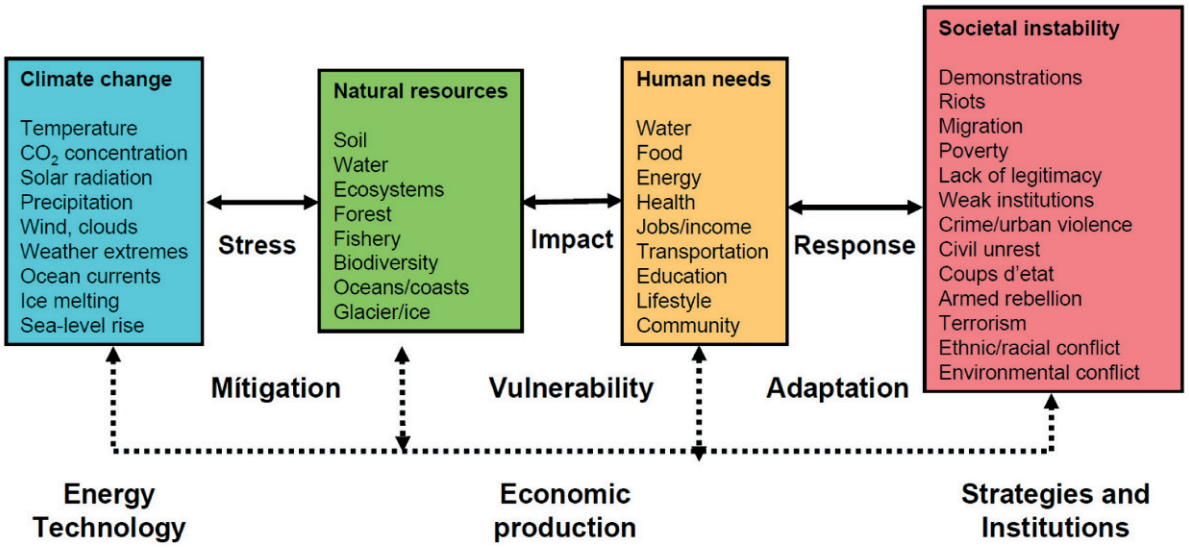
Figure 42.1: Causal relationships between climate change, natural resources, human needs and societal impacts. **Source:** The author.



This chapter will assess these issues by discussing the link between climate change impacts, human responses and societal strategies within an integrated framework of climate-society interaction. An integrated assessment framework will be introduced to analyse the causal chain between climate change, natural resources, human needs and societal stability, with a focus on the sensitivities that couple different systems and variables (42.2). Impacts of and responses to climate-induced stimuli will be evaluated in terms of vulnerabilities and adaptive capacities, threats and security risks, instabilities and conflicts (42.3). This analysis serves as a basis for developing strategies to reduce security risks and conflicts and stabilize the climate-society interaction (42.4).

42.2 Integrated Framework of Interactions Between Climate and Society

42.2.1 Integrated Assessment Framework

Since human societies rest on certain environmental conditions, a changing climate that significantly alters these conditions will cause stress to social systems and has an impact on human life and society. Whether societies are able to cope with the impacts will depend on their responses to change and their abilities to adapt to or solve associated problems. Finding human responses and societal strategies that avoid potential security risks and conflicts of climate change is a major challenge. To analyse these processes more systematically, an integrated assessment framework of climate-security interactions is developed, using concepts and methods rooted both in the social sciences and in complex systems analysis (Cho 2009). To assess the implications for security and conflict that could affect societal and political stability, it is crucial to not only understand the dynamics of systems, but also the perceptions and response patterns of human beings to climate-induced environmental change and how this shapes the social interactions in their respective societies.

Figure 42.1 shows the causal links between climate stress, environmental impacts, human responses and societal consequences, building on related approaches such as the IPAT equation and the Kaya formula (Scheffran/Stoll-Kleemann 2003) or the PEISOR concept, (see Brauch 2005b, 2009a; Brauch/Oswald Spring 2009a; Oswald Spring/Brauch 2009). Changes in the climate system (such as marked changes in temperature and precipitation) affect natural resources (e.g. soil, water, ecosystems, forests, biodiversity), through a sequence of complex interactions. Depending on vulnerability, adverse environmental changes will stress basic human needs and desires (such as the availability of water, food, energy, health and wealth). These impingements on human needs may impair the stability of societies that can appear in violent forms, such as riots, insurgencies, urban violence or war, which in return can aggravate social disruption. Feedback mechanisms allow societies to adapt to the changing situation and mitigate climate stress through

strategies and institutions that apply technology, human and social capital for adjusting the economy, the energy system and human behaviour. To determine the couplings along this causal chain, it is important to identify the sensitivities that measure how variables in one level modify variables in another level. For instance, desertification caused by climate change may undermine food security and force people to migrate or take violent actions. Many more of these linkages are feasible and future research may help to understand the most likely and most significant ones for crisis areas that are most affected by climate change (hot spots). Estimating the sign of these linkages or even the strength may help to sketch impact graphs which can serve as an analytical framework.

42.2.2 The Climate-Environment Link

The interaction between climate change and environmental change is determined by the laws of nature and can be represented by a set of system variables that are mutually interconnected. The degree of environmental change is indicated by the sensitivity of environmental variables, organisms and ecosystems to the stress caused by climate change events, such as global and regional temperature change; a drop in precipitation; the increase in floods and storms; or sea-level rise. The rise of global temperature and its variation alters many natural processes and cycles, including precipitation patterns, ice formation, biological systems and their distribution. Climate change has a multitude of potential impacts on the natural environment which are closely interrelated. For instance, less water affects ecosystems and soil conditions; sea-level rise threatens many coastal regions. Extreme weather events, such as hurricanes, flooding and heat waves, are expected to increase in frequency and strength and can be highly destructive where they hit. Large-scale events such as the loss of the monsoon, the melting of Greenland or West Antarctic ice sheets or the shutdown of the thermohaline circulation can trigger irreversible "tipping points" in the climate system (LentonHeld/Kriegler/Hall/Lucht/Rahmstorf/Schellnhuber 2008).

Where natural resources are in a critical stage, global warming may degrade the environment as a source or as a sink of natural resources. Many natural systems are vulnerable to climate change and have limited adaptive capacity, such as glaciers, coral reefs, mangroves, arctic and mountainous ecosystems, wetlands as well as biodiversity hot spots. Some of the ecosystems may undergo irreversible change, and some may remain intact despite external influences. Adaptive ecosystems are able to preserve their existence through feedback cycles that maintain stability within viable limits. If these feedback cycles are disturbed as a result of climate change, rapid, even catastrophic changes may occur, leading to the loss of valuable functions of the ecosystem. Whether these functions can be preserved against likely disturbances indicates the stability and resilience of the ecosystem (42.3.4).

42.2.3 Human Vulnerability and Responses

The environmental effects of climate change events have multiple impacts on human needs. Potentially affected are systems that provide these needs, including water, food and energy supplies, agriculture and land use, health, urban life and migration patterns, networks and infrastructures, economic activities and political processes. Environmental stress through floods, storms, droughts or heat waves may directly threaten human health and life, others gradually undermine the well-being over an extended period, such as food and water scarcity, diseases, weakened economic and degraded ecological systems. Life-threatening extreme weather events are expected to increase in frequency and strength. Storm and flood disasters could endanger large populations, e.g. in Southern Asia. The melting of glaciers could jeopardize water supply for people in extended areas, e.g. in the Andean and Himalaya regions. The impacts of climate change on human beings and societies depend on their vulnerability and responses. Some responses could help to adapt and minimize the risks, others may cause more problems. For instance, migration is a possible response not only to poverty and social deprivation, but also to environmental hardships. What human actions can do or not do depends on the magnitude of climate change which is a function of the changing temperature. For existential threats the spectrum of responses may be restrained, making non-legal and violent acts more likely, but could also force people to work together to improve the chances for survival.

42.2.4 Societal Impacts, Instabilities and Adaptive Capacities

Environmental changes caused by global warming not only affect the life of human beings, but may also have larger societal effects, either by undermining the infrastructures of society or by inducing destabilizing human responses and interaction patterns of social systems. The associated socio-economic and political

stress can undermine the functioning of communities, the effectiveness of institutions and the stability of societal structures. Societies which depend more on the environment, tend to be more vulnerable to climate stress. The stronger the impact and the larger the affected region, the more challenging it becomes for societies to absorb the consequences. In the worst case, climate change could trigger a cycle of environmental degradation, economic decline, social unrest and political instability that could accumulate to become security threats and aggravate conflicts. For instance, due to water scarcity and soil degradation, agricultural yields could further drop and diminish food supply. Extreme weather events put the economic infrastructure at risk, including industrial sites and production facilities as well as networks for transportation and supply of goods. Each region of the world will be affected differently. In less wealthy regions climate change adds to already stressing conditions – high population growth, inadequate freshwater supplies, strained agricultural resources, poor health services, economic decline and weak political institutions – and becomes an additional obstacle to economic growth, development and political stability (UNDP 2007). The societal implications crucially depend on how human beings, populations and social systems respond to climate change. An increase of forced migration by climate change would create more migration hotspots around the world, each becoming a nucleus for social unrest (WBGU 2008). If multiple systems are affected by multiple impacts, cascading effects could occur (Karas 2003) and overwhelm societies. Large-scale changes in the Earth System, such as the loss of the Amazon rainforest and the Asian monsoon or the shutdown of the thermohaline circulation, could cause disasters on a continental scale.

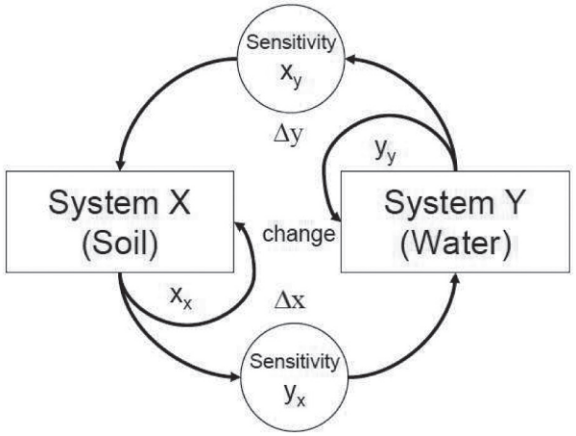
42.2.5 Sensitivity and the Causal Chain from Climate Change to Societal Impacts

The impact of climate change on society depends on the linkages among the various system variables along the causal chain. They can be measured by the pair wise sensitivities between variables, i.e. how much the change of one variable x induces a change in another variable y which is denoted as sensitivity y_x (figure 42.2). According to the IPCC (2007a) sensitivity in the context of climate change is the

> degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

A prominent example is climate sensitivity, i.e. the temperature change induced by a doubling of CO_2 concentration in the atmosphere. Since several intermediate variables are involved, estimates are needed for each of the sensitivities which together multiply to give the overall sensitivity.[1]

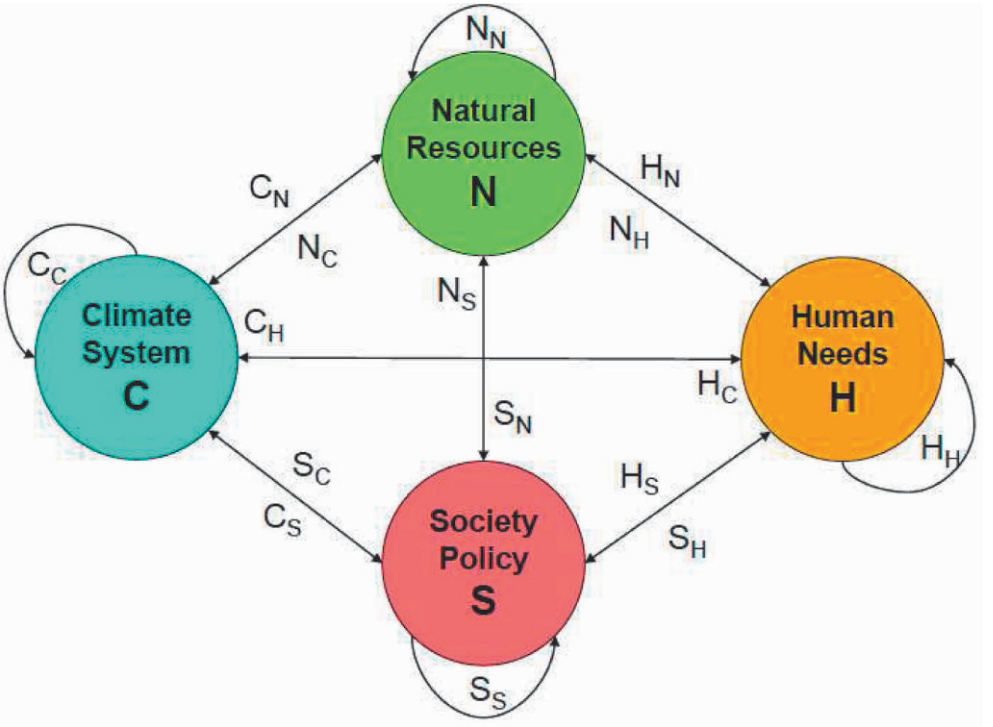
Figure 42.2: System-system interaction (exemplified here by water and soil systems). **Source:** The author.



The possible causal chain from climate stress to societal instability can be constructed through a series of links between them where the couplings between variables are determined by the sensitivities. Changes in the climate system C affect the natural environment and resources, N, through a sequence of complex interactions. Environmental changes will put stress on human needs and desires H (e.g. by reducing the availability of water, food, energy, health and wealth) and ultimately trigger societal impacts and instability events S. The links between variables at each of these levels and the associated variables will be represented by a sensitivity matrix X_Y, which indicates how sensi-

1 The sensitivities determine how a change in one variable x affects either itself (self-impact x_x) or another variable y (mutual impact y_x). The self-impacts determine whether an increase in variable x leads to further growth ($x_x > 0$), which is the case for exponential growth, or to a decline ($x_x < 0$) for exponential decline. The mutual impacts either represent a positive coupling ($y_x > 0$) or a negative one ($y_x < 0$). For human action, the self impacts determine whether someone's action has a positive or negative effect on itself, the mutual impacts represent friendly or hostile relations.

Figure 42.3: Mutual sensitivities in the climate-environment-human-society interaction. Source: The author.



tive a variable in system X is with regard to a variable change in system Y.

Statistical multivariate analysis of data about previous cases allows estimates the entries into the sensitivity matrices: the stress induced to natural resources by climate change (N_C), the impact of environmental change on human needs and living conditions (H_N), and the societal consequences of changes in human living conditions (S_H). The coupling between climate stress and societal instability can be represented by the combined matrix, S_C, which captures both the direct linkages from climate change to societal stability and the indirect linkages through environmental and human impacts. Other linkages are also relevant here, such as the coupling between human needs and climate change, H_C, between societal and environmental change S_N, or the reverse feedback couplings C_N, C_S, N_S and so on. Since there is an internal dynamics in each of these systems, there are internal couplings of variables within the climate system, natural resources, human needs and society, denoted by matrices C_C, N_N, H_H and S_S (figure 42.3).

With these sensitivities the network of interconnections can be constructed between the various system variables. Having this network allows to understand the spread of climate events through the network of connections. Relevant changes in the climate-environment interaction are denoted as events, e.g. an increase or a drop in precipitation, the loss of a species or a natural disaster. With this approach, a stability analysis for the interaction matrix of network linkages can be performed, represented by the sensitivities between system levels (42.3.4). This setup makes it possible study the impact of triggering events (e.g. mass migrations, extreme weather events, social movements), and find cascading sequences and tipping points. With this analysis it is also possible to generate the probability of future destabilizing events occurring under specified conditions, which has implications for developing an early warning system.

Many of the sensitivities are however unknown and depend on other variables. Due to non-linear effects, an increase in average mean temperature above a certain threshold (such as 2 °C) may result in disproportionate impacts, such as a widespread reduction of agricultural output in regions of Africa, South Asia or Central and South America (Hare 2006; Schellnhuber/Cramer/Nakicenovic/Wigley/Yohe 2006). Food insecurity in one country may further increase competition of resources and force populations to migrate into neighbour countries. This chapter addresses the overall sensitivity of security and conflict to global temperature change, i.e. how much do security and conflict increase in particular regions with a particular

rise in temperature. In the following section the focus will be on how human and societal response patterns shape that interaction, where the impacts will be evaluated in terms of vulnerabilities, threats and security risks, instabilities and conflicts.

42.3 Climate Impact Dimensions

42.3.1 Vulnerability and Adaptation

The impact of climate change on systems, persons or social groups depends on their vulnerability to loss (damage, harm, or hazard). According to the *Oxford English Dictionary* (Oxford 2009) a system is vulnerable (from Latin *vulnerare* 'to wound') if it is exposed to being attacked or harmed. This implies that events or acts may interfere with the normal operation of a system in a negative way. Blaikie, Cannon, Davis and Wisner (1994: 275) provide a human-centered definition of vulnerability as the "characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard." Thus, vulnerability depends on the person, the type of event and the actions taken against the hazard. Some persons may be more vulnerable to the same event than others, and some may not be vulnerable at all. An event causing vulnerability may be compensated by responses to protect against it or avoid it in the first place.

There is a range of different interpretations of vulnerability (Adger/Lorenzoni/O`Brien 2009, Brauch 2005a, 2007a), partly due to the diversity of the issues involved. A number of studies have discussed conceptual aspects of vulnerability.[2] One approach to present a formal framework (Ionescu/Klein/Hinkel/Kumar/Klein 2009: 3) defines "vulnerability *of* something *to* something" as a relative concept, depending on: (1) the entity that is vulnerable, (2) the stimulus to which it is vulnerable and (3) the preference criteria to evaluate the outcome of the interaction between the entity and the stimulus. In this framework, the classification of vulnerability is a judgement referring to a possible future for a present entity, e.g. a potential event of causing harm. In terms of the preference criteria chosen, vulnerability has a negative connotation and classifies events into desirable and undesirable.

Within the context of climate change, the meaning of vulnerability has evolved over time (Füssel/Klein 2006). The core concept of vulnerability has been defined by the IPCC (2007a) as the "degree, to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes." And further: "Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity." The operationalization of the IPCC vulnerability concept has proven difficult, partly because of the diversity of potential events associated with climate change, the variety of possible impacts and systems affected, all of which have different sensitivities and adaptive capacities.

The vulnerability concept is complicated because it involves the adaptive activities of the affected systems. For the IPCC (2007a) adaptation is the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". To adapt, a system must be able to respond to a climatic stimulus and take actions that either diminish harm or compensate for it by establishing positive values. The capability to take such actions is the adaptive capacity which is influenced by a number of factors (e.g. poverty, state support, economic opportunities, the effectiveness of decision-making, social cohesion). Each of those factors is affected by other variables, e.g. state support is a function of income and labour support, public education and health, law and (dis)order, credit and protective security (Barnett/Adger 2005: 4).

The overall assessment of vulnerability and adaptation depends on the balance between potential damage, costs and benefits. Implementation of adaptation measures is a costly process which compares with the benefits they produce. Since complete invulnerability against all potential pathways for harm is impossible, the question is where to draw the line between what is tolerated and which further actions are taken that will ultimately depend on whether the additional efforts are worth the potential harm avoided.[3] An insurance may compensate for a loss but this is difficult for

2 See especially: Jones (2001); Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher, Schiller (2003); Ribot (2009).

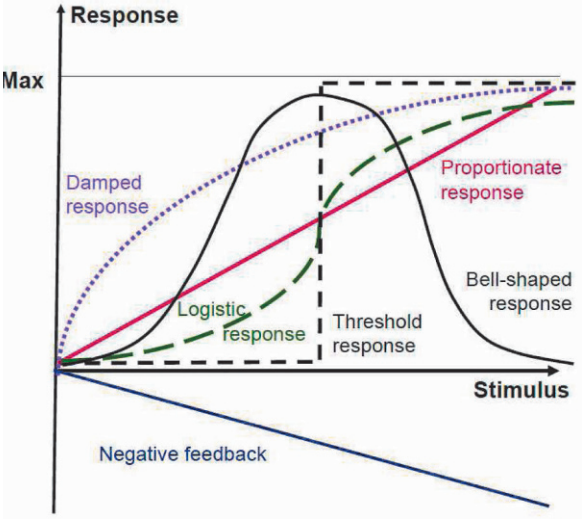
3 It is worth noting here that the limits of invulnerability became a major policy issue in the debate SDI debate of the 1980s when the Reagan Administration was seeking mutually assured survival against nuclear attack and Paul Nitze established a set of criteria to put the SDI program on more practical grounds (see Scheffran 1989).

loss of life. One approach to further operationalize the vulnerability concept is to develop indicators to measure the intensity of climate change, its harmful impact on various systems and the effectiveness of adaption measures to reduce the harm. In this approach vulnerability would be the ratio between net damage and the intensity of climate change which can be reduced by adaptation.[4] An additional question is who will experience the damage and damage reduction and who will pay for it. A global assessment would not distinguish between the different actors but in reality the issue of equity matters considerably (42.4.4).

The relationship between stimuli, losses and adaptive efforts will ultimately depend on the response functions of the respective systems (figure 42.4). For a linear response function the adaptive response is proportionate to the stimulus (positive feedback) or inversely proportionate (negative feedback). In reality, responses can only occur within resource limits, given by a maximum and minimum response. Alternative response functions are dampened with increasing stimulus when approaching the upper limit, or they represent a logistic growth function, starting slowly until they reach a rapid transition point. A special case is a one-step response function where a switch towards the maximum response occurs at a particular stimulus. These response functions can either represent the real action that is taken or a target response to meet a particular objective, e.g. maximizing value, minimizing damage or to guarantee a minimum viability condition for existence (e.g. water and food consumption needed for life or zero profit for a company). Failing to achieve a target response leaves an adaptation gap.

Climate change will affect groups and sectors in society differently. Key variables are location and the group affected. Warming is greater at high latitudes than in the tropics, sea-level rise will have different impacts around the globe and some regions will experience more intense rainfall, others more dry periods. In some regions intense rainfall could lead to devastating floods, in others nobody may be harmed. Heat stress can be more fatal to elderly people than to young people. In South Asia tropical storms can kill tens of thousands of people, at the US Gulf coast they can lead to billions of dollars worth of damage. There are also significant differences in the degree to which regions, groups and sectors are able to prepare for or respond to the effects of climate change. Countries in Northern Europe have more advanced technological capabilities, financial resources and institutional systems to respond to sea-level rise proactively and protect their population than countries in Southern Asia or small island states in the South Pacific. For more frequent droughts, rich farmers will be better able to invest in irrigation technology than poor and less educated farmers.

Figure 42.4: Different response functions to stimuli. **Source**: The author.



4 In mathematical terms, for a system with an expected value W and climate change occurring with intensity X causing an expected loss (damage) Y(X), the net value under conditions of climate change would be V = W - Y(X). Vulnerability could be defined as the ratio y_x = Y(X)/X which is the average value loss to climate intensity. If costs C for adaptation efforts are applied, net value may increase by D(C), either by increasing value to W(C) > W or by reducing damage to Y(C,X) < Y(X). Then adapted net value would be V(C) = W(C) - Y(C,X) - C = V + D(C) - C where the costs for adaptation are diminishing the net value (provided the units are comparable). Adaptation measures would be beneficial for V(C) > V which is the case for D(C) > C. Vulnerability under adaptation would then turn into $y_x(C)$ = (Y(X) - D(C))/X which would be lower for D>0 if the costs for adaptation are not taken into consideration. An extended view could modify this assumption and also specify the functional relationships Y(X) and D(C). For instance, if damage is proportionate to climate change intensity (Y(X) = y X), adaptation costs are proportionate to climate change intensity (C = c X) and avoided damage is proportionate to adaptation costs D(C) = d C, then the net value gain is positive for adaptation efficiency d > 1 (more damage is avoided than cost spent per unit of investment). Vulnerability under adaptation would then be y_x = y - cd, if costs do not count as a loss, and y_x = y - c (d -1) otherwise.

Given the significant impact of climate variability on the natural environment, more affected are agricultural societies which rely more on natural resources and ecosystem services. Due to water scarcity and soil degradation, agricultural yields will further drop. The most serious climate risks and conflicts are expected in poor countries, which are vulnerable to climate change, have less capital to invest in adaptation and thus cannot take the responses needed: "Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies" (IPCC 2007a). A progression of climate change will increase the vulnerability of weak and fragile states and further reduce their adaptive capacities. Some regions such as Bangladesh and the African Sahel are more vulnerable due to their geographic and socio-economic conditions and the lack of adaptation capabilities. According to Nordas and Gleditsch (2005) those with ample resources "will be more able to protect themselves against environmental degradation, relative to those living on the edge of subsistence who will be pushed further towards the limit of survival." Climate change can thus reinforce obstacles to development and heighten poverty, thereby increasing the risk of conflicts in these societies.

The stronger the impact and the larger the affected region, the more challenging it becomes for societies to absorb the consequences. Storm and flood disasters could threaten large populations, e.g. in Southern Asia, China and Central America, the melting of glaciers could jeopardize water supply for people in extended areas, e.g. in the Andean and Himalayan regions. Water and food for about a billion people are already at risk, agricultural areas are overexploited in several world regions. Large-scale changes in the Earth System, such as sea-level rise, the loss of the Amazon rainforest and the Asian monsoon or the thermo-haline circulation (THC) shutdown, could have incalculable consequences on a continental scale.

Wealthier countries are not immune either. While the impacts on some developed countries may be moderate or even positive at small temperature change (greater agricultural productivity, reduced winter heating bills, fewer winter deaths), they will become more damaging at higher temperatures as predicted towards the end of this century. Extreme weather events put the economic infrastructure at risk, including industrial sites and production facilities as well as networks for transportation and supply of goods. Depending on their type and intensity, climate impacts become a major obstacle to economic growth, regionally as well as globally.

The Stern Review concludes that the costs of climate change for developed countries "could reach several percent of GDP as higher temperatures lead to a sharp increase in extreme weather events and large-scale changes" (Stern 2006: 157). Rising temperatures exacerbate existing water shortages on drylands in Southern Europe, California and South West Australia; reduce human security and agricultural output; increase the investment required in infrastructure and the costs of damaging storms and floods, droughts, heat waves and forest fires. During the 2003 heat wave in Europe, 35,000 people died and agricultural losses reached $15 billion (Stern 2006: 150). Abrupt and large-scale changes in the climate system could have a direct impact on the economies of developed countries, ranging from several meters of sea level rise, following the melting of the Greenland ice sheet, to several degrees of cooling in Northern Europe, following the THC-collapse. As impacts become more damaging, they may have severe consequences for developed economies, including population movements and disruption to global trade and financial markets[5].

42.3.2 Risks and Threats

Risk is the "chance of injury, damage, or loss" (Webster's Dictionary 2009). Risk analysis is applied to situations which have multiple, uncertain outcomes, and determines the vulnerability to these events, in terms of estimated losses and their probability (usually risk is the product of these two variables). To estimate the risks of climate change, information would be needed on the expected damage and probability of climate-induced events, as well as their timing and measures for risk reduction. Each of the pathways from climate change to societal impacts comes with a risk that is specific to the persons or systems affected. There is a sequence of probabilities along the causal chain: the probabilities for certain emission scenarios, atmospheric stabilization levels, global temperature change, climate change in each region, type of harm for each affected system, and finally the probability for each of

5 See the report by: Stern, Peters, Bakhshi, Bowen, Cameron, Catovsky, Crane, Cruickshank, Dietz, Edmonson, Garbett, Hamid, Hoffman, Ingram, Jones, Patmore, Radcliffe, Sathiyarajah, Stock, Taylor, Vernon, Wanjie and Zenghel (2006).

the possible responses and societal instabilities. Having reliable estimates for each of these probabilities is a challenging task. A practical approach is to focus on the essential pathways and develop aggregated risk indicators to measure how countries are potentially affected by climate-related stimuli, including the loss of lives, health, money or natural resources, ranging from moderate to catastrophic risk.

The term threat is often used synonymous with risk, but there are differences (Brauch 2005a, 2007a). While risk assessments often deal with systemic contexts regarding technical or natural systems, they claim a certain degree of objectivity, threat perceptions are often based on subjective attitudes towards an event or person. In many definitions threats are related to intentional acts. For instance, the *Compact Oxford English Dictionary* (2009) defines threat as: "1. a stated intention to inflict injury, damage, or other hostile action on someone; 2. a person or thing likely to cause damage or danger; 3. the possibility of trouble or danger." While the first meaning requires a declared intention to impose damage (whether realistic or not), the second evaluates the likelihood of events causing a loss. In the third definition, the mere possibility of danger qualifies as a threat. A threat also implies that those who are threatened feel vulnerable to the threat. A threat by someone is meant to induce fear within someone. To understand and prevent threats, it is important to understand the responsibility of those who cause it.

During an armed conflict, threat assessments and perceptions are concerned with each other's military capabilities and the motivations to use them. Here threats combine the capability to threaten and the motivation to threaten. Without capability a threat is not credible, without motivation it is not likely. Each without the other is only a hypothetical threat. For instance, someone may claim to blow up the world, but to make it a credible threat requires the capability to trigger a major nuclear war. While France and the UK have the capability to attack each other with nuclear weapons, this threat is widely seen as not credible and thus unlikely.

Today the term threat is used excessively. Threats are coming from almost everything, including ethnic groups, criminal gangs, epidemics, terrorism, dangerous food, poverty, economic mismanagement, overpopulation, failed states, refugees, and pollution, to mention a few (Heurlin/Kristensen/Søby 2006). And they are affecting almost everyone, from the single individual to the globe, affecting various dimensions of loss (life, health, money, jobs etc.). The meaning of threat has been extended to events which have no identifiable intention, such as threats by car accidents or natural disasters, as if someone or something (god, fate, misfortune) is responsible for it. This attitude is extended to the animal word, e.g. when a bear is threatening a human being. Threat perception is sensitive to signals indicating a threat (e.g. a statement of threat declaration or a particular body language), assuming that a subject is responsible for sending these signals in preparation or as a warning of real actions.

Various sources have extended the threat terminology to climate change, as exemplified by the phrase 'threat multiplier' (in 42.1) above). In this view, since everyone is contributing to climate change and everyone is affected by it, we all pose threats to ourselves (chap. 94 by Brauch/Dalby/Oswald Spring). Similar phrases have been coined to warn against the threat of nuclear annihilation, putting climate change into the same category of 'common threats' to humanity, although the causes are quite different (Cerutti 2007). In this understanding, nuclear weapons and greenhouse gases would both be indicators for the capability to threaten, making their reduction an important policy goal (Schell 2007). Countries with high per-capita emissions would pose a larger threat to others than countries with low per-capita emissions. On the other hand, developing countries, which are less responsible for global warming, would be affected much stronger and would be less capable to take countermeasures. This asymmetry between those who predominantly cause global warming and those who are largely affected by it, adds to the existing injustice between rich and poor. To solve the problem in a cooperative and sustainable manner, it is important to avoid aggravating threat perceptions between the developed and the developing world, between North and South. Here it is important to make the distinction that global warming is not an intended threat but an unintended risk in the quest for wealth. However, the use of fossil fuels makes the production of wealth and the generation of risk two sides of one coin. The challenge is to decouple wealth and risk by using energy sources and lifestyles that avoid the unnecessary risks of global warming. This does not mean that those who keep high emissions, knowing about the consequences, should not take responsibility for their actions.

The risks and threats of climate change are quite heterogeneous and shaped by a number of factors, including geographical location, the entity affected and the social environment. Risk assessment also depends on the knowledge and perception of people which for real world actors are bound to a window of attention,

using limited information selected in temporal, spatial, social and other dimensions. A spatial window pays more attention to near-distant events while far events are more 'out of view'. Similarly, temporal windows are restrained to the near past and future, and social windows involve close relatives, friends and colleagues while people outside of the own social network have much weaker links. Due to the long delays between emissions and climate impacts, these risks may be out of the temporal window. Impacts on regions and people that are remote receive less attention; they are outside of the 'radar screen'. It is a challenge for education and the media to expand the window of attention regarding climate impacts.

42.3.3 Security Concepts

With the end of the Cold War and increasing globalization the security landscape has fundamentally changed and the debate on climate change contributes to this process. The meaning of security has been transformed and became more comprehensive, including economic, political, social and ecological dimensions (Dalby 2008). The more comprehensive security concepts include not only military capabilities, but human, economic and environmental measures as well, with natural resources becoming a key currency of security.

In a negative sense, security is the ability to protect against danger, threat and doubt, hence the "evil of insecurity" (Wolfers 1962: 153). In a more positive sense, security means the preservation of values, "the assurance people have that they will continue to enjoy those things that are most important to their survival and well-being" (Soroos 1997: 236). Security is future-oriented and not only weighs potential damage but also expected values; in short: it is the difference between chance and risk. Security risks have both an objective and a subjective dimension (Wolfers 1962: 150): "Security, in an objective sense, measures the absence of threats to acquired values, in a subjective sense, the absence of fear that such values will be attacked." Objective security is achieved "if the dangers posed by manifold threats, challenges, vulnerabilities and risks are avoided, prevented, managed, coped with, mitigated and adapted to by individuals, societal groups, the state or regional or global international organizations" (Brauch 2007a: 3). Concerning subjective judgements and perceptions, reasons for fear should be avoided. A system facing threats can take measures to protect its core values and avoid harmful interference with its structure. Broadening the concept implies that security is not only freedom from fear, but also freedom from want.

To operationalize and specify security, it is important to determine the subject whose security is of concern, the values that are affected, the causes of risk, the vulnerability to harm and fear, as well as the capacity to protect against threats. Security may be positive with regard to some values and negative with regard to others. For instance, a prisoner may have secured access to food and housing or be safe from traffic accidents, but would be very insecure regarding freedom of choice and having contact with friends. The degree of insecurity increases if essential core values and basic human needs are affected. Concepts of national and international security are built on the integrity of territorially organized sovereign nation states within the system of international law as represented by the United Nations. National security policy aims at "protecting a nation's people and territories against physical assault and protection of vital economic and political interests" (Anderton 1985: 5). Military security policy deals with actions by determined adversaries who intentionally seek to inflict damage, e.g. by use of military force. During the Cold War, national security was dominated by the bilateral East-West conflict and nuclear force assessments.

If the society's core values change, the security context also changes. In the emerging new world (dis)order, a large number of actors and factors shape the security discourse in a complex way (Scheffran 2008b). Facing a rapidly changing world, security is ultimately linked to the question of identity, i.e. the social entity that individuals predominantly identify with and which they seek to protect. Is it the own person, the family, friends, the nation, the whole of humanity or even future generations? At one end stands the egoist individual who seeks to maximize utility; at the other end it is the global subject seeking to protect all of humanity and nature. If long-established identities are threatened, their defence is often pursued under exclusion of those who are different. With the conflicting tendencies of globalization and fragmentation, social identities are torn between changing and sometimes contradicting roles and relationships. Climate change could support both the tendency towards fragmentation and unification of humanity, between the poles of a Hobbesian struggle of "everyone against everyone" and the development of a world society.

The vulnerabilities, risks and threats posed by climate change have implications for security policy.

New concepts of security are important which could serve as building blocks of climate security:

- *Common security*: Since common threats require common responses, climate security is best realized not against but together with others, addressing the climate problem with joint responses and an unprecedented level of cooperation. In the concept of common security, which was born during the East-West rivalry, "no country can obtain security, in the long run, simply by taking unilateral decisions about its own military forces" (Blackaby/Barnaby/Väyrynen/Bahr/Kaldor/Rothschild/Wiesner/Lodgaard/Sæter/Holst 1986: 203). In the words of the Palme Commission (1982: 139): "States can no longer seek security at each other's expense; it can be obtained only through cooperative undertakings." To face the common threats posed by climate change it is much more effective to work together than against each other.
- *Ecological security* describes environmental problems as security risks, whether self-inflicted or caused by others. The concept was developed in the context of environmental destruction from wars and arms races (Westing 1986, 1989a). Ecological problems often have a trans-boundary effect and cannot be resolved by military instruments. On the contrary, it may often be more beneficial to convert military resources for environmental protection (UNDDA 1991; Scheffran 1992). The problems cannot be resolved by one state alone; they require a global effort. The concept of ecological security was criticized as too broad and inadequate, partly because it would allow the military to expand its instruments into environmental policy (Deudney 1991; Brock 1997).
- *Human security*: Those affected by climate change are in the first place human beings. Thus, it is consequent to develop the concept of 'human security' which is centered on the security and welfare of human beings (UNDP 1994), while national and international security have been largely the domain of governments and the military. One approach to operationalize human security is based on "shielding people from acute threats and empowering people to take charge of their own lives." (CHS 2003: iv). Potential losses of human life from a variety of sources are considered (King/Murray 2001–2002; Owen 2002). Another approach focuses on interpersonal violence in crime, terrorism and armed conflict (Human Security Report 2006). It is increasingly recognized that it makes sense to look at a spectrum of concepts and indicators when studying the security of individuals and societies (Wallensteen 2007). While armed conflict remains relevant because of its potential for destruction and disruption of societies, not all forms of 'downside' risks for lives and livelihoods are covered (Brzoska 2007). This way it is also possible to deal with the argument that human security is a vague concept (Paris 2001).

If the impacts of climate change provoke responses that affect the whole society, the consequences may also become an issue for national, international or global security, and contribute to its securitization (Wæver 1995, 2008; Buzan/Wæver/de Wilde 1998). Some of the climate impacts may indeed force governments and the UN Security Council to take actions, and some could involve the military (e.g. for disaster management, in response to massive refugee flows, or in conflicts induced by environmental stress). That does not imply that global warming is predominantly a threat for national or international security or that it will likely lead to a military confrontation or even climate wars (Welzer 2008). Comprehensive security remains an ambiguous concept which allows to 'soften' security policy by including multiple security dimensions, but it could also 'harden' environmental policy by militarizing it and providing new reasons for intervention, thus leading to more insecurity (Brock 1997).

Security indicators are a quantitative approach to measure the degree of insecurity, conflict or instability of a region to climate change. Risk indicators measure how countries are affected by weather-related loss events. The *Climate Risk Index* developed by Anemüller, Monreal and Bals (2006) uses the number of deaths and the amount of overall losses in US$. For the years 1995 to 2004 the 10 most affected countries are Honduras, Bangladesh, Somalia, Venezuela, Nicaragua, Vietnam, Dominican Republic, France, India and China. Security diagrams couple climate-related environmental stress with the susceptibility of societies and the occurrence of 'crises'. This integrated approach facilitates the interdisciplinary assessment of climate change and the impacts; fuzzy set theory helps to convert expert opinion about critical indicators into numerical values (Alcamo/Endejan 2001; Alcamo 2008).

42.3.4 Stability and Instability

The stability concept is rooted in the natural sciences but is relevant in the social sciences as well (Scheffran 1983, 1989). During the bipolar East-West conflict, sta-

bility was a prominent term in international security and arms control. In the complex world (dis)order that followed the breakdown of the Cold War, which in itself was a major event of political instability, the stability concept has celebrated a revival (Scheffran 2008b). Facing an economic crisis and the spread of destabilizing factors, the world is confronted with an 'axis of upheaval', including states that are "united not so much by their wicked intentions as their instability", as Niall Ferguson (2009: page) notes. In this view, three factors made the location and timing of lethal organized violence more or less predictable in the last century: ethnic disintegration, economic volatility, and the decline of imperial structures. While environmental causes are not considered among those instability factors, it is likely that they will add to them. Besides preliminary attempts to model the link between climate change and international stability (Scheffran/Jathe 1996; Scheffran 1999), there is still a lack of understanding about the implications of global warming for international and societal stability.

In a general sense, stability implies that "minor disturbances will not be magnified into a major disturbance, but on the contrary, dampened so as to have only a small and disappearing impact" (Ter Borg/Tulp 1987: 50). If magnification processes exceed dampening mechanisms, minor causes can have major impacts and instability could lead to a breakdown of essential properties of a system. The question is to identify the essential properties that are to be kept stable, the time and probability for which these are to be maintained, and whether disturbing events can be compensated by mechanisms that prevent magnification. An increase in systems complexity can create possible instabilities which may be compensated by introducing new control variables. If systems complexity grows faster than control complexity, the control mechanisms are overburdened, and the system can get 'out of control'. This could be an issue in the context of climate change when a series of complex interactions is triggered that overwhelm both environmental and social systems, which could combine to complex cascades of instability.

There are similarities and differences of the stability and security concepts. Both evaluate the impact of something to something. Security is judged by a subject that seeks to avoid or counter potential threats; stability takes an outside look on an interaction process among system variables or subjects. Both may evaluate a change of conditions as positive or negative, where stability is mostly dealing with a change in qualitatively different systemic conditions (e.g. a transition from peace to war, from conflict to cooperation or from environmental destruction to sustainability). Although the instability of a threatening regime may be seen as desirable, international or societal instability caused by climate change is widely held as undesirable.

Sensitivity is a key term in the stability concept. If a system is more sensitive to changing conditions, it tends to be unstable if there is no correcting mechanism that maintains its stability. Highly sensitive responses (overreactions) could destroy the structure of a system. The sensitivities between key variables and responses can be combined in the interaction matrix which can be mathematically stable or unstable (similar to the sensitivity matrices in section 42.3.5).[6] If climate change affects the stabilizing mechanisms of systems, they could become unstable and break up. It is possible that for given sensitivities, a climate-related event induces a major instability event in society. But climate change could also modify the sensitivities in one or the other way, triggering a cascading sequence of events.

Depending on the type of systems, disturbances and responses, various meanings of stability can be considered in the climate context.

42.3.4.1 Stability of the Climate System, Ecological and Economic Systems

The *UN Framework Convention on Climate Change* (UNFCCC 1992: 5) in Article 2 demands stabilization of atmospheric greenhouse gas concentrations at levels that "prevent dangerous anthropogenic interference with the climate system." Such a level should be achieved "within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (Ott/Klepper/Lingner/Schäfer/Scheffran/Sprinz 2004; Scheffran 2008d). Thus, conditions for ecosystem and economic stability determine tolerable

6 The interaction matrix contains the sensitivities $_{x}y$ between two variables x and y, and its stability is given by its eigenvalues which are indicators of the exponential magnification or dampening of the dynamics. For a two-variable interaction with positive self-impacts $x_x>0$ and $y_y>0$ and negative mutual impacts $y_x < 0$ and $x_y < 0$, the instability condition would be $x_x\, y_y - x_y\, y_x < 0$, which represents the intuitive notion that the negative mutual impacts exceed the positive self impact. With different signs of the impact sensitivities and more variables, the mathematical condition would be different (Scheffran/Hannon 2007).

windows for the admissible speed and magnitude of climate change (Petschel-Held/Schellnhuber/Bruckner/Toth/Hasselmann 1999). Over a short time horizon, ecosystems would be able to adapt to a slowly changing environment. With a longer time horizon and more dramatic changes, ecosystems could become unstable and irreversibly damaged. Ecosystems exhibit adaptive capacities within a viability limit beyond which they can break down (Aubin/Saint-Pierre 2007). These thresholds are often difficult to determine. Similarly, economic processes of production and consumption have a certain stability against disruption, as experienced in major crises and wars in the past. Economic systems can be adjusted to wartime production in a short time and are able to adjust after a war. There are limits of what an economic system and the political stabilization mechanisms may digest, as seen in the Great Depression of the 1930's and in the recent economic crisis. Within these limits, an economic system may be able to adapt to a long-term gradual climate change (despite considerable costs of a transition to a low-carbon society), but regional disasters or abrupt climate change may exceed this capability.

42.3.4.2 Stability Against Escalating Threats

In a multi-actor environment, a perceived loss of security for one actor may provoke reactions leading to a loss of security for other actors whose responses may result in insecurity for all. This notion of stability is reminiscent of the 'security dilemma' which describes a situation where countries build arms to enhance their security but threaten other countries and force them to increase their arsenals as well. This process found its expression in the concept of arms race stability which was a guiding principle for nuclear arms control during the Cold War. The simple version of this concept (two nations building nuclear weapons) needs to be modified in today's multipolar world in which many more threat dimensions and actors are involved, including non-state actors. Nonetheless, as long as actors feel threatened by actions of others and counter them with threatening responses, this logic could drive a destabilizing 'threat race'. Increasing the threat perception could increase the likelihood that a threatening force is actually used, especially in a crisis. The classical example was the Cuban Missile Crisis. The concept of crisis stability attempts to reduce the motivation for the use of violence and the pressure for quick and pre-emptive actions, e.g. through force structures that minimize pre-emptive advantages (e.g. by first strike attack) and technical instability of weapon systems against error or failure. If climate change increases each other's threat perceptions, this could provoke responses adding more threats. For instance, natural resources or agricultural production could be degraded and the affected people seek survival at the cost of others, or they make others responsible for their initial loss. In both cases, to pursue or defend their interests, actors could increase or actually use violent means, including the use of a more threatening language. Non-state actors and non-military threats could trigger conflicts between states and their military forces. To stabilize the interaction, actors could move towards a mutually beneficial cooperation, e.g. by resource sharing and risk management, and abstain from the use of violence. Most important is to avoid a climate crisis that turns into a military crisis.

42.3.4.3 Human, Societal and Political Stability

Societies require structures to make sure that cooperation is beneficial, rules are accepted and social interaction remains effective and predictable. The social contract is based on the consent by a large majority of citizens to rules, regulations and institutions that maintain social order and serve as the glue to keep society together. The stability of societies refers "to the durability of political institutions and to robust social structures", while destabilization "can be understood as a process that (gradually) causes an originally stable political and social situation to break down" (WBGU 2008: 236). Societal structures that loose credibility and support from the citizens become weak and unable to maintain order. Individuals, who experience personal losses (life, income, property, job, health, family and friends) and find their personal identity at stake, may be more tempted to violate established rules and select non-legal actions including violence, even more if these actions offer benefits and low risk of punishment. Along these lines, personal instability caused by loss of human security could trigger societal and political instability, and vice versa. Disruptive climate change could contribute to this process. Especially vulnerable are societies that are already on the edge of instability, such as states in transition from authoritarian to democratic regime, states unable to protect citizens from harm and are lacking legitimacy, and failing states with social fragmentation, w*eak governance structures* and inadequate management capacities. Here the marginal impact of climate change could make a decisive difference, *undermine the ability to solve* the underlying problems, and further dissolve state structures, leading to their collapse.

In this context relevant is the debate on 'failed states' (Milliken/Krause 2003; Rotberg 2003; Schneckener 2004; Starr 2008). Such states cannot guarantee the core functions of government, such as law and public order, welfare, participation and basic public services (e.g. infrastructure, health and education), and the monopoly on the use of force. These core functions are pillars of security and stability, and if any of them is missing, state failure becomes more likely. Weak states may be able to safeguard the monopoly on the use of force, but have severe deficiencies in providing welfare, rule of law and democratic participation. In fragile states, welfare and rule of law are working, but the monopoly on the use of force is severely restricted or absent, affecting the control of state territory and borders (e.g. against separatist forces). In failed states none of the core state functions is effectively performed, making state collapse likely. Whether a state fails is determined by long-term structural factors, such as the endowment with natural resources, the economic infrastructure, power constellations, demographic development and ethnic diversity, which make states sensitive to medium-term processes driving their erosion, e.g. social discontent, ethnic differences, separatist movements, economic crisis or political mismanagement. States are then vulnerable to abrupt changes that trigger the collapse of state structures, including "military intervention, refugee flows, military coups and revolution, massive violent repression of the opposition (e.g. massacres), social unrest, famine, civil war, etc." (WBGU 2008: 43, based on Schneckener 2004). In such states spirals of corruption, crime and violence could erupt, leaving a power vacuum that is filled by non-state actors such as private security companies, terrorist groups and warlords. A prominent example is Somalia, a country controlled by powerful non-state actors (clans). In sub-Saharan Africa about one-third of countries are considered at risk of state failure. Examples for weak states in other world regions are Colombia, Afghanistan, and Kosovo.

Climate change could potentially affect short, medium and long term factors of destabilization along different pathways, although the empirical basis to test these links is weak. In a hypothetical scenario, increased environmental stress and resource scarcity could induce structural changes and make states susceptible to triggering events such as natural disasters. These developments may undercut the ability of governments to satisfy the needs of citizens and to provide opportunities for wealth and prosperity. Combining the pressure from outside with a reduced ability of governments to prevent and cope with the impacts may become a task too big for many societies. Climate risks could add to other problems, such as high population growth and density, inadequate freshwater supplies, strained agricultural resources, poor health services, economic decline and weak political institutions. In climate-security hot spots the erosion of social order, state failure and violence could go hand in hand. In the worst-affected regions, climate change could spread to neighbouring states, e.g. through cross-border migration, ethnic links, environmental resource flows, black markets or arms exports. An increase of forced migration would create more migration hotspots around the world, each becoming a possible nucleus for social unrest. Such *spill-over effects can* destabilize regions and expand the geographical extent of a crisis. With increasing climate impacts, the problem solving capacity could also decline, possibly leading to a tipping point of no return.

It is widely assumed that low-income countries are more vulnerable to instability than wealthy countries, and some countries are more vulnerable due to their natural geographic and socio-economic conditions. At present it seems unlikely that distortions in developed countries will lead to massive security problems or societal instability. However, developed countries cannot ignore the economic impacts, the migratory pressures, the demands for humanitarian assistance, and may be drawn into climate-induced conflicts in regions that are hardest hit by the impacts. Their own infrastructures and networks for energy and water supply, transportation and communication, production and trade are vulnerable to disruption by disasters. Hurricane Katrina, the most costly natural disaster so far, was a vivid signal that, even in highly developed societies, flood disasters could lead to a temporary breakdown of public order. As this example shows, poor and marginalized communities will also be the most vulnerable in developed countries. If the frequency and severity of such disasters increases, they would be more difficult to manage.

42.3.5 Conflict and Cooperation

Conflicts often emerge from incompatible actions, values, and priorities of actors who fail to reduce their differences and tensions to tolerable levels. The actions taken undercut each other's values and provoke responses generating further losses. A conflict escalates if actions by conflict parties aggravate the conflict tension and intensity, which corresponds to an inherently unstable interaction (as discussed in 42.3.4).

If unresolved, conflicts consume a considerable amount of resources, forcing conflict parties to extreme actions and the use of violence, until the capability to act is exhausted, if not replenished by other sources. Conflict resolution can help to reduce the conflict tension and stabilize the interaction by involving actors to learn and adjust their actions until an agreement is reached. Cooperation is a process in which actors adapt their goals and actions in a mutual beneficial way. The transition from conflict to cooperation requires mutual adaptation towards common positions and mutually beneficial actions that stabilize the interaction (Scheffran/Hannon 2007). Whether this succeeds depends on the governance capacity of societies to prevent or manage conflicts.

Whether climate change contributes to conflict is perhaps the most difficult question because it depends on all the factors described above. As the WBGU (2008) notes, climate change could also unite the international community to set the course for a dynamic and globally coordinated climate policy. If it fails to do so,

> climate change will draw ever-deeper lines of division and conflict in international relations, triggering numerous conflicts between and within countries over the distribution of resources, especially water and land, over the management of migration, or over compensation payments between the countries mainly responsible for climate change and those countries most affected by its destructive effects (WBGU 2008: 1).

Four conflict constellations are particularly relevant here: degradation of freshwater resources, decline in food production, increase in storm and flood disasters, and environmentally-induced migration (chap. 41 by Bauer).

Empirical studies do not provide a clear picture so far, which may be due to the fact that climate change is an issue of the future. Some indications can be acquired by looking at historical cases which suggest that the rise and fall of civilizations was indeed affected by a changing climate (Fagan 2003). Recent studies have found significant statistical correlations between a changing average global temperature and the frequency of war, e.g. during the Little Ice Age (Zhang/Brecke/Lee/He/Zhang 2007). But Buhaug, Theisen and Gleditsch (2008) argue that a simple relationship between temperature change and the number of armed conflicts cannot be justified by data over the last two decades because the number of such conflicts has declined after the end of the Cold War, while temperature has increased. One possible explanation is that climate change so far has not directly affected large-scale conflicts such as war but more likely will cause small-scale events of societal instability and low-level conflict which may have increased in recent decades, as suggested by the Heidelberg Conflict Barometer which distinguished five conflict intensities, from latent conflict to war (HIIK 2008). Gathering data about such small-scale events is an important task of on-going and future research.

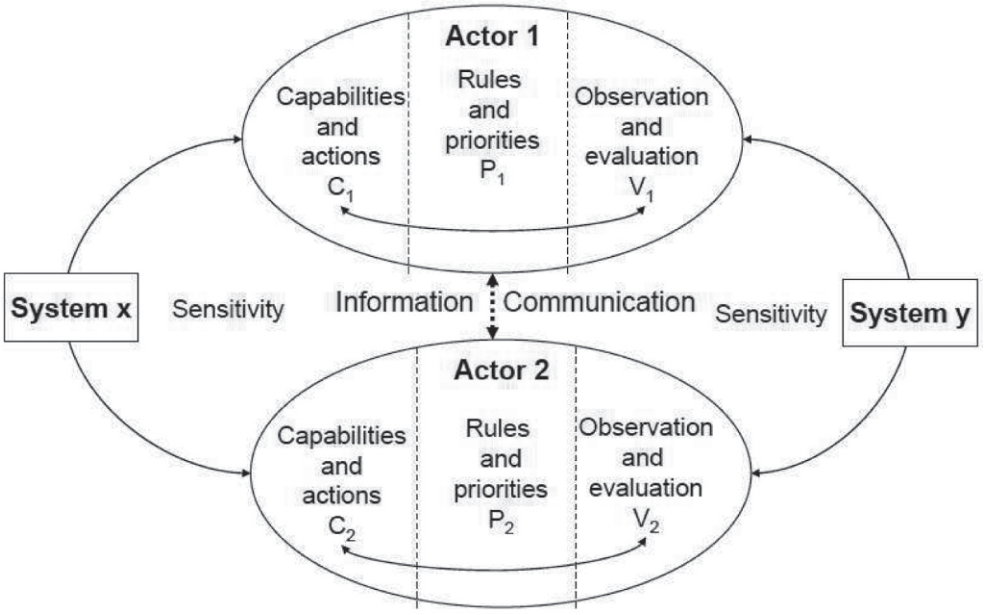
Until more data is available, it is promising to look at regional case studies of environmental conflict which are important to explore the relationships in detail.[7] During the 1990's, several research groups have examined how the scarcity of natural resources, such as minerals, water, energy, fish and land, affects violence and armed struggle. These include the Toronto Project on Environment, Population and Security (Homer-Dixon 1991, 1994), the Swiss *Environment and Conflict Project* (ENCOP; Baechler 1999), the International Peace Research Institute in Oslo (Gleditsch 1997), the Woodrow Wilson Center's Environmental Change and Security Project (Dabelko/Dabelko 1995), and Adelphi, formerly the Institute for International and European Environmental Policy (Carius/Lietzmann 1999; Carius/Tänzler/Maas 2008). The review of 73 empirically recorded 'environmental conflicts' which occurred between 1980 and 2005, showed that these had a regional scope and did not present a serious threat to international security (Carius/Tänzler/Winterstein 2006).

Some scholars have questioned the usefulness of the concept of environmental conflict. According to Gleditsch (1998) the meaning of 'environmental conflict' is often not clear and important variables are neglected. Some models are virtually untestable; the causality of the relationship is sometimes reversed; foreign and domestic conflict is not distinguished. Barnett (2000) argues that the environmental conflict hypothesis is theoretically rather than empirically driven. Some point out that it is not the scarcity of natural resources that is driving conflict but their abundance (Collier 2000; de Soysa 2000; Le Billon 2001; Peluso/Watts 2001), suggesting that the results strongly depend on the type of resource.

The analysis of environmental and climate-induced conflicts can be translated into impact diagrams, incorporating the interaction among multiple

7 See the studies prepared for WBGU (2008) that can be accessed at: <http://www.wbgu.de/wbgu_jg2007_engl.html#jg2007expertisen>; see chap. 26 by Brauch; chap. 27 by Giese and Sehring and chap. 28 by Heberer and Senz.

Figure 42.5: Interaction between two actors and two systems. **Source:** The author.

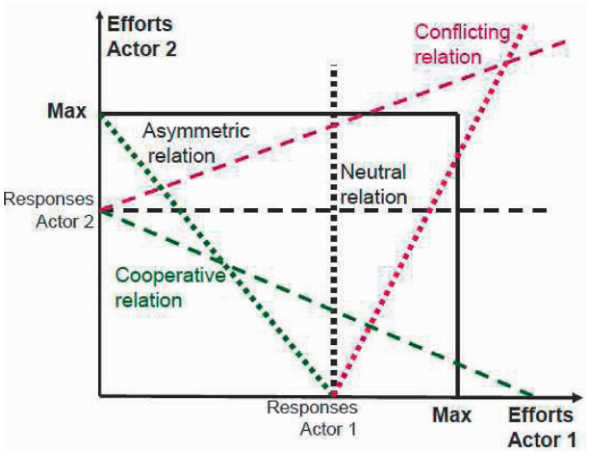


actors into an agent-based model within the integrated assessment framework explained in 42.2 (figure 42.5). Each actor i is represented by its capabilities (C_i) used to make efforts in actions changing the environment (given here by systems x and y). The outcome of the actions is observed and evaluated with a value function (V_i) which guides the change of actions according to internal decision rules and priorities (P_i). The actors are interconnected to each other directly through communication processes that exchange information, or through the impacts of each other's actions on the systems environment. Linkages between the actors are given by the sensitivities which determine how the value of one actor is affected by the efforts of each actor, which depend on the decision rules and action priorities. If the mutual sensitivities are negative, this corresponds to a hostile or conflicting relationship which causes losses to each other; if they are positive, this is a friendly or cooperative relationship which is beneficial to both. In addition, the self impacts have to be considered, i.e. how an effort made by an actor affects his/her own value. With these sensitivities it is possible to construct the social network among multiple actors, which is connected to the environmental system dynamics they are embedded into.

Whether conflict or cooperation prevails in social interaction depends on the responses of each actor, given here by the decision rules and action priorities, and whether they can be changed by learning and adaptation. Figure 42.6 depicts different types of response functions which show how the efforts of one actor to achieve a given value goal are adjusted to efforts of another actor. If the actions are disconnected and independent of each other, effort is kept constant as long as the own goal does not change (neutral relation). In a competitive relationship, effort increases with the effort of the other actor and both experience a loss, while in a cooperative situation the efforts may decrease for the same goal and both benefit from each other. In the mixed cases, one agent cooperates and the other not, which in some cases may still be better than mutual conflict. In a competitive case, a point of mutual agreement is possible, but the question is whether that point is within the admissible range of maximum efforts. If agreement is not possible within admissible efforts, there is an unresolved conflict unless actors add more resources or change their goals. Alternatively, one or both actors change their behaviour by switching to other action rules what makes his or their own actions more efficient and less threatening to the other actor to make the agreement more feasible.[8]

For instance, a case may be assumed where the two actors are a developed and a developing country which invest capital (efforts) into different energy paths to produce goods that contribute to economic wealth (value). Established decision rules and action priorities use only fossil fuels which contribute to climate change and value losses for both, determined by the sensitivities in human-environment interaction. The more they invest into fossil fuel to achieve a given

Figure 42.6: Conflicting and cooperative relationships between two actors making efforts to achieve value goals according to given action rules. **Source:** Modified from Scheffran/Hannon 2007: 82.



wealth, the more they cause losses to each other and to themselves, affecting both mutual and self impacts. With the losses from climate change increasing, the more the agreement point moves further upwards, until value goals are no longer feasible for both within maximum efforts. In this case, actors could switch to military force to acquire a higher share of fossil fuels by violent means, to compensate for climate-induced losses or do harm to the competitor in other ways. As an alternative, actors could switch to alternative energy sources to produce economic wealth with lower carbon emissions and thus less climate losses. In this case, both can cooperate to lower their costs, e.g. by transfer of low-emission technology (Ipsen/Rösch/Scheffran 2001).

Despite the simplicity of this diagram, it is possible to discuss a wide spectrum of possible scenarios with it, based on assumptions of the various sensitivities for action alternatives and involving more than two actors to discuss collective action problems. A degradation of the environment that affects the interests and values of some actors shapes conflicts in one or the other way, i.e. it may increase violent conflict or spur cooperation to resolve common problems. Whether climate risks undermine international security or become a source of major conflicts depends on the responses and learning mechanisms of the actors involved which are shaped by the societal structure, institutional frameworks and political strategies.

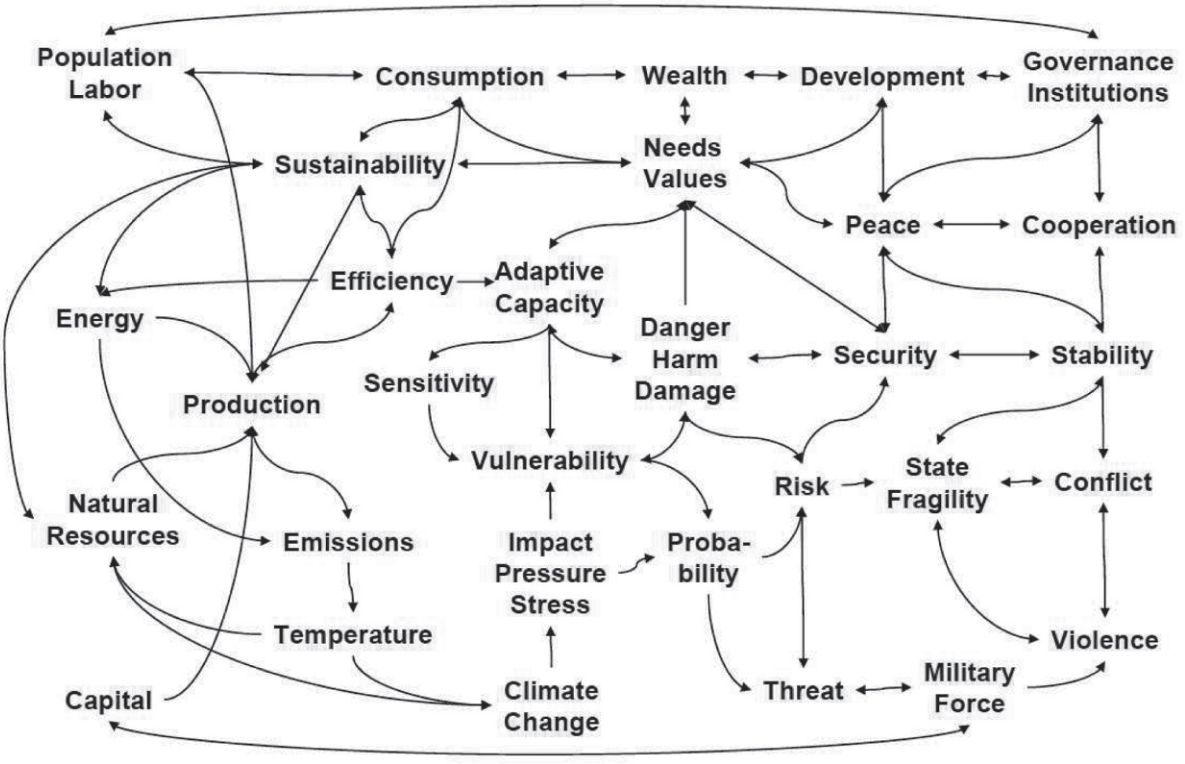
42.4 Strategies for Addressing Climate-Security Challenges

Climate change confronts humanity with multiple security risks and major challenges to its problem-solving capacities. The magnitude of the potential risks of climate change requires determined policies to manage global change within a new well-designed global governance architecture that combines sustainable environmental policy, development policy and preventive security policy. Global diplomacy is required to contain climate-induced conflicts, develop compensation mechanisms for those affected by climate change, implement global migration policy, and measures to stabilize the world economy (WGBU 2007). Avoiding climate security risks and mitigating conflicts induced by climate change requires an integrated set of strategies that address both the causes as well as the impacts of climate change.

The conceptual framework described in the previous sections provides guidance to develop such strategies for addressing the climate challenge to society, stability and security (see the key terms and variables in figure 42.7). The approach combines the downward slope towards climate change, security risks, instabilities and conflicts in the lower part of the figure, and the strengthening of economic welfare and human capability via sustainable development, with strategies to reduce vulnerabilities and risk in the upper part of the figure and establish the core functions of a world society through adaptive and participative governance. A set of integrated strategies to address climate security risks is described in the following which affect various parts of the climate-society interaction (figure 42.8).

8 In mathematical terms, let sensitivities $f_{11} > 0$ and $f_{22} > 0$ be the positive efficiencies (self impacts) of the efforts C_1 and C_2 of actors 1 and 2 on their own values V_1 and V_2, and $f_{12} < 0$ and $f_{21} < 0$ be the negative mutual impacts on each other's values. Then this would be a competitive interaction and a switch to cooperation would require that the mutual impacts become positive, thus switching from an adverse to a friendly relationship. Even under conditions of conflict, it may be possible to move the agreement point into the admissible range of efforts by increasing the self impacts, e.g. by improving efficiency. For an unstable conflict, given by the instability condition $f_{11}\, f_{22} - f_{12}\, f_{21} < 0$, an agreement point does not exist and the conflict escalates to utmost efforts, unless actors do not change their goals.

Figure 42.7: Landscape of key terms and variables in climate-security analysis. **Source:** The author.



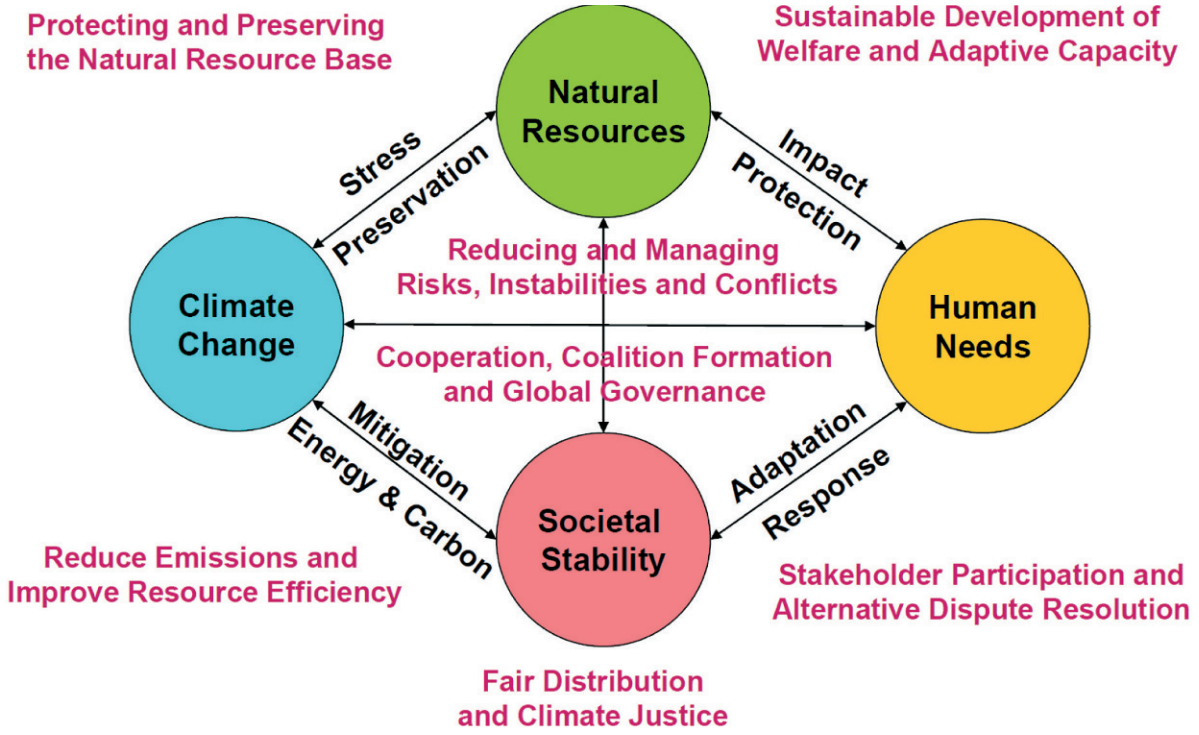
42.4.1 Sustainable Development of Welfare and Adaptive Capacity

Climate change is the result of a non-sustainable economic structure that threatens both the natural resource base and the well-being and capabilities of people. Since wealthy regions are less vulnerable and unstable, and have better adaptive capacities to manage the effects of climate changes, economic development is an important strategy to reduce security risks and stabilize societies. An essential strategy to prevent and minimize harmful climate impacts is sustainable development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report 1987: 43). Accordingly, human needs and capabilities of present and future generations are to be satisfied within natural resource limits. Regenerating human capabilities and adaptive capacities in a sustainable manner makes societies more resistant to climate change and allows them to invest into low-carbon energy alternatives and the establishment of institutions. Reducing poverty and establishing human rights would significantly improve the conditions for survival, strengthen human security, and build problem-solving capabilities. Less wealthy countries need development cooperation in various fields (Carius/Tänzler/Maas 2008), going beyond current levels *of* Official Development Assistance funding. Other measures include supplemental international financial assistance, e.g. expansion of microfinance institutions and instruments or an international environmental migration fund.

42.4.2 Reduce Emissions and Improve the Efficiency of Natural Resource Use

Greenhouse gas (GHG) emissions are the main cause of climate change, and their reduction remains a predominant strategy to stabilize carbon concentration at levels that prevent dangerous climate risks and permit societal stability. The task is tremendous, as global greenhouse gas emissions need to be reduced by at least half by the mid 21st century. This requires more efficient and alternative uses of energy and other natural resources to create wealth with less resources. To strengthen international efforts and agreements, a number of instruments are available for this purpose, including taxes, transfer of capital and technology, tradable emission permits and other Kyoto instru-

Figure 42.8: Strategies for climate security within the integrated assessment framework. **Source**: The author.



ments (Clean Development Mechanism, Joint Implementation). In each stage of the life-cycle of goods and products (resource exploration, exploitation, transport, transformation, use and recycling) efficiency improvements can be achieved, by innovative technology, economic instruments such as taxes and investment, behavioural changes and societal reorganization. The transition towards a more efficient and sustainable energy system with less carbon emissions requires new financing instruments and regulatory schemes. In developing countries, multilateral funds (e.g. Global Environment Facility, Carbon Finance Unit) can make important contributions. Subsidies for fossil fuels need to be reduced and channelled into renewable energy sources. Increasing crop yields help to improve agricultural efficiency, reduce carbon emissions from land use and establish agricultural markets that strengthen adaptive capacity in rural areas.

42.4.3 Protecting and Preserving the Natural Resource Base

Consumption of natural resources should not exceed the natural carrying capacity for these resources. Limits are given by the finiteness of non-renewable resources, by the limited regenerating capacity of renewable resources, and by the limited ability of nature to absorb wastes. Sustainability requires that the underlying ecological processes are to be protected against disturbing changes of environmental conditions that could trigger tipping points and cascading breakdowns. To maintain the integrity and adaptive capacity of ecosystems, biodiversity needs to be preserved through building of nature preserves, sustainable land use, limitation of harvest rates, and preservation of endangered species. This would also protect terrestrial carbon stocks, especially tropical forests, against overexploitation and deforestation. Adaptation capacities of ecosystems against climate change need to be strengthened, recognizing their service for human societies. Within limits, ecosystems can be managed to adapt to and survive climate change.

42.4.4 Fair Distribution and Climate Justice

The resources, benefits and risks for each social entity are shaped by allocation and distribution mechanisms, market processes, human rights as well as power and interest structures. Equity strategies seek to achieve a fair distribution between those who have the highest responsibility for climate change and those who are most affected, between north and south, rich and poor, current and future generations. Fair and efficient burden-sharing in a global frame-

work of climate justice would balance responsibilities and impacts among countries, satisfying the 'polluter pays' principle and the 'ability-to-pay' principle. With the formula of 'common but different responsibilities' the UNFCCC assigned different roles for industrialized and developing countries in climate policy. The challenge is to agree on collective emission targets that avoid dangerous climate change and will not be exceeded by all human beings. Several proposals have been made to balance emissions, including the *Triptych* approach to share emission allowances among a group of countries, the *Contraction & Convergence* concept with a joint target of per-capita emissions, and the *Common but Differentiated Convergence* proposal where countries are flexible to select the path appropriate to their development (Höhne/Phylipsen/Ullrich/Blok 2005). As the largest emitters of greenhouse gases, the developed countries have a particular responsibility as well as the power to reach an agreement on reducing emissions to a non-dangerous level. Less-wealthy countries could benefit from adaptation capabilities in wealthy countries which would be liable for compensation of losses in the most affected regions. A global diplomacy could help to contain climate-induced distributional conflicts, as well as the development of compensation mechanisms for the victims of climate change.

42.4.5 Reducing and Managing Risks, Instabilities and Conflicts

To implement the UNFCCC, the impacts of climate change need to be limited to non-dangerous levels. A reasonable and systematic specification of the overall objective with regard to key parameters is still missing. To specify 'danger standards' based in ethical norms would serve as guidelines for orientation to build legitimacy and acceptability of negotiation results. Art. 3.3. of UNFCCC requires "to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects". Lack of scientific certainty is no sufficient reason to postpone precautionary measures. Concrete measures include disaster relief, protection of refugees, conflict management, among others. Resources from the military, the police and emergency services could be used to protect against the worst effects of disasters, e.g. using troops to contain wildfires or floods, to control crime and looting, evacuate refugees and crisis management (UNDDA 1991; Scheffran 1992). It is important to understand the conditions under which climate-related changes will translate into destabilization and conflict, and find factors that make societies more robust to resist and more able to adapt. Societies need to develop and collaborate on mechanisms to handle conflict and capabilities to manage disasters, including emergency planning and establishment of clear decision-making structures and procedures. Global information systems for early warning could help with timely responses to extreme events and crises. A database would collate information from different sources and UN institutions and address all threats to human security. Arms control, non-proliferation and disarmament would reduce the destructive potential of military forces (especially weapons of mass destruction) that could be used in conflicts. Preventive arms control restrains advanced technical weapons development, for instance of miniaturized vehicles that could be used in terror attacks. Forces need to be restructured towards defensive postures. Regional security concepts would establish conflict resolution mechanisms and confidence-building measures. A high priority should be given to stabilizing fragile and weak states that are threatened by climate change. For instance, the OECD's Development Assistance Committee has set up a Fragile States Group that has defined Principles for Good International Engagement in Fragile States and Situations. The capacity to manage environmental risks must be maintained and reinforced, even under difficult political and economic conditions. Emphasis should be given to crisis prevention which is less costly than crisis management and intervention which often come too late. Critical are strategies that allow human beings and institutions to respond in a constructive and mutually beneficial way and provide alternative venues for grievances and differences.

42.4.6 Stakeholder Participation and Alternative Dispute Resolution

Participation of citizens with their interests and capabilities, knowledge and perceptions, responses and interactions is a key for dealing with the challenges of climate change and managing associated security risks, instabilities and conflicts. Renn, Webler and Wiedemann (1995: 3) define public participation as "forums for exchange that are organized for the purpose of facilitating communication between government, citizens, stakeholders and interest groups, and business regarding a specific decision or problem." Instead of conflicting forms of expression it includes "public hearings, public meetings, focus groups, surveys, citizen advisory committees, referendums and initiatives, and negotiation, among other models." Fo-

cus groups have proven successful in various contexts as a process of group discussion and evaluation of critical societal issues such as climate change (Wibeck/Dahlgren/Öberg 2007). Participation of stakeholders in dialogues is significant in natural resource management (Stoll-Kleemann/Welp 2006). Multi-stakeholder sustainability planning is a social learning mechanism based on the vision of partnership between members of society and their environment, involving stakeholders in the formulation, monitoring and follow-up of sustainable development strategies. It contributes to the formation of social capital, the democratization and stabilization of societies, and can prepare the ground for cooperation, negotiation and conflict resolution (Scheffran/Stoll-Kleemann 2003). Regional participatory assessment will include experts and stakeholders from the regions of concern into a discussion of key links and variables of the climate-society interaction (including gender issues), an evaluation of climate impacts and the design of strategies. Alternative dispute resolution and mediation is an interactive process to reconcile divergent interests and settle environmental and natural resource conflicts.

42.4.7 Cooperation, Coalition Formation and Global Governance

The magnitude of the potential security risks of climate change requires determined policies to manage global change within a new well-designed global governance architecture that establishes rules, regulatory systems and functioning institutions. To master the global and long-term challenges, global governance would create and reinforce multilateral regimes that involve cooperation between states and non-government actors from the local to the global level (Scheffran 2008d; Lempert/Scheffran/Sprinz 2009). Recognizing that anthropogenic climate change constitutes a common problem of humankind, the international community must establish common solutions and cooperative approaches that combine sustainable environmental policy, development policy and preventive security policy into an integrated concept for sustainable peace (Scheffran 1998; Brauch/Oswald-Spring 2009a). To address the climate challenge and its long-term nature with high uncertainties, new concepts of adaptive governance are appropriate that seek to influence the many decision points along the causal chain from climate change to societal instability to avoid cascading risks and prevent the breakup of natural and social systems.

Whether climate-induced pressures upon societies erupt into crisis and conflict depends primarily upon the performance and problem-solving capacity of the states in question. Cooperative approaches include the international transfer of investments and technologies to shift the composition and learning rates of the energy system towards emission reductions. To implement Art. 2 of the UNFCCC, states need binding and verifiable agreements.

The more climate change advances, the more important adaptation strategies in the affected countries will become and these must be supported by international development policy in agriculture, water, food security and disaster prevention. Adaptive governance is arising out of the needs at the state and local level and "involves the evolution of new governance institutions capable of generating long-term, sustainable policy solutions to wicked problems through coordinated efforts involving previously independent systems of users, knowledge, authorities, and organized interests" (Scholz/Stiftel 2005). Adaptive management is essential to adjust to actions and interactions among multiple factors and actors in the complex environment created by climate change and to find the best combination of global mitigation and local adaptation strategies (Scheffran 2008c).

Agent-based approaches allow to represent adaptive agents who follow decision rules based on incomplete knowledge and updated information within a spatial and temporal window of perception, and thus respond to changing circumstances. They are also appropriate to manage the multi-level decision-making process between local and global agents, and the transition between individual and collective action that leads to the formation and breakup of coalitions. This conceptual and analytical framework to global governance is adequate to analyse the conditions for moving from conflict to cooperation.

To overcome diverging interests it is important to build coalitions among those with common interests to establish a regime for sustainable climate security. Win-win solutions among industrialized and developing countries help to avoid a North-South conflict (Ipsen/Rösch/Scheffran 2001). Cooperation becomes feasible if participation is in the developing countries' best interest, e.g. because it supports local environmental goals or provides access to low-carbon investments and advanced technology to fulfil both environmental and economic goals.

Governance capacity is particularly relevant in the context of environmentally induced migration (Biermann/Pattberg 2008). *Migration policy needs to be*

integrated into development cooperation that strengthens the adaptive capacities of people living in poverty and the rights of environmental migrants. Another area is cooperation on transboundary water management which should encourage regional sharing of water resources to avoid water crises and facilitate developing countries' access to current scientific data on regional water availability.

42.5 Conclusions

The climate-society interaction is highly complex and not fully understood. This chapter develops an integrated assessment framework to assess the causal chains of events and impacts from climate change to environmental, human and societal consequences. These are determined by the sensitivities between the key variables and their response patterns to changing conditions. Human and societal responses depend on their vulnerabilities to climate-induced stimuli and their adaptive capacities which determine the threats and risks to security as well as the instabilities and conflicts. Within the introduced framework it is possible to specify conditions for vulnerability, instability and conflict which can help to structure climate change impacts and classify responses into those that affect these conditions in one or the other direction,

The chapter discusses different security concepts (common, ecological and human security) which are adequate as building blocks of climate security, and introduces key stability concepts (economic and ecological stability, escalation stability, societal stability) that are relevant in the climate change context. Whether climate change leads to more conflict or more cooperation depends on the type of resource that is affected and by the adaptive responses selected by the key actors. Based on this analysis we introduce a set of strategies to enhance climate security, prevent environmental conflicts with an early warning system and stabilize societies. These include measures for sustainable development of human and social capital to strengthen adaptive capacities, emission reductions to mitigate the problem, managing and reducing security risks and threats, as well as participatory approaches to involve stakeholders in problem solving and adaptive governance on global and regional levels. Integrating these strategies into a concept of sustainable peace is a key to avoiding, reducing and solving the security problems associated with climate change.

43 New Threats? Risk and Securitization Theory on Climate Change and Water

Anders Jägerskog

43.1 Introduction[1]

Buzan, Wæver, and de Wilde (1998) argue that states and societies 'securitize' issues to highlight their urgency. This has been the case with the environment and particularly water.[2] In this chapter a number of consequences of this phenomenon will be addressed. For example, what are the implications of this securitization on policy formulation both for the security and for the environment sector? Is the securitization process leading to policy priorities that are relevant from a security perspective or is the debate getting blurred? The threat posed to and by the environment differs from traditional threats to state security. Traditional threats deal with military and strategic issues while environmental challenges are seen as incrementally growing threats. The Climate Change issue which has really taken off during the last years, is of course also seen (or indeed branded) as en environmental security issue. The importance of climate change is further elevated as it is seen as affecting, in a destabilizing manner, also food security, water availability, and health issues. It is conceived as a future cause for environmental migrants. Thus, the main importance of climate change as a security issue is that it affects and furthers other environmental scarcities (IPCC 2007a). It is also evident that the issue has gained interest among the defence establishments (US National Security Council Memorandum, 27 March, 1998). And in 2007 the UN Security Council held its first ever debate on climate change and how it affects peace and security.[3]

Similarly, the water problem in the Middle East has also been characterized as an issue with national security implications for the states in the region (Shuval/Dweik 2007). The angle of this chapter is of a multi-disciplinary nature although predominantly related to political analysis (predominantly security focused) as well as sociological perspectives.

The chapter is divided into an introduction followed by aim, background, and theoretical framework (sections 43.1–43.1.4). Then the Israeli-Palestinian water negotiation process is analysed (43.2), especially the risk perception in the negotiation process 43.2.1). Section 43.3 discusses climate change and securitization, and in section 43.4 the findings are discussed and conclusions drawn.

43.1.1 Aim

The chapter has two aims that are interrelated: *first* to discern how climate change has been subject to a securitization within the international community at large. It is assumed that the climate change discourse has been securitized since the end of the Cold War. *Secondly*, to analyse how certain aspects in the water negotiations in the Jordan River Basin have either been emphasized or de-emphasized, drawing on risk theory. Arguably the securitization of an issue area relies on being emphasized by certain actors. By analysing these two concepts they could usefully inform each other.

Furthermore, the risk theory perspective has potentially strong (but not yet very well understood) linkages to securitization. By understanding how certain issues are being stressed or de-emphasized our understanding of why certain issues may become securitized will improve. In addition, climate change will negatively affect water availability in dry areas as the Middle East, what makes the link between climate and water even more urgent.

1 This chapter is partly based on Jägerskog (2003). All copyright permissions have been obtained.

2 For example, Homer-Dixon (1994) argues that environmental issues might be a threat to state security.

3 See UN News Agency: <http://www.un.org/News/Press/docs/2007/sc9000.doc.htm>.

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43.1.2 Background

During the Cold War the concept of national security was, almost exclusively, defined in military terms (Brauch 2008). Security policy was almost identical with defence policy and was often portrayed as a 'zero-sum game'. After the Cold War ended scientists and professionals have increasingly challenged this narrow perspective (Brauch/Oswald/Mesjasz/Grin/Dunay/Behera/Chourou/Kameri-Mbote/Liotta 2008).

The term 'environmental security' was given significant attention after the end of the Cold War in 1989. Several research projects were launched to analyse links between the environment, national security, and violent conflict. Environmental security issues received much attention as they filled a void in the international security system during its transformation after the end of the Cold War (Brauch 2005; Jägerskog 2004).

Ullman (1983) argued for a wider and more inclusive concept of security. However, he pointed out that environmental 'threats', among them global climate change, have no causal link to national security. They were treated as security issues as they undermine the carrying capacity of the earth, and therefore might lead people and states to take up arms to maintain or gain access to the declining natural resources. Hence, environmental threats are indirect threats as opposed to direct military threats that had dominated the security debate previously. It is argued that increasing pressures on the ecosystems and on renewable resources of the earth impact on people's health and welfare, and in the long run they might pose an equal risk to security as military threats (Jägerskog 2000).

Brauch (2005) has comprehensively reviewed the environment and security debate and further clarified the concepts of 'threats', 'challenges', vulnerabilities', and 'risks' as they are all important facets of the environmental security discussions. In addition, a further development of the security debate continued during the 1990's when the human security concept was launched (including both traditional security aspects as well as new ones such as the environment but also social and economic aspects) primarily by the Commission on Human Security lead by Amartya Sen and Sadako Ogata. Brauch (2005) summarized the human security threats, challenges, vulnerabilities, and risks related to *underdevelopment* (freedom from want), *conflict and human rights violations* (freedom from fear) and *hazards and disasters* (freedom from hazard impact).

In the recent discussions on climate change the economics of the impacts have been dealt with at considerable length in the Stern Review commissioned by the British Government. Among the main predicted repercussions of global climate change are (IPCC 2007a):

- *Human settlements*. When flooding and landslides in combination with a sea-level rise occur it will force people to migrate (environmentally-induced migrants). Climate change will increase the number and intensity of extreme weather events and natural disasters, what will increase both the economic damage and the human toll.
- *Water*. In 2008, some 1.7 billion people live in water-stressed regions. With climate change this figure will rise significantly. It will also negatively affect the availability of freshwater (IPCC 2007a; UNDP 2006).
- *Health*. With a rise in temperatures diseases, such as malaria, will spread to new areas. A decline in biodiversity will lead to a decline in human security as multiplicity of species is an important base for research on new medicines, new crops, etc. (Jägerskog 2000).
- *Food security*. Food security is defined as "having a continuous supply of enough food to be able to live an active and healthy life" (Linnér 2000; FAO 2003). Climate change will negatively affect the agricultural sector (particularly in the South) and thus endanger food security. And in addition the issue of *biofuel*, which is more 'climate friendly' but at the same time consumes a lot of water and thereby is affecting the water scarcity situation negatively, complicates the picture (Falkenmark/Berntell/Jägerskog/Lundqvist/Matz/ Tropp 2007; Lundqvist/Barron/Berndes/Berntell/Falkenmark/Karlberg 2007).

43.1.3 Theoretical Framework

43.1.3.1 Theory of Securitization

Traditional security studies have an objective view of what constitutes a security issue. This approach focuses on military issues and external threats to the security of a state. In contrast, the 'securitization approach' by Buzan, Wæver, and de Wilde (1998) views security as *socially constructed*. They argue that security is not an objective feature of threats. 'Securitization' is seen as an extreme version of politicization. In a securitizing act an issue (or a set of issues) is presented as an existential threat. If the issue is subse-

quently recognized by the public or large parts of the public then the issue has been securitized. Hence the status of an issue depends on the subjective judgements of the public (Wæver 2008, 2008a).

The significance of risk in a negotiation is rarely considered. The risks involved in the water negotiations are of a natural scientific nature and are at the same time politically and culturally determined. As the process of securitization is socially constructed so is risk (or its perception). By using risk theory it may be understood why some risks are emphasized and others are de-emphasized. In the case of the waters of the Jordan River Basin this aspect of the negotiation is particularly important since it pinpoints the ways in which water is subordinated to other political priorities, what results in certain risks being de-emphasized. In addition, it is useful since it helps in identifying constructed realities within the respective societies that influence and effectively 'set the boundaries' for the negotiations.

43.1.3.2 Risk Theory

In the literature there are two main ways of interpreting risks (Beck 1995, 1999). *First*, there is the *natural–scientific objectivism* about hazards that basically identifies risks using scientific techniques of observation, measurement, and calculation. The strength of this perspective is that, through the instruments used, it enables risks to be categorized so that they are definable in terms of probability. However, its inherent weakness is that it fails to recognize that scientific 'facts' are situated and interpreted in cultural and political contexts. The critique of the natural–scientific approach leads to the second approach of *cultural relativism*. This approach emphasizes the contextual aspects of risk but it has an inherent weakness as it fails to recognize the nature of 'real' hazards.

Ulrich Beck argues for a third way to analyse risks – a *sociological perspective* – which combines both. He is interested in the 'cultural disposition' of groups and individuals when they single out certain issues as risks and ignore others. Here it is important to look at the symbols that drive individuals and societies to view certain matters as risks. Symbols that can 'touch a cultural nerve and cause alarm', of which water in the context of the Middle East is a good example that can help people focus on an issue while ignoring others. This is also evident in the debate on climate change and its implications.

Both groups that want to emphasize the risks of climate change as well as those that would like to de-emphasize are best understood in their cultural context, to draw on Beck's concept. In addition, the risks (or the perceived such) are different in the modern world as opposed to the pre-modern era. Beck (1999: 4) highlights that "risk and risk societies combines what once was mutually exclusive – society and nature, social sciences and material sciences, the construction of risk and the materiality of threats."

Another influential thinker on risk is Mary Douglas, who also argues that risk is best analysed through the prism of culture. As an anthropologist she holds that individuals should be seen in their social environment. Douglas argues in her 'cultural theory' that it is possible to understand how some issues which might be perceived as risks are emphasized and others are de-emphasized through looking at the institutions that are created in cultures and which set limits for action (Douglas 1992). The process whereby certain aspects of risk have been emphasized or de-emphasized in the negotiations in the Jordan River Basin is evident. For example, Jordan and Israel in their agreement chose to de-emphasize the provisions in the event of drought.

In order to point out the variable significance of risk it is also necessary to examine both the scientific and the cultural-political discourse. Kopagen (1995) points out the importance of various myths within which issues such as water and territory play a part. To understand risk perceptions in the Middle East it is important to acknowledge the specific cultural and socio-psychological context in which the water issue is situated. There is also a tendency among scientists to downplay uncertainty when communicating scientific results to decision-makers (Wynne 2001).

Another feature that is presumed to be central in the analysis of risk is the notion of 'otherness'. When discussing risks, individuals and societal groups are prone to identify other individuals or societal groups as the source of risk. This is particularly evident in cases where the 'other', in one way or another, threatens to overtake the self – or, in the case of water, claims or uses a water resource which is perceived to belong to oneself (Lupton 1999).

Bar-Siman-Tov deals with the issue of uncertainty and risk while moving from war to peace. He argues that uncertainties pose dilemmas in negotiations as states aim to reach agreements. When a state makes a concession in a negotiation it takes a risk since it cannot be certain what it will gain (or lose) by making that move. Hence, risk management strategies are deemed very important in negotiations. However, Bar-Siman-Tov views risks as largely objective, identifiable, and definable in terms of probability, and his

ideas are thus not as useful for identifying socially constructed risks (Bar-Siman-Tov 1999). This concept relates to culture and identity that are identified as crucial for negotiators dealing with water in the Arab-Israeli context as their identity is rooted in the parties' respective cultures, which largely dictate how they view and react to each others proposals in the negotiations (Fauré/Rubin 1993).

43.2 The Israeli-Palestinian Water Negotiation Process

The opportunities and obstacles in the Israeli-Palestinian water negotiations must be analysed in their context. Thus, what might be seen as an obstacle in the water negotiation could, when linked to other issues, such as refugees or borders, actually be an opportunity. What can be seen as an opportunity and an obstacle can also be seen as a risk.

With the end of the Cold War a 'window of opportunity' opened for the states in the Middle East, as it was no longer an arena for the struggle between the superpowers. The mutually hurting situation – for Israel through the Intifada and for the PLO through the danger of being sidelined by others in efforts to settle the Israeli–Palestinian conflict, felt among the Israeli Labour Party leadership and the PLO leadership, respectively – thus presented an opportunity to start a process aimed at reaching a solution to the conflict.

Clearly, transboundary waters do no fit in the traditional security discourses of international relations (Hurrel 1995). This implies that there is an opportunity for cooperation on water resources. Entering into a joint management institution over a shared water resource does not represent a zero-sum game, in which the loss of one party is a gain to the other, but a positive-sum game where cooperation is something from which both parties can gain (Wolf/Hamner 2000; Sosland 2007). People from both sides emphasize the need for joint management and cooperation. Thus, in the discourse on transboundary waters cooperative management is seen as the best option.

Using a functionalist or idealist approach to international relations one might also hypothesize that water can be a source for future cooperation on other issues. Such a development has not happened so far in the Israeli-Palestinian case. However, using a more realist reasoning, along the analytical lines of Lowi (1993), it can be argued that 'high' politics (such as national security concerns) decides what is agreed upon in areas of 'low' politics (such as water). Indeed, while water cooperation might be the best possible solution for all parties in the basin, it is still Israel, which is in the hegemonic position, that dictates to a great extent what is acceptable and what is not (Nicol/Steenbergen/Sunman/Turton/Slaymaker/Allan/de Graaf/van Harten 2001). Obviously, its hegemonic position is an opportunity for Israel and an obstacle for the Palestinians. The power asymmetry between the parties, with Israel being the stronger on issues such as human resources, military power and economics, is also an obstacle for the Palestinians in obtaining the best possible outcome, while it is an opportunity for Israel to push its interest even harder.

The Palestinians also identified other obstacles. For example, as the Palestinians have repeatedly stated, the parties wanted to discuss and negotiate quite different agendas and issues. While Israel was interested in discussing cooperative ways to find 'new' or additional water, the Palestinians argued that the starting point has to be to identify the water rights. Only after they have been agreed is it possible to discuss other issues. These discussions have also been part of the Joint Water Committee deliberations since the Interim Agreement. A further obstacle for the Palestinians is water data. Since they have not had a functioning measuring system for a long time they need 'raw data' from the Israelis. According to the Palestinians they are only receiving processed data, which makes it difficult for them to make informed decisions and judgements.

In the Interim Agreement signed in Taba in 1995, Israel acknowledges that the Palestinians have water rights, which is partly a victory for the Palestinians. But what these water rights actually imply is not spelled out but is to be negotiated as part of the final status negotiations. The water rights issue was discussed during the negotiations in spite of Israel wanting to postpone it, and according to Uri Shamir these were the hardest issues.

43.2.1 Risk in the Negotiations: Perceived and 'Real'

The risks in the water negotiations are both 'real' and constructed risks. On one level there are the 'real' risks definable by scientific observation and on another level there are the culturally constructed risks (Beck 1995). However, the division between both types of risk is not clear cut: for example, a predominantly culturally influenced risk can be portrayed as a scientific (or real) risk. The problem of diverging risk perceptions, which may all be based on expertise, is

highlighted by Sjöstedt (2001) who shows that in the negotiations between Slovakia and Hungary on the dam on the Danube River the authorities made different use of experts, which led to contrasting perceptions of risk. Furthermore, as is pointed out by Meir Ben-Meir (a former Israeli head of the Joint Water Committee) some issues in negotiations are left vague, thus making it possible to avoid the division of risk, because otherwise it might be impossible to reach an agreement.

The risks primarily perceived by the Israelis in the negotiation with the Palestinians concern water quality and quantity. Some Israelis argue that it might be risky for Israel to rely on water from the aquifers emanating from the West Bank as the Palestinians could pollute the water in these aquifers, thus reducing both quality and quantity. These claims can, of course, be based on hydro-geological science but they might at the same time be influenced by a cultural disposition on the part of the Israelis not to view the Palestinians as trustworthy. In the case of the claim that the Palestinians could pollute the aquifers, the question can be asked why they would be interested in doing so when they rely on the aquifers themselves. The logical answer to this question suggests that the risk that some Israelis are highlighting here has more to do with a lack of trust of the Palestinians and is driven more by cultural dispositions than by natural-scientific arguments. It might be argued that this connects very much to what Lupton (1999) calls the notion of 'otherness', which means that groups are prone to identify other groups as the source of risk. That is particularly true in cases where the 'other' is perceived as threatening to overwhelm the 'self'. As a result of the distrust, the Israelis are reluctant to give up the degree of control that they have over the West Bank waters.

Palestinians, on the other hand, focus on water rights, with a particular emphasis on Palestinian sovereignty over water, as a starting point. They see the main risk to themselves as not achieving what they view as their appropriate water rights. The Palestinian argument is connected to the land issue and is emotionally laden. Control or sovereignty over water is a symbol of importance for the long-awaited Palestinian state. This reflects well the ideas of Kopagen (1995), who emphasizes the cultural attachment to the land and water.

One evident risk of focusing heavily on water rights as the top priority is that the Palestinians will achieve a less favourable deal in terms of water allocation. An agreement with Israel is likely to be based on the level of current use. If, on the other hand, the negotiators' emphasis shifted to the more vague principle of equitable utilization, Palestine could have a better chance of achieving larger allocations. The political-cultural history of the Arab-Israeli conflict is an important factor in understanding why some issues are de-emphasized and others are emphasized. The fact that the Palestinians emphasize water rights can be seen as a result of their long history of having no rights, and the damage to their interests as a result of occupation.

As argued above, water was of less importance in the peace negotiations than issues such as Jerusalem, borders, settlements and refugees. Obviously, this affects risk perceptions on water. Certain risks (loss of water) are de-emphasized by the parties when they stand to gain in areas that are politically more important. Thus a trade-off takes place between issue areas in the negotiations. Consequently, risk perception in the peace negotiations, involving various interlinked issues, is influenced by strategic choice and politics as well as by culture and history.

The water negotiations should not be viewed as isolated events. First, we need to look at the actual agreements and at the various mechanisms that have been created as instruments to deal with the risks and conflict issues that might surface. Second, the water clauses of the agreement need to be put into a wider negotiation context. An awareness that a sacrifice might be made by one party on a certain issue (for example on water) in exchange for a reward in another area is imperative. Thus, some risk issues might be emphasized, de-emphasized, or left out as mutually agreed 'vague' issues because of various complex negotiation linkages.

When a state makes a concession in a negotiation it cannot be certain what it will gain (or indeed lose). The issue of effective risk management strategies and tools is, therefore, very important (Bar-Siman-Tov 1999). Both the Israeli-Palestinian Interim Agreement and the Israeli-Jordanian peace agreement provide for a Joint Water Committee. These committees are useful as both confidence-building measures and conflict resolution mechanisms.

Thus, risks and uncertainties, both those that have been included in the agreements and those that have not been included, can be dealt with within these bodies. Indeed, as Ben-Meir, said: "Both parties acknowledge the importance that it [the JWC] stays in place." This is reiterated by a Palestinian member of the JWC, Ihab Barghouti, who maintains that it is an important body although its work is hampered by being linked to other political issues. A retrospective,

'follow-through' analysis of the water negotiations helps us, as has been shown above, to examine the risks included in agreements as well as those that are not (Zartman 1999). Furthermore, it gives us a view of the joint mechanisms established to deal with the risks. In this regard regime theory is relevant as it focuses on how joint mechanisms can become institutionalized and thereby generate norms and rules for conflict management so that the parties are better able to deal with common issues of dispute. The existence of such mechanisms has been manifested in the Israeli-Jordanian water relations during the recent periods of drought (Jägerskog 2003). Having highlighted the positive aspect of the Joint Water Committee it should be noted that to a large extent Israel uses its hegemonic role to dominate the discourse in the committee and thereby steer the outcome to its liking (Selby 2003a).

43.3 Climate Change and Securitization

In the environmental sector the environment is seen as a referent object that has to survive. If the environment is degraded to the point of no return all other issues will lose meaning. Hence, the security of the environment has to take priority over all other issues. The basic underlying rationale of those who argue for a security concept where environmental security is taken into consideration is that in a global perspective humankind is living beyond the carrying capacity of the earth.

In the environmental sector there is a rather large dependence on scientific authority as a basis for policy decisions. Hence, epistemic communities play a rather large role in setting the agenda. They are, therefore, an important securitizing (or de-securitizing) actor for the environment. The securitizing acts within the security discourse are often a reflection of some tactical rationale employed in order to increase the importance of an issue. While some try to securitize issues there are also those who try to de-securitize issues. This situation has been evident in the debate between the Bush administration and the European Union on the Kyoto Protocol. The Europeans have tried, in the political discourse, to securitize the issue of global warming while the Bush administration has tried to de-securitize it. It has also been evident that there are forces within the US that have tried to securitize the issue. The House democrats managed to get a provision into the State Department bill directing President Bush to continue to negotiate the Kyoto treaty that he rejected. The resolution states that "global climate change poses a significant threat to national security, the American economy, public health and welfare and the global environment."

In the debate on the Kyoto Protocol there are four main securitizing actors: *First*, there are the two political entities, the US wants to de-securitize the issue while the EU wants to securitize it. *Secondly*, there are different epistemic communities. There is one (and by far the largest group) that argues that human controlled emissions contribute to global warming and argue that something needs to be done about it (IPCC 2007a). Then there is the group of scientists that argue that it is not certain that carbon emissions contribute to global warming, at least not the extent of it. They also criticize the methods the first group uses.

If we look at the large political entities they tend to approach the world with rather different mindsets. The member states of the EU emphasize naturally, multilateral agreements and common regimes that tie states together. The European project is not by accident used as a 'definition' of functionalism. Thus, they are interested in things that tie states together and climate control is such an issue. The US, on the contrary, tends to view the world from a pre-dominantly realist perspective – military power, national and economic interests determine international politics. Being in the position of the sole hegemon it is easy to argue like Bush when he said that the cost of the Kyoto Protocol was greater than the United States wanted to bear, and therefore skipped it. It is evident that the EU has its own reasons for attempting to securitize the issue while the US has its reasons de-securitizing it.

The different epistemic communities are composed in different ways. The main body for the scientists dealing with climate change of the governments of the world is the *Intergovernmental Panel on Climate Change* (IPCC). They have been a main securitizing actor in the scientific discourse arguing that the main reason for the global warming is a result of human activities. The other group of scientists is in a minority but they have criticized the IPCC for methodological arrogance and insist that the evidence for global warming is far from certain. Thus, they are attempting to de-securitize the issue. According to risk theory the respective communities are emphasizing and de-emphasizing the issue. Besides the scientists debating climate change, the media are also playing a role in the emphasizing or de-emphasizing of the risks associated with climate change (Oreskes 2004).

There are also linkages between the political entities acting in a securitizing manner and the epistemic group doing the same. This applies also to the groups aiming at a de-securitization. The political entities, quite predictably, reach for the scientific arguments that suit their purpose. For example, in scrapping of the Kyoto Protocol President Bush referred to the "incomplete state of scientific knowledge of the causes of, and solutions to, global climate change."

The French Environment Minister Dominique Voynet, relying on the work of the IPCC, referred to the new US position as "suicidal and irresponsible." Even the sometimes ambivalent UK government that sometimes sided with the USA and not the EU on certain issues, came out harshly, through its Environment Minister Michael Meacher, on the US when he said that global warming is "the most dangerous and fearful challenge to humanity over the next 100 years."

In a much highlighted speech in 2004, the British PM Tony Blair said "our effect on the environment and in particular on climate change is large and growing." UK Foreign Secretary Margaret Becket has furthermore highlighted how she believes climate change will change the security situation stating among other things

> The basic science of climate change is no longer in dispute. But the scale and urgency of the challenge we face is worse than we had feared. Tackling climate change is an imperative, not a choice, a problem for today not tomorrow. I am in no doubt that today being a credible foreign minister means being serious about climate security because the question for foreign policy is not just about dealing with each crisis as it hits us. Our obligation to our citizens is to put in place the conditions for our future security and prosperity in a crowded and interdependent world.

43.4 Discussion and Conclusions

It was hypothesized in the beginning of the chapter that the issue of climate change has been subject to a securitization within the international community. It is found that the issue of global climate change has indeed been securitized by some actors but it is also found that there are actors that have attempted to de-securitize the issue. Perhaps not surprisingly, the willingness to securitize (or de-securitize) the issue of climate change is not only determined on scientific grounds but determined by interests and cultural disposition/context. Hence, when President Bush argues that it is not in the US interest to be a part of the Kyoto Protocol it is because, in his view, it hurts US economic interests. Quite rationally he reaches for the arguments of the epistemic group that argue that there is no clear-cut scientific evidence for global warming, let alone the role of carbon emissions in it. On the other side of the spectre we find the Europeans that argue forcefully that global warming is indeed happening and at a faster rate than ever, and accordingly embrace the conclusions of the IPCC. It is concluded that it is imperative to include an analysis of the politics surrounding the issue of climate change in order to unmask and understand the major forces that are engaging in the discursive battle of securitization and de-securitization respectively of the issue of global warming. A lesson drawn from this exercise is that the concept of security is inherently constructed since it is subjectively defined. From a policy perspective this is important since when creating policies the policymaker would benefit from an increased understanding of the forces that shape a discourse on climate change and the security risks allegedly associated with it. That would help the policymaker not only to adjust his policies to the prevalent discourse but to go beyond it.

The other aim of this chapter has been to analyse how risk perspectives have been incorporated into the water negotiations in the Middle East peace process. Specific attention has been given to why some issues are seen as risks in the negotiations and other issues are not. In particular, what are the decisive political processes in this regard?

It is concluded that when a risk is situated in the wider negotiation context, it may become apparent that some risks are emphasized or de-emphasized as a result of various linkages between different areas of the negotiations. It enables us to understand why some issues that might be termed risks are not part of the negotiations. The reason why measures that would be helpful in this regard are not included is that they are politically stressful. For example, the Palestinians would not agree to work simultaneously to find 'new' water and discuss water rights. Rather, they would like to finalize a division on what there is today first and then move on to discussions on 'new' water. It is also found that the issue of risk in the negotiations cannot be viewed in isolation, as the water issue is subordinate to more salient political issues in the negotiations. One party might overlook a risk in the water negotiations in order to gain something in another area. Hence, the issue of political feasibility and linkages between issues are identified as important. For example, if one party were given the opportunity to gain something on the question of Jerusalem he

would most likely be prepared to compromise on water. Thus a major conclusion seems to be that risk perception is not only culturally informed but also informed by politics, especially in negotiations.

Table 43.1: Risk and Securitization. **Source:** The author.

	Risk Perception	
Referent Object: Climate Change or Water	**Emphasizing Risk**	**De-emphasizing Risk**
	Securitization (Water and/or Climate Change branded as a security issue)	De-securitization (Water and/or Climate Change branded as a non-security issue)

On a final note it is concluded that there are linkages between the two theoretical perspectives employed in the chapter (table 43.1). The referent object in the two cases discussed were water and climate change, and while the processes discussed are rather dissimilar the ways in which the issue of risk is being either emphasized or de-emphasized explains the degree to which the referent object is being securitized or not. In line with a more constructivist approach the risk perception focus is a constructivist approach to the issue.

While the perspectives of Buzan, Wæver, and de Wilde (1998) that deals with securitization processes are useful in analysing the climate change discussions and the perspectives drawn from risk theory are useful in analysing the Israeli-Palestinians water negotiations, one can also discern how the perspectives overlap. The process that drives a securitization is similar and includes comparable facets as those that drive proneness to risk (or vice versa). The actors that argue that climate change is a security issue see this as a high risk and emphasize this. The actors that view climate change as a 'normal' issue try to de-emphasize it. And those that argue that certain aspects in the water negotiations shall be viewed as a risk employ a securitization logic.

In both the securitization process as well as the process of moving describing an issue as a risk or not as a risk through either emphasizing or de-emphasizing, the actors that are active in the processes are informed by their cultural and political circumstances in which they are situated. Thus, the respective processes might look quite apart at first glance but in the process of determining if an issue is a *vulnerability* or a *threat* the interests by the actors that collide (or collude) with a certain scientific (or other idea) is actually one of *knowledge construction.*

44 Dealing With Uncertainties in Climate Change Impacts Assessments: A Case Study on the Nile Basin

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44.1 Introduction[1]

With the publication of the fourth assessment report of the *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b, 2007c) the international scientific community has seen a major shift in priorities. A few years ago the scientific debate was focussed on the detection and attribution of climate change. The emphasis has now shifted towards assessing the impacts of the changing climate on social and economic concerns to inform adaptation and mitigation policies worldwide.

Among other things this change in focus has generated an unprecedented demand for climate projections at the regional and continental level. However making climate projections as the basis of water resource planning, for example, still represents a very challenging task for the scientific community. The study of climate and all the practical challenges associated with it, evolved under the assumption that the climate is stationary. Recent observations not only show this assumption to be untrue, but that emissions from human activity are likely to have been the largest contributor to changes that are potentially threatening the sustainability and diversity of some of the world's greatest ecosystem services, such as the Nile River basin.

Ten riparian countries contribute to and benefit from the Nile's water. 98 per cent of Egypt's freshwater resources come from the Nile and like other countries it also depends on the basin to sustain agriculture and provide power from hydroelectric generation.

Various climate impacts studies have highlighted that the Nile basin is highly vulnerable to the projected changes in temperature, precipitation and sea level we may see by the end of the century. For example, without the building of flood defences, the expected sea level rise in the Mediterranean could submerge a large area of the most fertile lands of the Nile Delta (chap 45 by El Raey). This highlights that countries like Egypt are not only susceptible to impacts within their borders but to those on a larger continental scale as well.

The risks climate change brings to the people of the Nile region will be exacerbated by their low adaptive capacity; the high levels of poverty; poor access to existing water supplies and sanitation; and the low efficiency of water use. Current and future changes in climatic conditions constitute a major environmental risk that may jeopardize Egypt's development gains and efforts for poverty reduction. The *Joint Programme* (JP) on Climate Change Risk Management in Egypt, with participation of six different UN organizations, aims to ensure achievement of the *Millennium Development Goals* (MDGs) in the face of climate change through sustainable energy development strategies and effective management of climate risks in key affected sectors, identified in the *Initial National Communication* (INC) as coastal zones, water resources and agriculture. This programme should help Egypt align its climate risk management and human development efforts in responding to possibly series climate threats. One of the JP components, which is carried out through UNEP, focuses on improving the knowledge of the impacts of climate change, through preparation of *Regional Climate Model* (RCM) pro-

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jections and to use these predictions to assess the hydrological impact of climate change on the Nile.

This chapter presents a methodology adopted to address the impacts of climate change on water resources in the Nile Basin using RCMs. The assessment is a joint effort by the UK Met Office, DHI (*Danish Hydrological Institute*) Water, Environment and Health, and the Egyptian *Ministry for Water Resources and Irrigation* (MWRI) and is funded by UNEP and UNESCO.

Starting with a discussion of uncertainties in climate projections (44.2) and how they affect the assessment of climate impacts (44.3), this chapter outlines some common methods used to constrain uncertainty and details the simple yet flexible approach followed in the Nile project (44.4) to identify the impacts of climate change.

44.2 Uncertainties in Climate Projections

There are three commonly recognized sources of uncertainty in climate projections: the uncertainty due to the natural variability of the climate system, the uncertainty in future greenhouse gas emissions (forcings) and that resulting from our incomplete understanding of how to represent important climate system processes in climate models (Stainforth/Allen/Tredger/Smith 2007). All of these are likely to be important in predicting the future climate of the Nile basin.

Natural variability is believed to be the principal source of uncertainty for seasonal to decadal predictions (Cox/Stephenson 2006). Initial condition uncertainty and sampling uncertainty are likely to be particularly relevant in regions, such as part of the tropics, characterized by low frequency processes. The teleconnections between the sea surface temperature in the Pacific and the rainfall in tropical Africa due to ENSO is just one example of the importance of these processes on the seasonal to decadal time-scale.

For centennial projections, the response of the climate system to large modifications in the forcings (greenhouse gases and aerosol concentration) is expected to exceed the natural fluctuations of the system, the point at which this occurs being known as the "time of emergence" (Giorgi/Murphy/Noguer/Keen 2009). Thus, on long timescales the dominant sources of uncertainty are those concerning the forcings, over which we have some control as a society, and the model uncertainty associated with how the climate system is approximated in the numerical model used for the projections (Cox/Stephenson 2006).

On the decision-relevant time-horizon (30–40 years) it is model uncertainty, i.e. our inability to perfectly describe the state of a chaotic system, which forms the largest fraction of the total uncertainty (Cox/Stephenson 2006) suggesting this as the area to be more thoroughly analysed when assessing the local impacts of climate change.

44.3 Impact Studies and Uncertainties

There is strong evidence that in many regions freshwater resources are particularly vulnerable to projected changes in climate, the consequences of which could be wide-ranging (IPCC 2007a). Assessing prediction uncertainty is therefore particularly important for impacts studies. Planning for the worst case scenario may waste money and resources. Underestimating risk may mean infrastructural damage or even loss of life.

Although the study of climate is a very old science, a systematic analysis of the uncertainties inherent in its prediction was only pioneered in the 1990s. The assessment process has been continually refined and the release to the public of the *United Kingdom Climate Projections 2009* (UKCP09) presents both the first systematic evaluation of the uncertainty associated with climate projections and the first attempt to translate such assessment into impacts studies.

The Met Office Hadley Centre, in the project on *Quantifying Uncertainty in Model Predictions* (QUMP) pioneered the use of systematically designed *Global Climate Model* (GCM) ensembles to explore the uncertainties in climate projections (Murphy/Sexton/Barnett/Jones/Webb/Collins/Stainforth 2004). UKCP09 use data from the QUMP ensemble as well as high resolution regional climate models (RCMs) and a complex statistical post-processing technique to derive probabilistic predictions for changes in several meteorological parameters over the UK on climate timescales.

The methodology developed for UKCP09 is in principle available to use for other regions but it would require running further RCMs and is, as of yet, too expensive and complex to be applied worldwide to every situation of interest. Furthermore, it should be recognized that the uncertainty in climate projections represents only a part, albeit significant, of the uncertainty in the impacts assessment.

The extent of hydrological impacts due to climate change will depend on the dominant hydrological

processes and also on the feedbacks between the hydrological system and the atmosphere. In hydrology, several authors (Beven 2000; Butts/Payne/Kristensen/Madsen 2004) classify the sources of modelling uncertainty into the following main groups: model input (boundary or initial conditions), observational data uncertainty used in the calibration process, sub-optimal parameter values and incomplete or biased model structures. In the hydrological community ensemble modelling has focussed mainly on investigating the effect of parametric and input error (Beven/Freer 2001), and more recently on model structure uncertainty (Butts/Payne/Kristensen/Madsen 2004; Georgakakos/Seo/Gupta/Schaake/Butts 2004). However, a comprehensive and systematic ensemble-based study of all sources of hydrological uncertainty is also extremely complex and computationally demanding. Therefore, the initial focus is on the uncertainties in climate projections, arguably the most significant.

44.4 Nile Basin: A Case Study

The Nile is a crucial resource for the economy of eastern and north-eastern Africa (figure 44.1). Agriculture, energy production and livelihoods in general all depend strongly on the river flow (Adly/Ahmed 2009; Kameri-Mbote/Kindiki 2009). For this reason alone, assessing the impacts that climate change may have on water resources in the Nile Basin is of critical importance (chap. 45 by El Raey).

In this project the UK Met Office regional climate model was run several times using different GCM members to provide driving conditions. This enabled the creation of an ensemble of regional (high resolution) projections, likely to be more informative than a simulation based on a single model scenario. This procedure is not country-specific, so this study of Egypt can be considered as testing a pioneering approach that the UK Met Office is likely to apply in other parts of Africa, in South America and in Asia.

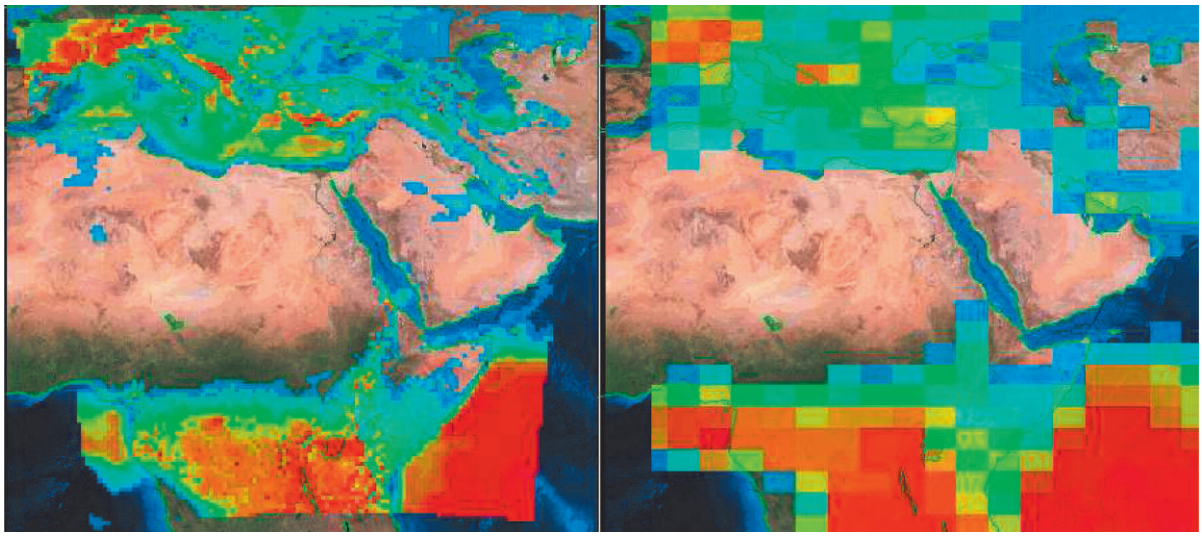
44.4.1 Regional Climate Simulations

Outputs from GCM for a given emissions scenario are provided at a horizontal resolution which is normally too coarse for regional assessments of the impacts of climate change. This is particularly true for water resources, where local effects such as rain shadow and orographic enhancement can be very significant. Therefore different forms of downscaling from climate model scale to hydrological scales are required (Fowler/Blenkinsop/Tebaldi 2007). Here, dynamical downscaling was performed with PRECIS, a modified version of the Met Office Hadley Centre's regional model HadRM3, designed to run on PCs (Jones/Noguer/Hassell/Hudson/Wilson/Jenkins/Mitchell 2004).

Figure 44.1: This satellite image shows the northern portion of the Nile which is being modelled as part of the case study. At the apex of the delta is the Egyptian capital city of Cairo. To the west are the Great Pyramids of Giza. North of here the Nile branches into two distributaries, the Rosetta to the west and the Damietta to the east. Also visible in this image is the Suez Canal, a shipping waterway connecting Port Said on the Mediterranean Sea with the Gulf of Suez. **Source**: courtesy of <nasaimages.org>.

When downscaling dynamically, i.e. with the use of a RCM, particular care needs to be taken with the design of the model domain. If the domain is too small it may prevent the proper internal development of reliable high resolution detail. If the domain is too large it will increase computational expense without adding further information. Over large scales the RCM solution may also diverge from that of the GCM, complicating the interpretation of the climate change projections (Jones/Murphy/Noguer/Keen 1997). In addition, the domain edge should avoid steep topography as the noise generated by interpolation can propagate inside the domain. For this case

Figure 44.2: The rainfall comparison between the regional climate model output and the driving GCM reveals that some significant orographic features are missing in the GCM description. **Source:** Met Office Hadley Centre. ©British Crown Copyright.



study a domain was chosen that extended well beyond the natural border of the Nile basin, (figure 44.2) of the order of 180 x 150 point at 50 km resolution. This was to ensure the area of Blue Nile sources, which account for most of the river runoff, were central to the domain.

44.4.2 Initial Phase: Ensemble Selection and Downscaling

Driving regional climate simulations with different GCM ensemble members is cutting edge technology. As such, the criteria by which to select the most appropriate GCMs is not yet a well-established discipline. Potentially, there are several criteria that could be applied; e.g. maximizing the range of climate change signals, ensuring the best fit to observed climate changes or accurately representing the important aspects of climate variability.

In this project the simplest and most conservative approach was followed. The fit of each GCM member to observations was analysed in a two step process. Firstly a set of climatic processes considered important for the hydrology of the Nile basin were identified. The most important of these were the seasonal cycle of precipitation both over west Africa (west African monsoon) and over the Great Horn of Africa. The Indian monsoon precipitation and temperature along the Nile were also considered. The ensemble members were then ranked according to their ability to reproduce observations of these variables.

The model uncertainty in representing present day climate was sampled as evenly as possible in order to provide the widest possible set of non-discountable alternatives, resulting in five ensemble members being selected to supply boundary conditions to the RCM. This selection process is shown as a flow chart in figure 44.3. Figure 44.4 is a simple comparison between one of the RCM projections and CRU climatology. One of the common problems in assessing the impacts of climate change is the definition of the baseline of past averages against which to compare future projections. It is commonly assumed (Jones/Murphy/Noguer/Keen 1997) that a 30-year period is the minimum needed to capture important aspects of the low frequency variability of the climate. For this study the time-window has been extended to 50 years to better characterisse the natural variability.

In contrast to the UKCP09 which were produced using RCMs with their physics modified to match the GCM they are downscaling, only a single version of the RCM was used for the Nile project. This approach, where different physics are used in the GCM and RCM, corresponds to the standard approach within the international regional modelling community (e.g. as applied in the ENSEMBLES and NARCCAP projects). The advantage of the approach applied here is that it provides a valuable way of assessing the impacts of large scale forcing on the domain of interest. The differences between the five simulations were often large (figures 44.5 and 44.6).

Figure 44.3: Schematic layout of the project: **Source:** Met Office Hadley Centre. ©British Crown Copyright.

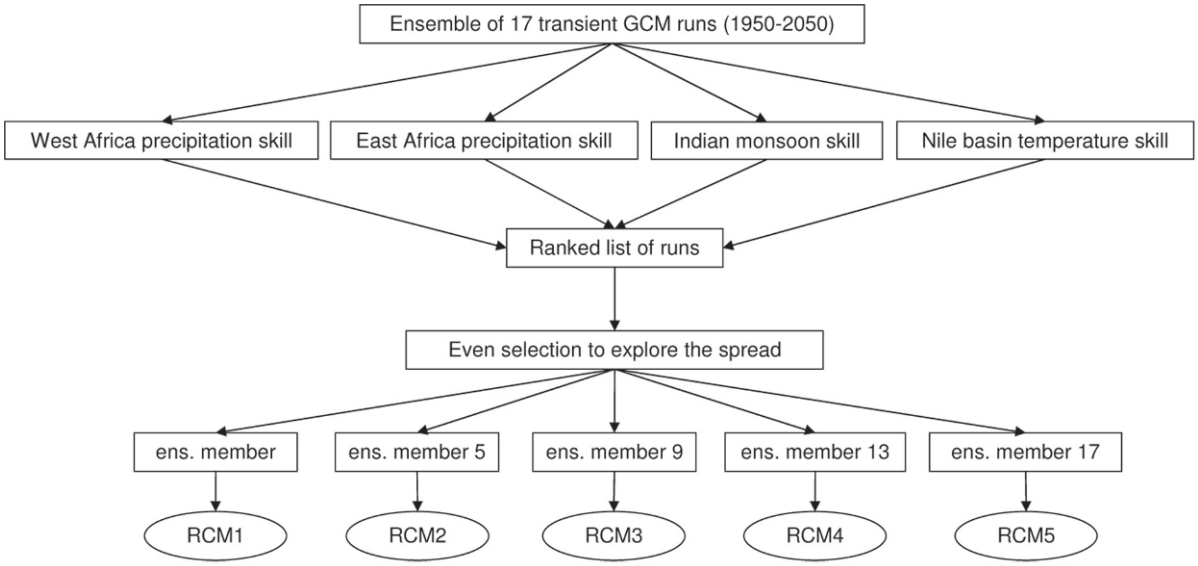
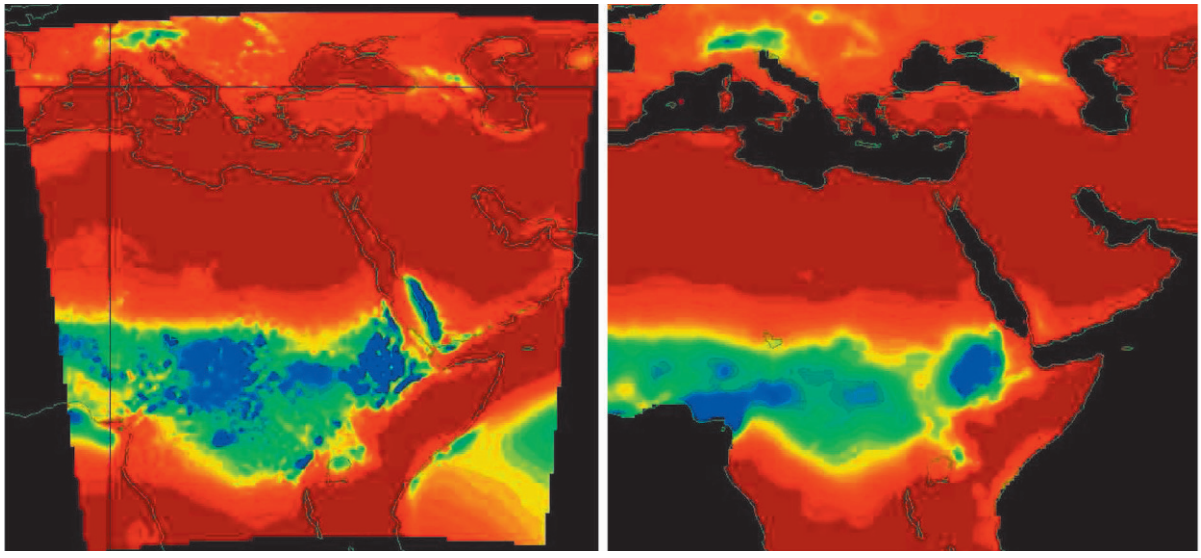


Figure 44.4: Comparison between one of the five regional climate model simulations (left) and the climatology (CRU) for June, July and August. Excluding the sea for which CRU does not provide data the comparison appears to be reasonable. There are two main areas of discrepancies: the Gulf of Guinea and the west Arabic peninsula. In the East African Highlands, where the Blue Nile source is located, the comparison for this specific ensemble member seems to be in very good agreement with CRU datasets. Both datasets, here plotted with the same colour scale, represent a 30-years average: **Source:** Met Office Hadley Centre © British Crown copyright.



The discrepancies are only attributable to differences in the large scale forcing from the GCM since the processes within the RCM domain are represented in the same way in all experiments. Basing an adaptation strategy on a single run, as on a single model study, is not recommended.

44.4.3 Second Stage: Coupling Regional Climate Projections With a Basin-wide Hydrological Model

While the 50 km resolution used in the regional simulations may provide an accurate representation of the climate processes, the hydrological processes often need to be represented at a smaller scale.

Figure 44.5: Monthly temperature and precipitation for different ensemble members. The symbols and error bars represent the 30-year average and standard deviation of the observations averaged over the entire Nile Basin area, for the period 1961-1990. The coloured lines represent the 30-year average climate data from the 5 GCM ensemble members used in this study, averaged over the same period. **Source:** Met Office Hadley Centre. ©British Crown Copyright.

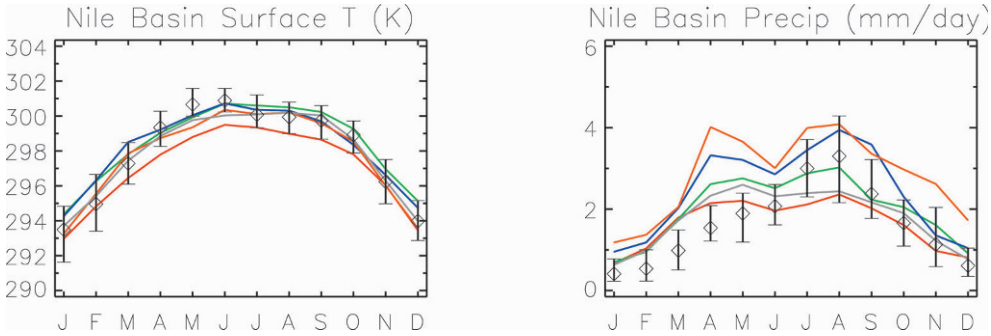
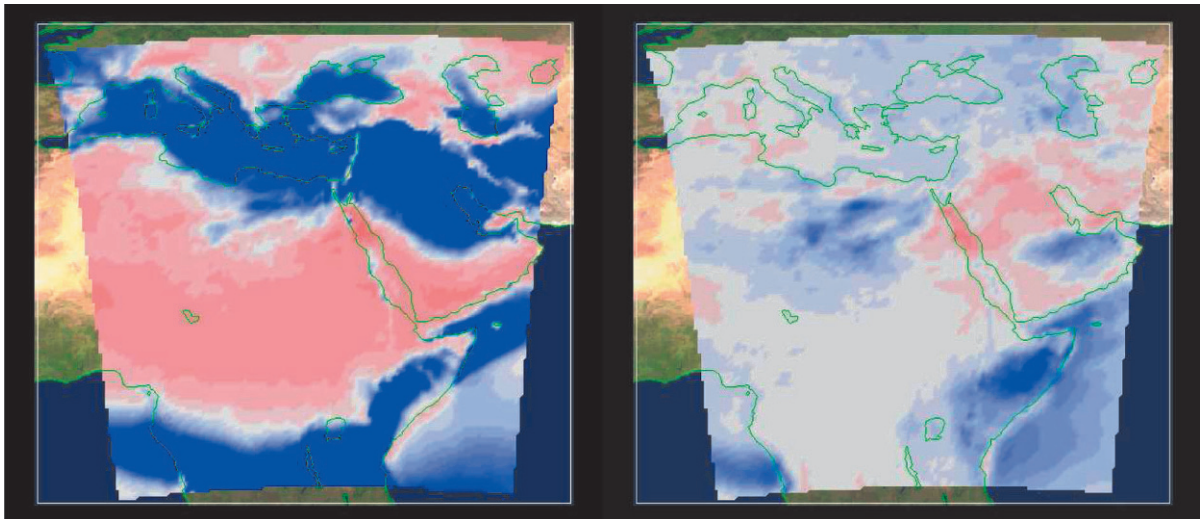


Figure 44.6: Rainfall percentage difference (blue +100 per cent and above red -100 per cent) between two different projections. The two plots represent DJF and JJA, respectively. In certain areas such as southern Africa and the Mediterranean the difference between the two simulations can be as large as a factor of 10. **Source:** Met Office Hadley Centre. ©British Crown Copyright.



In order to provide an estimate of the impact of climate change on the inflow into the High Aswan Dam a basin wide (5 km) gridded model was adopted. This model, currently used operationally at the Nile Forecasting Centre, takes as input the information provided by rain gauges and satellites to calculate the run-off (MWRI, Nile Forecasting System, Version 5.1, 2007).

This case study focuses on uncertainties in the regional climate response to global climate change, not uncertainties in emissions scenarios. Therefore only the SRES_A1B scenario is considered here[2].

To couple the regional climate model with the hydrological model, a simple change factor will be implemented. Using 50 years of data (1950–2000) a baseline reference of monthly precipitation totals and monthly evaporation totals will be calculated. These values will be compared with those obtained by analysing RCM output for the period 2020–2050. For each month, for each ensemble member, a multiplicative change factor will then be calculated. These factors will then be used to modify present day daily time series and consequently generate synthetic time series representative of future conditions. The *Nile Forecasting System* (NFS) can then be run using the modified

2 Anthropogenic climate change is directly controlled by the atmospheric concentration of greenhouse gases. By 2050s A1B and A2 scenario appear to be almost identical.

timeseries as an input. These estimates of Nile runoff will then be compared with those predicted by NFS for present day conditions in order to extract the climate change effect.

44.5 Conclusions

Due to the limited resolution of the current generation of global climate models a downscaling step is often needed in order to assess the impacts of climate change. Different techniques ranging from the statistical to the dynamical can be used to perform this operation. Independent of the particular technique adopted, it is fundamental to take into consideration the uncertainties associated with the climate projections. In the Nile project we followed a new methodology developed at the UK Met Office Hadley Centre to assess the uncertainty associated with the climate model formulation. Five global model runs were selected based on model performance from an ensemble of seventeen transient runs (IPCC A1B scenario) to drive a regional climate model for the Nile basin. The project, which will provide the MWRI of Egypt with an up-to-date assessment of the impacts climate change may have on Nile runoff, has already had influence on the design of other projects. The interim results of the regional climate modelling seem to suggest the existence of very significant differences between different simulations. These differences are solely due to the way the GCM is formulated, already considered to be the main source of uncertainty for near-term (e.g. 2030s-2050s) climate projections (Cox/Stephenson 2006). On longer time scales the forcing uncertainty will be the dominant factor while on the seasonal to decadal range uncertainty due to climate variability is likely to constitute the largest component of the overall uncertainty.

Well-established methods for choosing among the different projections do not yet exist. In the next few years it may become possible to extend the complex statistical techniques developed for the UKCP09 to other countries. At present the methodology adopted for the Nile project represents a simple and effective way of taking into consideration model uncertainty in the assessment of regional climate change impacts.

45 Mapping Areas Affected by Sea-Level Rise due to Climate Change in the Nile Delta Until 2100

Mohamed El Raey

45.1 Introduction

This chapter offers a general survey of the physical characteristics and importance of the Nile Delta region of Egypt and of the vulnerability to potential impacts of climate change. The relatively low land elevation, increasing soil salinity due to salt water intrusion and the low resilience of the communities makes this region highly vulnerable to potential impacts of climate change. A vulnerability assessment based on a mapping of hot spots using remote sensing and GIS technologies is introduced. The main objective is to identify and quantify potential biophysical and socio-economic losses according to various sea-level scenarios taking into consideration the well known delta subsidence rates. Results indicate high risks of direct inundation, salt water intrusion and socio-economic losses and call for proactive integrated planning for development of the coastal zone. The shortage of institutional capabilities, weak law enforcement and low population awareness are additional pressures that need to be addressed.

The large scale implications of climate change impacts on all sectors of human development have been well recognized by most countries and research institutions (e.g. IPCC 2007; Stern 2006; chap. 79 by Parry/Canziani/Palutikof/Hanson). Impacts vary over a wide range of induced changes of the ecosystems. Melting of polar caps, sea-level rise and increase of the intensity and frequency of extreme weather events and their biophysical and socio-economic implications are only few examples. Climatic changes cause a disaster for the global economy and human well-being, however, with some kind of early warning.

According to the studies assessed by the *Intergovernmental Panel on Climate Change* (IPCC), it was realized that human activities have led to a rise in the average earth's temperature by 0.74 degrees C since the late 1800's. It is projected to increase by another 2.0 °C to 4 °C by the year 2100. This rapid and continuous rise in the earth's average temperature has been traced to the increase in greenhouse gases in the earth's atmosphere. This rapid increase of the mean average global temperatures has actually been well observed and is expected to continue for several decades with high levels of certainty. In addition, the increase of temperature is expected to lead to a melting of a large portion of the polar cap as well as a huge expansion of deep ocean water. A world wide sea-level rise between 18 and 59 cm was projected by IPCC (2007) by the end of the present century. According to the synthesis report of the *Copenhagen Scientific Climate Conference* (2009: 10), "new estimates suggest a sea-level rise of around a metre or more by 2100."[1]

The continuous increase of temperature is expected to lead to changes of precipitation levels, which will then lead to shortages of water availability, deterioration of agricultural productivity and loss of coastal sustainability. Global circulation models have been trying to predict expected climatic conditions with reasonable certainty to warrant decisions.

The potential impact of sea-level rise over low elevation deltaic and coastal areas is expected to be very serious and includes direct and indirect inundation of beaches as well as salt water intrusion which is expected to lead to long range damage to urban systems as well as changes of agricultural productivity and public health. It is also predicted that the increases of

1 See: "Climate Change: Global Risks, Challenges and Decisions", Copenhagen 10–12 March 2009. All sessions. IOP Conference Series: Earth and Environmental Series; at:<http://www.iop.org/EJ/volume/1755-1315/6>; See: *Synthesis Report* by Katherine Richardson, Will Steffen, Hans Joachim Schellnhuber, Joseph Alcamo, Terry Barker, Daniel M. Kammen, Rik Leemans, Diana Liverman, Mohan Munasinghe, Balgis Osman-Elasha, Nicholas Stern, Ole WÊve: *Climate Change: Global Risks, Challenges & Decisions,* Copenhagen 2009, 10–12 March; at: <http://climatecongress.ku.dk/pdf/synthesisreport>.

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_45, © Springer-Verlag Berlin Heidelberg 2011

Figure 45.1: NASA Modis satellite image of Egypt, the Nile Delta and the Sinai Peninsula, 29 February 2000. **Source:** NASA Visible Earth. This image is in the public domain; at: **<**www.parstimes.com/spaceimages/nile_delta_2000.jpg**>**.

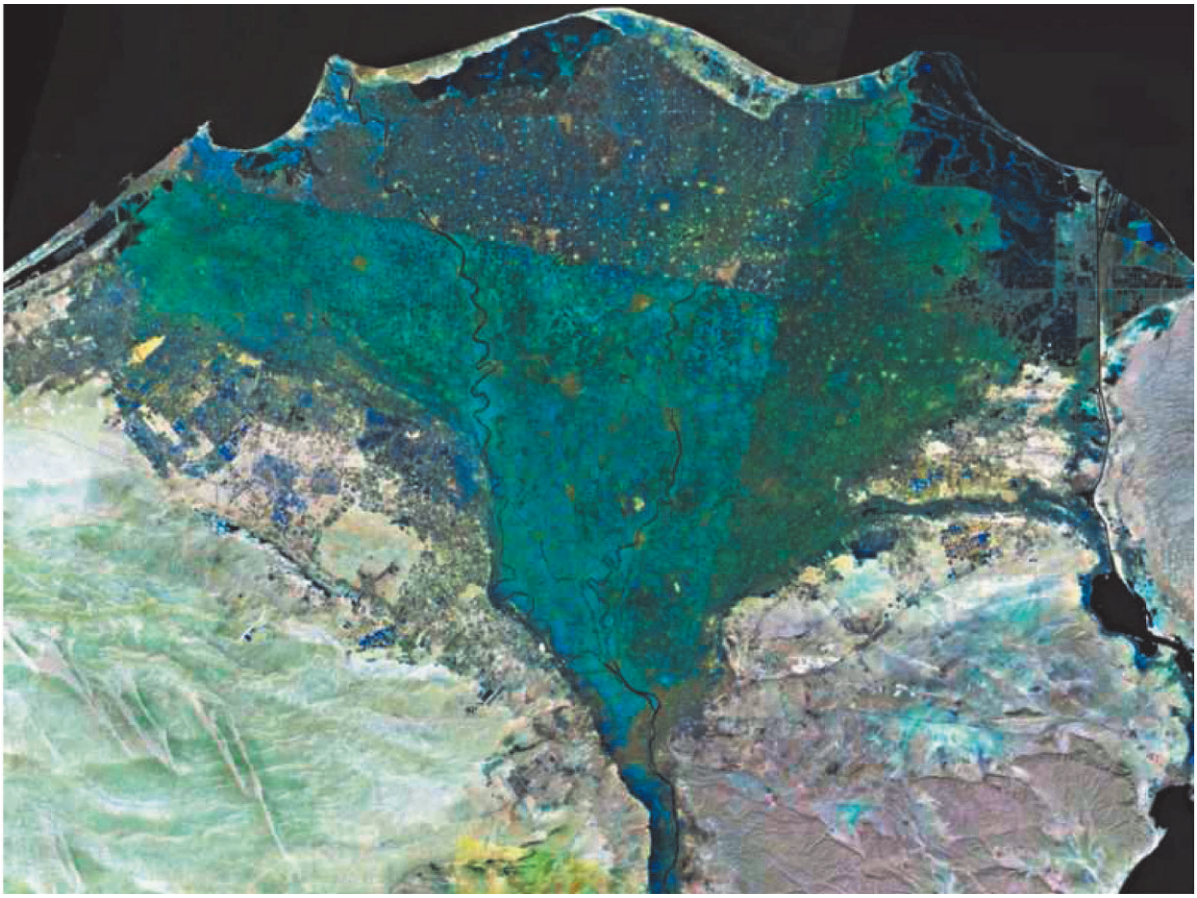
mean average temperatures will be associated with an increase of the intensity and frequency of extreme events such as dust storms, sand storms, heat waves and flash floods. The damage caused by the increase of intensities and frequencies of extreme events will also include agricultural productivity, maritime transport, and damages to property and health.

Egypt is characterized by an arid to semi-arid environment and low community resilience represented by limited water resources and technical capacity. The high population growth rate and the rapid spread of unplanned urbanization are main causes of concern due to the resultant increase in air and water pollution. The rise in temperature is expected to further exacerbate the dearth in water resources, increase the pressure on land resources and lead to a rise in the severity of sand and dust storms. The increased usage of fertilizers and pesticides is also expected to increase the rates of water and food pollution (figure 45.1).

The Nile Delta is 200 km long and 255 km wide, within a coastline of over 1000 km on the Mediterranean Sea. The low sandy coast of the Nile Delta stretches with an arc between Ras Abu Quir to the west and the Bay of Tinah, to the east (figures 45.1 and 45.2). Two branches of the Nile have formed the promontories at Rosetta and Damietta. Egypt's second largest city, Alexandria is located on the northwestern part of the coastal delta zone, with a population of 3.3 million in 1996, and more than 4.1 million in 2006 (CAPMAS 2006 census). Alexandria is the main harbour of Egypt and hosts around 40 per cent of the country's industrial capacity, in addition to being an important summer resort and trading centre. Other large cities in the northern, low-lying delta zone include the rapidly growing city of Damietta and the historic city of Rosetta and Port Said City to the eastern side of the delta.

The northern Egyptian lagoons are among the most productive natural systems in Egypt and they are internationally renowned for their abundant bird life.

Figure 45.2: Satellite Image of Nile Delta. **Source:** Landsat 7 false colour image of the Nile Delta; this image by NASA is in the public domain; at: <http://commons.wikimedia.org/wiki/File:Nile_delta_landsat_false_color.jpg>.



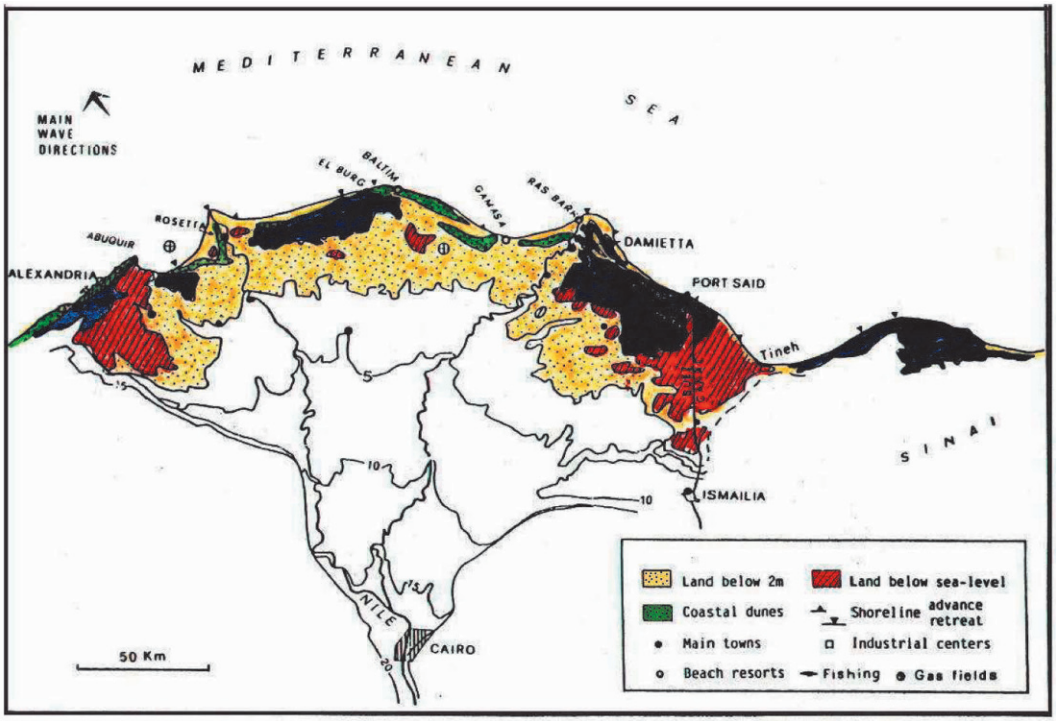
These northern lakes constitute about 25 per cent of the total Mediterranean wetlands and are responsible for the production of over 60 per cent of the fish catch of the country. Since the lakes are relatively shallow, climate change can lead to an increase in water temperature, which could result in changes in the lake ecosystems as well as changes in its yield.

Tourism, industry, agriculture and service sectors are significant contributors to Egypt's economy. Tourism currently represents 11.3 per cent of GDP, 40 per cent of the total of Egypt's non-commodity exports and 19.3 per cent of Egypt's foreign currency revenues. The industrial sector's contribution to the GDP in 2006/07 was around 17.2 per cent. The agriculture sector accounts for roughly 14.8 per cent of the GDP. Agriculture contributes about 30 per cent to Egypt's commodity exports, which makes it a major revenue-generator. Of Egypt's overall labour force, 30 per cent works in the agricultural sector, mostly in the Nile Delta (Egypt Initial National Communication 1999).

Economic conditions in Egypt have improved considerably over the years. In 1990–1991, the real GDP growth rate was 3.7 per cent. By the end of fiscal year of 1998, the growth rate reached 5 per cent, fuelled primarily by private sector investments through a continued rapid privatization and institution-building. Results of the economic and financial performance indicated a great improvement during FY 2006/2007 and first quarter of FY 2007–2008. Egypt's economy achieved a growth rate of 7.1 per cent, which is the highest growth rate in the preceding 10-year period. However, despite these patterns, the failure to raise living standards for the average Egyptian has led to continued government subsidies for basic needs and, consequently, a sizeable budget deficit of roughly 7 per cent of GDP in 2007–2008.

Egypt's Human Development Report (UNDP 2004b) reports a positive response to concerted efforts by the GOE to reduce two major gaps: 1) the gender gap, and 2) the gap between Lower and Upper Egypt. The gender gap reduction is clearly reflected in

Figure 45.3: Contour map of the Nile delta region indicating areas of the delta below sea-level (in red), the 2m contour and below in yellow. **Source:** Sestini (1991) with modifications by El Raey.



improvements in the education index; however, deficits in political empowerment and in economic participation still persist. The gap in the Human Development Index (HDI) values between Lower Egypt and Upper Egypt remains large but has also started to narrow during the last decade.

The objective of this chapter is to survey the methodology used to map vulnerable areas and to assess the potential impacts of sea-level rise and to present results an estimate of the costs of the impacts of the projected sea-level rise based on several scenarios. It identifies gaps of our knowledge and responds to questions on future needs for upgrading institutional capabilities, integrating monitoring and research efforts, transferring technologies and upgrading community resilience.[2]

45.2 The Nile Delta Region

The Nile delta region is fairly unique in the distribution of its population, topography, land-use, agricultural productivity and economic activities, which makes it extremely vulnerable to any potential impacts on its water resources and coastal zone. The River Nile supplies 95 per cent of the country's total water needs, including water intensive irrigated agricultural land along its banks and the delta. Agriculture is quite critical to the national economy as it employs 30 per cent of the work force and contributes 17 per cent to the GNP (IDSC 2009). Major urban centres, commerce, and industrial activities are also confined to the narrow corridor along the Nile and the coast around its delta. The rest of the country (about 95 per cent) is desert and does not support much population or economic activity (figure 45.3).

The Nile Delta region lies within the temperature zone, which is a part of the great desert belt. The average temperatures in January and July in Cairo are 12 °C and 31 °C, respecttively. Minimum and maximum temperatures in Cairo are 3 °C and 48 °C, respectively. Rainfall over the Nile Delta is rare and occurs in winter. Maximum average rainfall along the Mediterranean Sea shore, where most of the rain occurs, is about 180 mm. This amount decreases very

2 For additional publications of this author on this topic see i.a., Agrawala, Moehner, El Raey, Conway, van Aalst, Hagenstad and Smith (2004); El Raey (1991, 1993, 1994, 2000); El Raey, Ahmed and Korany (1997); El Raey, Frihy, Nasr and Dewidar (1998, 1999); El Raey, Nasr, Frihy, Desouki and Dewidar (1995); El Raey, Ahmed and Korany (1997); El Raey, Nasr, Frihy, Fouda, El Hattab, Elbadawy, Shalaby and Mohamed (2005)

Table 45.1: Population and rates of population growth of major coastal cities of the Nile delta. **Source:** Human Development Report (UNDP 2005).

	Population (thousands)			Annual population growth rate		
	1986	1996	2003	1960/86	1986/96	1996/03
Alexandria	2 927	3 339.1	3 755.9		1.3	1.7
Port Said	401	472.3	529.7	1.9	1.6	1.7
Suez	328	417.5	478.6	1.8	2.5	2.0
Damietta	740	913.6	1 056.4	2.5	2.1	2.1
Egypt	48 254	59 116.8	68 648.0	2.4	2.1	2.2

rapidly inland to about 26 mm in Cairo (Sherif/Al Rashed 2001). The Nile delta region is the most fertile land of Egypt which depends mainly on water that reaches the region through the River Nile with resources on the Ethiopian hills and Lake Victoria some several thousand kilometres to the south (Sestini 1991; Adly/Ahmed 2009; Kameri-Mbote/Kindiki 2009).

The Nile delta coast stretches about 300 km and hosts a number of highly populated deltaic cities such as Alexandria, Port-Said, Rosetta, and Damietta. These cities are also critical centres of industrial and economic activity. In addition, the Nile delta coastal zone includes a large portion of the most fertile low land of Egypt. The topography is generally sloping from the apex at Cairo to the Mediterranean coast at a rate of about 1 m/km with varying sand dunes, ridges and low elevation areas near the coast. The coastal zone of Egypt hosts five northern lakes which constitute about 25 per cent of the wetland of the Mediterranean and are considered main sanctuaries for birds and fish resources.

45.2.1 Population

The population of Egypt has grown 2.0 per cent per year for the past 10 years reaching 72.6 million according to the 2006 census. The growth rate was about 2.1 per cent during the previous decade. In the period from 1976 to 1986 growth reached 2.8 per cent a year. Population growth in urban areas was 22.4 per cent over a decade, only slightly above 22.2 per cent for the growth in rural areas, where 58 per cent of Egyptians still live. Emigration helped to hold down the rate of population growth at home. According to the 2006 census, 3.9 million Egyptians are living abroad. With the Egyptians abroad and those living in Egypt the total population is 76.5 million people, compared with 61.5 million in 1996. The percentage of illiterates among Egyptians aged 10 or older had fallen to 29.3 per cent, from 39.4 per cent in 1996 (CAPMAS 2006).[3]

45.2.2 Land Use

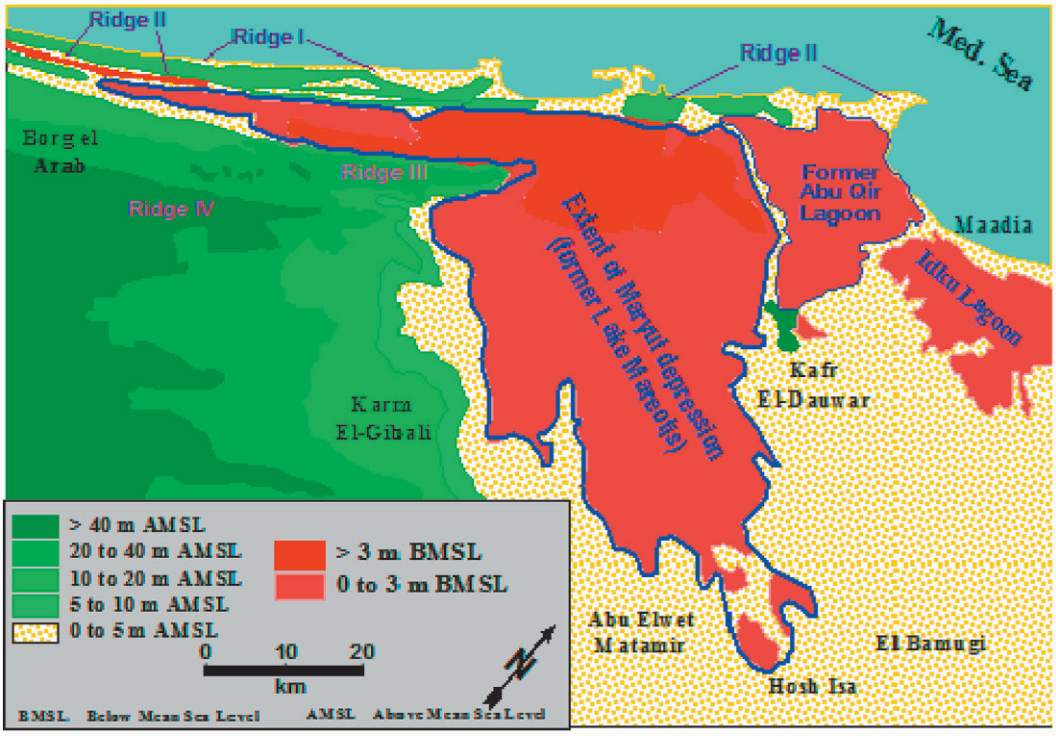
Unplanned urbanization in many coastal and non-coastal cities has been responsible for the creation and expansion of slum areas around major cities. In the absence of strong institutional systems for monitoring, assessment and enforcement of land use regulations, land use plans are not expected to be fulfilled and strong interference of land use is well observed in major coastal cities such as Alexandria, Damietta and Port Said. In fact, most of the land located below sea-level rise is fully occupied by urban settlements, industries and agricultural land.

45.2.3 Topography

The topography of the delta varies from about 200 m elevation at Cairo at the apex of the delta to near zero on the Mediterranean some 200 kilometers to the north. The northern region of the delta hosts several important lakes such as Lake Maryut, Lake Edku, Lake Brullus and Lake Manzala. The wet lands of northern Egypt constitute about 25 per cent of the total wetland of the Mediterranean and provide over 66 per cent of the fish catch of the country. The topography of the northern coast is highly variable. Figure 45.4 shows the major part of the area below sea-level to the south eastern part of Alexandria near Abu Qir Bay. The Mohamed Ali Sea wall with a length of 10 km that was built over 200 years ago protects the low land area from inundation from the water of the Abu Qir Bay.

3 The estimates of Egypt's population and population density (1950–2050) by the Population Division of the UN are accessible at: <http://esa.un.org/unpp>.

Figure 45.4: The topography of the area to the east of Alexandria City indicating areas below sea-level (in red). **Source:** US Defence Mapping Agency (1961, 1973, 1975, 1977).



45.2.4 Subsidence

The eastern part of Lake Manzala (Port Said and the northern part of the Suez Canal) appears to subside at a rate of 4.5 mm yr-1 (Stanley/Warne 1993), faster than any other region along the Nile Delta coast. The *sea-level rise* (SLR) is expected to cause a landward shift of the salt wedge and to increase the rate of saline seepage to the topsoil of the delta. This may have serious impacts on agriculture and drainage conditions, and potentially on available groundwater resources in the upper Nile Delta. Accelerated SLR will enhance the increase in salinity. Combined with the notion that it is unlikely that the lake will expand inland (as protection measures will be taken), this leads to the general prediction that shallow wetland areas will decrease and that the reed beds will become less abundant (due to higher salinity).

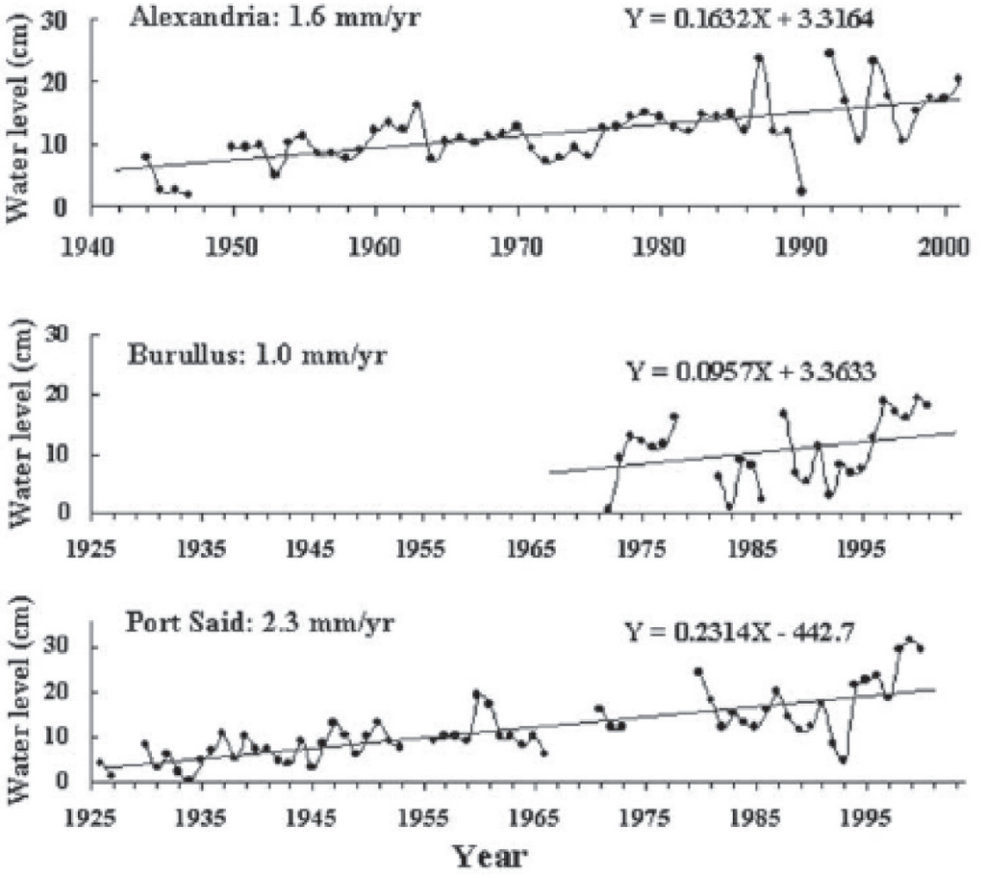
45.2.5 Beach Erosion

The projections of the Nile Delta promontories Rosetta and Damietta are currently undergoing extensive change due to both natural and anthropogenic pressures. The highest rate of erosion occurs along the outer margins of these promontories. This erosion is a result of the combined effects of the cut-off of the River Nile sediment discharge by the Aswan High Dam and prevailing coastal processes. Erosion along the tip of the Damietta promontory has adversely affected homes and condominiums to the east at Ras El Bar, and it has destroyed the old coastal road from Damietta to Port Said and the lighthouse west of the river (Frihy/El Raey/Dewidar 1996). However, a number of protective structures have been constructed by the Egyptian authorities along this projection to reduce shoaling in the river entrance. The *sea-level rise* (SLR) is expected to enhance the rates of erosion.

45.2.6 Pollution

The western and southern sectors of Lake Manzala are supplied by drainage water from 7 main sources. Water from these drains enriches the lake with nutrients, including phosphate, nitrate, and silicate. In addition, some of these drains discharge considerable amounts of sewage and industrial wastes directly into the lake. The Ginka sub basin in the south-eastern sector of the lake is identified as a 'black spot'. SLR is

Figure 45.5: Water level variation at three Nile delta coastal locations indicating land subsidence. **Source**: Frihy (2003: 125) reproduced with permission of the author.



expected to enhance diffusion in the coastal area and magnify the adverse effects of this pollution.

45.2.7 Resilience

The risk associated with the SLR is related to hazard, vulnerability and resilience through:

Risk = Hazard x Vulnerability/Resilience of the community

It is quite clear that to reduce the risks of SLR, it is necessary to upgrade the low resilience of the population in the region. The resilience of the coastal community in the Nile delta region is considered very low not only because of the low education and awareness but also because of the shortage of institutional capabilities and low infrastructure in the region. The vulnerable community consists mostly of farmers, fishermen and industrial workers. The increasing rates of unemployment and low awareness increase the problem further.

45.3 Climate Change and Sea-Level Rise

There are conflicting projections of the future availability of the water of the Nile as a result of climate change. Yates and Strzepek (1998), using a monthly water balance model, reported that five of six *global circulation models* (GCMs) showed for doubled CO_2 levels increased flows at Aswan, with increases of as much as 137 per cent (UKMO). Only one GCM (GFDLT) showed a decline in annual discharge at Aswan (-15 per cent). The variations of the results indicate that more robust studies are needed to provide a more solid base for the design of public policy. However, the more plausible projections seem to point to a reduced availability of Nile water for Egypt in the future. In addition, Elshamy, Seierstad and Sorteberg (2009) confirmed this strong uncertainty using 17 IPCC models. This global sea-level rise combined with local land subsidence in many coastal areas, are expected to cause serious damage to many coastal ec-

Figure 45.6: A time series of satellite overlapped images of the north-western Nile delta coast with the Rosetta promontory over the period 1972-1991 indicating changes of the erosion pattern of the region. **Source:** El-Raey, Nasr, El-Hattab and Frihy (1995) based on Landsat MSS data for 1972, 1976, 1977, 1978, 1983, 1985 and 1991.

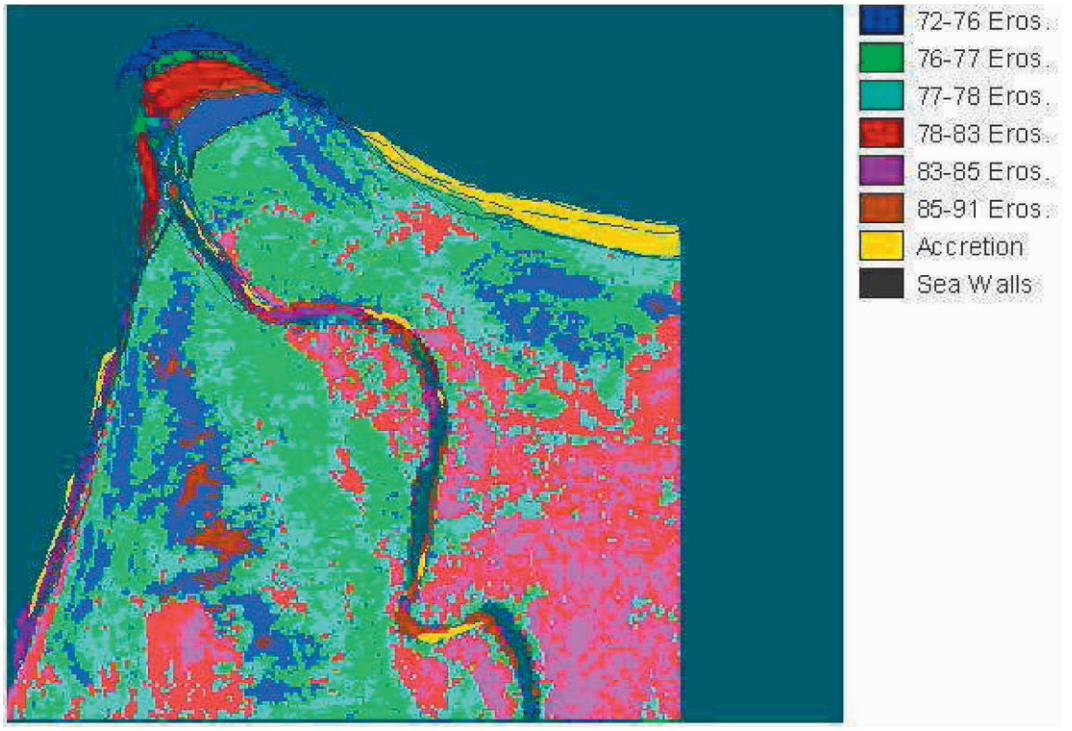
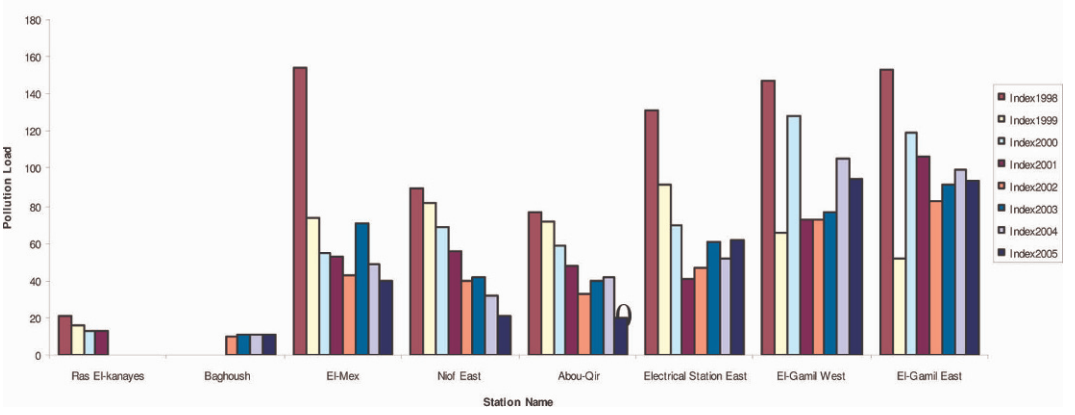


Figure 45.7: Pollution along the hotspots of the Mediterranean coast. **Source**: El Raey, Nasr, Frihy, Fouda, El Hattab, Elbadawy, Shalaby and Mohamed (2005).



osystems especially those of the low land deltaic coasts such as that of the Nile Delta in Egypt.

An overview of uncertainties of climate changes associated with the River Nile is presented in chap. 44 by Buontempo, Lørup, Sanderson, Butts, Palin, McCarthy, Jones, Betts and Antar.

45.3.1 Impacts of Sea-Level Rise on the Nile Delta

The impact of SLR on the Nile Delta can be divided into direct impacts of inundation and salt water intrusion and indirect impacts of loss of productivity, excessive soil salinity, health impacts and socio-economic implications.

45.3.1.1 Direct Impacts on Low Elevation Land in Cities

The IPCC's (1995) *second assessment report* (SAR) has adopted a seven step common methodology for estimating vulnerabilities to sea-level rise which could be summarized as:

1. Choose a case study area and specify climate change boundary conditions;
2. Characterize a case study area (physical, socio-economic);
3. Identify key vulnerabilities (tourism, oil sector development, etc.);
4. Assess physical changes and natural system responses;
5. Formulate response strategies;
6. Assess vulnerability and interpret results;
7. Identify needs and actions.

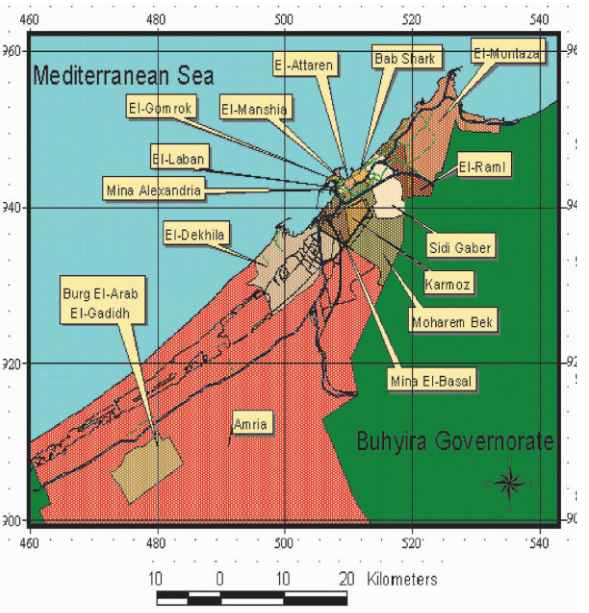
However, the IPCC's (2001, 2001a, 2001b, 2001c) *third assessment report* (TAR) suggested an expanded framework, based on the work of Klein and Nicholls (1999) as well as of Nicholls and Mimura (1998) for sea-level rise assessment that also examines resilience, resistance and adaptation aspects within linkages between natural and socio-economic systems.

45.3.1.2 Methodology of the Assessment

The methodology used by this author's team for estimating the potential impact of sea-level rise is based on using satellite images and GIS and can be summarized as follows for each scenario of sea-level rise:

1. Selecting and characterizing the study area and identifying key vulnerabilities;
2. Carrying out land-use classification of satellite images of the region identifying land cover and land use to the best accuracy available; and building a geographic information system of layers of land cover and land use and population distribution;
3. Building up a *digital elevation model* (DEM) based on the available topographic data on the area with a resolution of 1.0 m or better;
4. Registering and overlaying classified images to the DEM identifying vulnerable areas below the pre-assigned scenario;
5. Extrapolating population growth and distribution in these areas based on the maps;
6. Estimating loss of jobs based on distribution of the work force among sectors for each district; and
7. Identifying options of adaptation and policies and measures for protection and adaptation.

Figure 45.8: A map of Alexandria districts and Lake Maryut. The water surface of the lake is kept at 2.8m below sea-level by a set of pumping stations at El Mex. **Source:** This official map is in the public domain.



(a) Alexandria sub-districts

The output of this process depends on the resolution of the satellite image, the accuracy of available topographic data and the accuracy of the estimated distribution of the work force. The availability of higher resolution satellite imagery and more accurate topographic data will definitely contribute to a better accuracy of estimated impacts. The methodology was applied for several coastal cities, however, in this chapter the case of Alexandria will be considered in somewhat more detail.

45.3.1.3 Alexandria City

Alexandria city is located to the west of the Rosetta branch of the River Nile and is famous for its beaches as well as for its historic and archaeological sites. It has a population of about four million and hosts the largest harbour in the country as well as roughly 40 per cent of the Egyptian industrial activities. During summer, the city attracts over a million tourists. The extension of the city to the south is impeded by the existence of a large water body: Lake Maryut (figure 45.8). The water level in Lake Maryut is kept at 2.8 m below the sea-level through continuous pumping of water into the Mediterranean through the El Mex pumping station.

Figure 45.9: The main topographic features of Alexandria City indicating major ridges or hills (in dark black) and tunnels in between. **Source:** Abdel Hakim, Sobhy (1958); Alexandria City (Alexandria Library 1958).

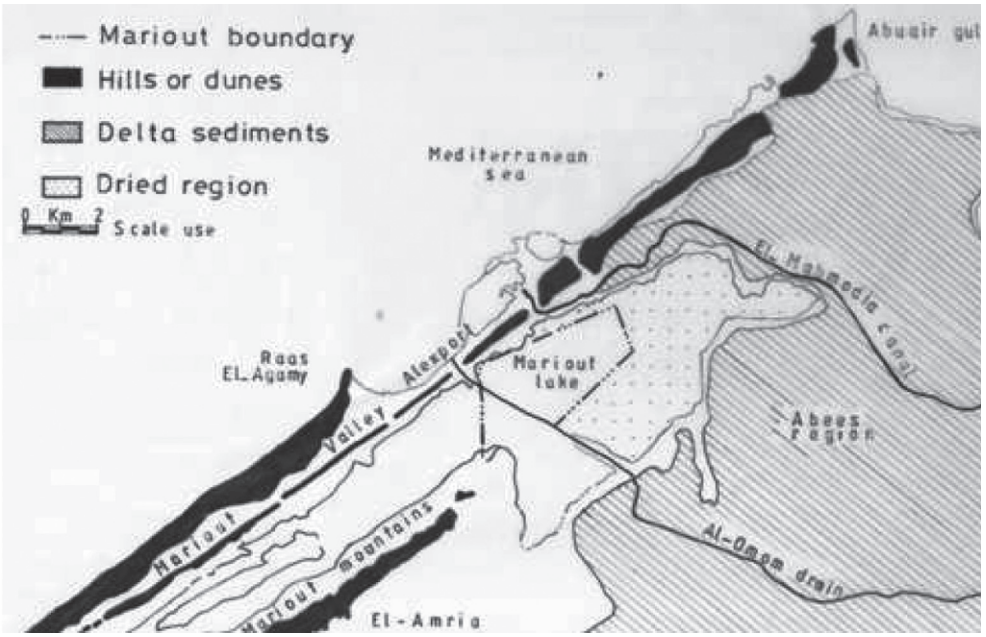
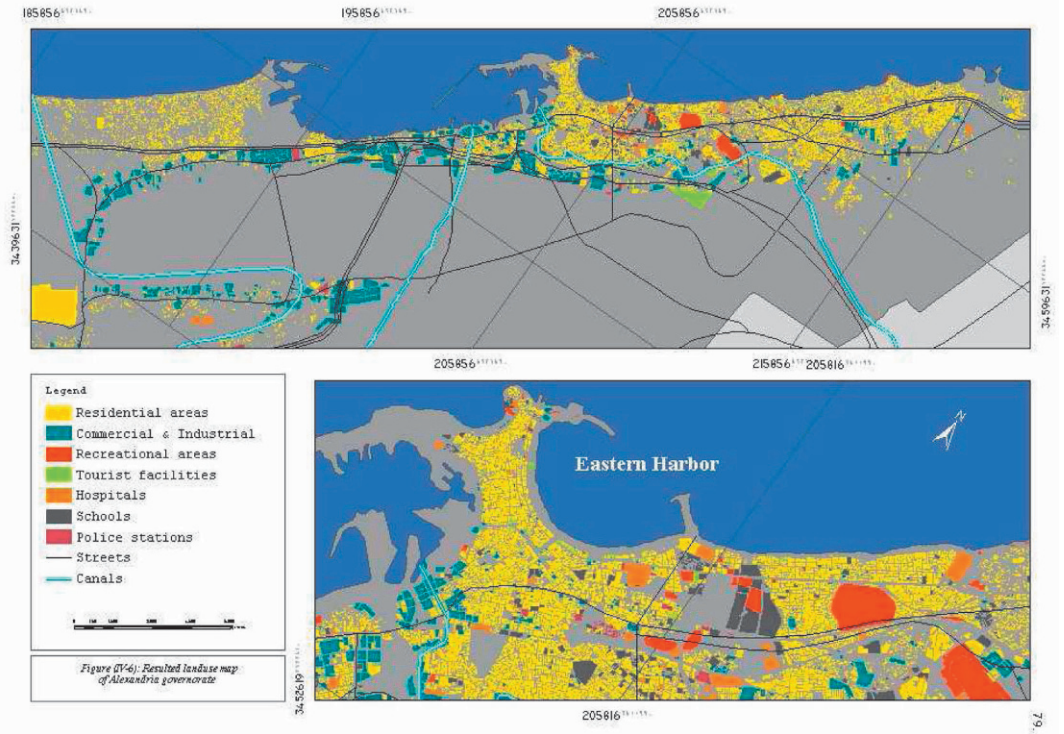
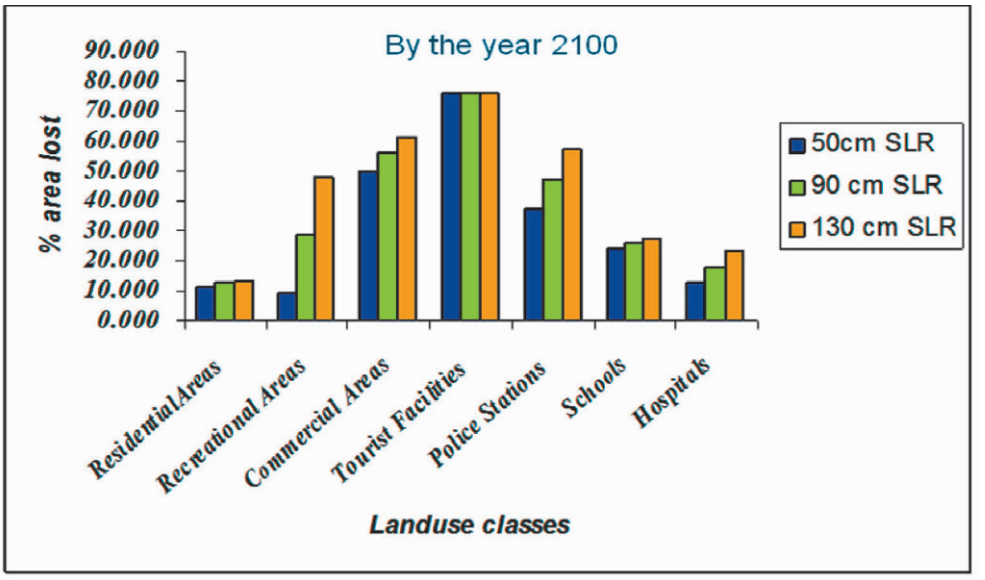


Figure 45.10: Land cover and land use of Alexandria City as observed based on an analysis of satellite images. **Source:** Al Hosaini (2006).



In order to assess the impacts of sea-level rise on Alexandria, a *Geographic Information System* (GIS) was created using the ARC/INFO environment. The GIS included land use layers as obtained from satellite images, a *digital elevation model* (DEM) and extrapolated data on population distribution. To assess the impacts from *sea-level rise* (SLR), a number of scenarios were assumed over the century (0.25, 0.5,

Figure 45.11: Percentage land-use to be affected by scenarios of sea-level rise in Alexandria. **Source:** Al Hosaini (2006).



1.0 m), taking land subsidence (2.0 mm/a) into consideration. Then, the percentage of the population and land use areas at risk for each scenario level were identified and quantified by the GIS analysis.

The outcomes for each SLR scenario in case of a 'business as usual' have been extrapolated to assess the potential loss of employment for each sector for the years 2010, 2025 and 2050, if no action is taken. Analyses of the results indicate that for a SLR of 0.5 m a sizable fraction of the low land inside the city will be inundated unless actions are taken for protection. It will lead to the loss of a number of touristic beaches and flooding of some agricultural and industrial areas. Also, over 1.5 million people will have to be relocated. Other expected losses include 195,000 jobs as well as land, properties and revenues in the range of US$ 30 billion. The loss of the cultural heritage is not being accounted for. These results are based upon an extrapolation of current national statistics, and are only intended as estimates of an order of magnitude. The results in table 45.2 indicate that the most severely affected employment sector will be industry, followed by tourism and agriculture. Fortunately, Alexandria Corniche was built for the purpose of better traffic flow which helped at the same time to protect a major part of the city from the potential impacts of SLR.

Table 45.2: Results of estimation of the impact of sea-level rise over Alexandria based on a scenario of SLR, if no action is taken. **Source:** El Raey, Fouda and Nasr (1997).

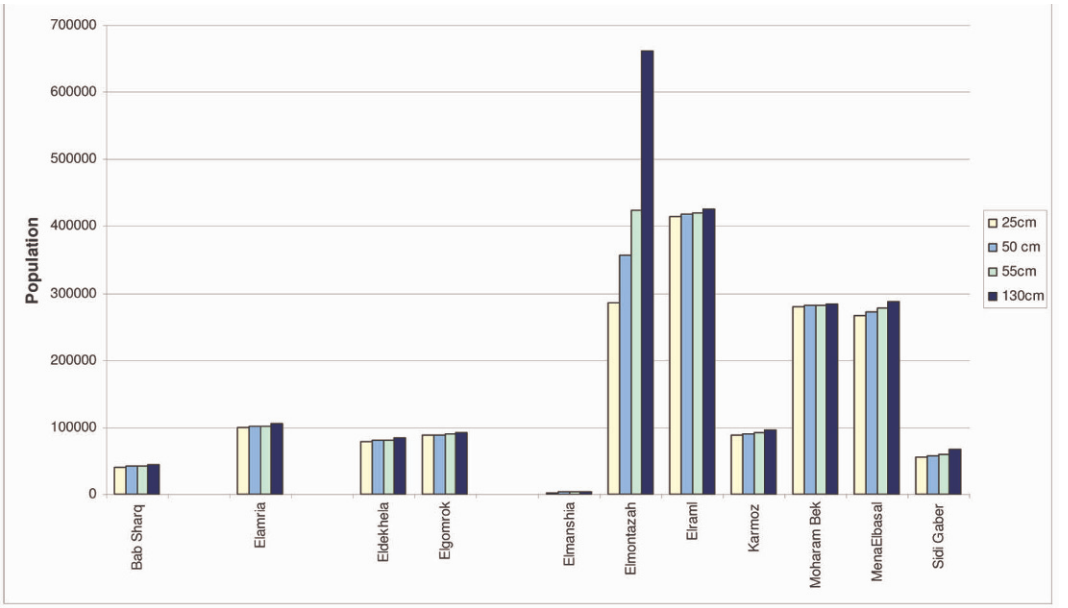
Year / Sector	**Year 2010 SLR = 18 cm**	**Year 2025 SLR= 30 cm**	**Year2050 SLR= 50 cm**
Area loss (km^2)	1.14	19.0	31.7
Population displaced x 1000	252	545	1.512
Loss of employment			
a- Agriculture	1.370	3.205	8.812
b-Tourism	5.737	12.323	33.919
c- Industry	24.400	54.936	151.200
Total loss of Employment	32.507	70.465	195.443

45.3.1.4 Rosetta City and Region

Rosetta city is a well-known Pharaonic and Islamic city located near the intersection of the Rosetta branch of the River Nile with the Mediterranean Sea east of Alexandria. Excessive erosion rates have been observed near the Rosetta promontory, due to the cessation of sediments following the building of the High Dam on the River Nile about 1000 km to the south. The region surrounding the city is well known for its water-logging and water-bogging problems.

Similar to Alexandria, a quantitative vulnerability assessment of the potential impacts of sea-level rise has also been carried out for Rosetta (El Raey/Dewidar/El-Hattab 1999: El Raey/Fouda/Gal 2000). For a sea-level rise of 0.5 m, the study estimated the loss of about one-third of its employment as well as the loss of US$ 2.9 billion (value of 1990) from land and property. As in the Alexandria study, the loss of

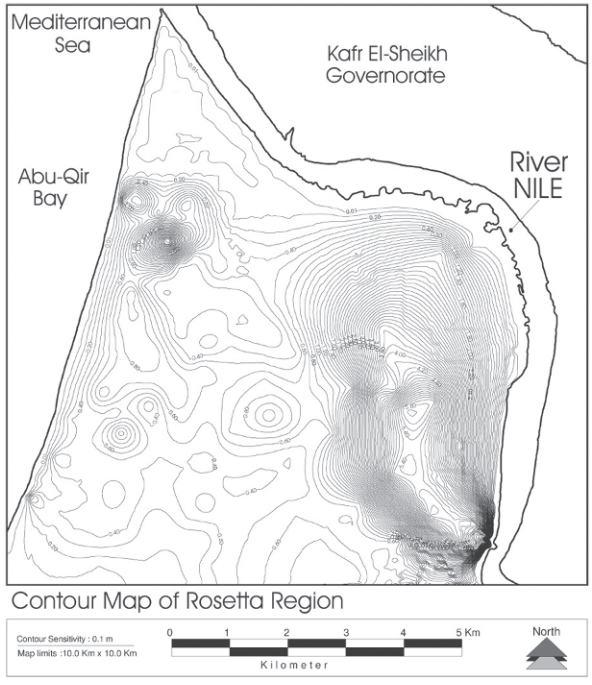
Figure 45.12: Loss of employment in each district of Alexandria City by various scenarios of sea-level rise. **Source:** Al Hosaini (2006).



historic and archaeological sites is unaccounted for. In addition, erosion problems are expected to be exacerbated by sea-level rise. So far, the Government has built a massive sea wall near the tip of the promontory as a protective measure against already existing erosion problems. However, recent observations indicate that this massive hard structure is seriously challenged by coastal erosion. Periodic beach nourishment may be a possible solution. However, plans for the development of the area should consider an approach in which decision-making is based on a detailed assessment of future conditions taking into consideration potential impacts of sea level rise.

A rise of 50 cm in the water level will result in a gradual loss of large coastal areas and a destruction of a large portion of Rosetta's historic Islamic heritage as well as flooding of a large portion of the agricultural land adjacent to the coast and the loss of 30,000 future employment opportunities (figure 45.13).

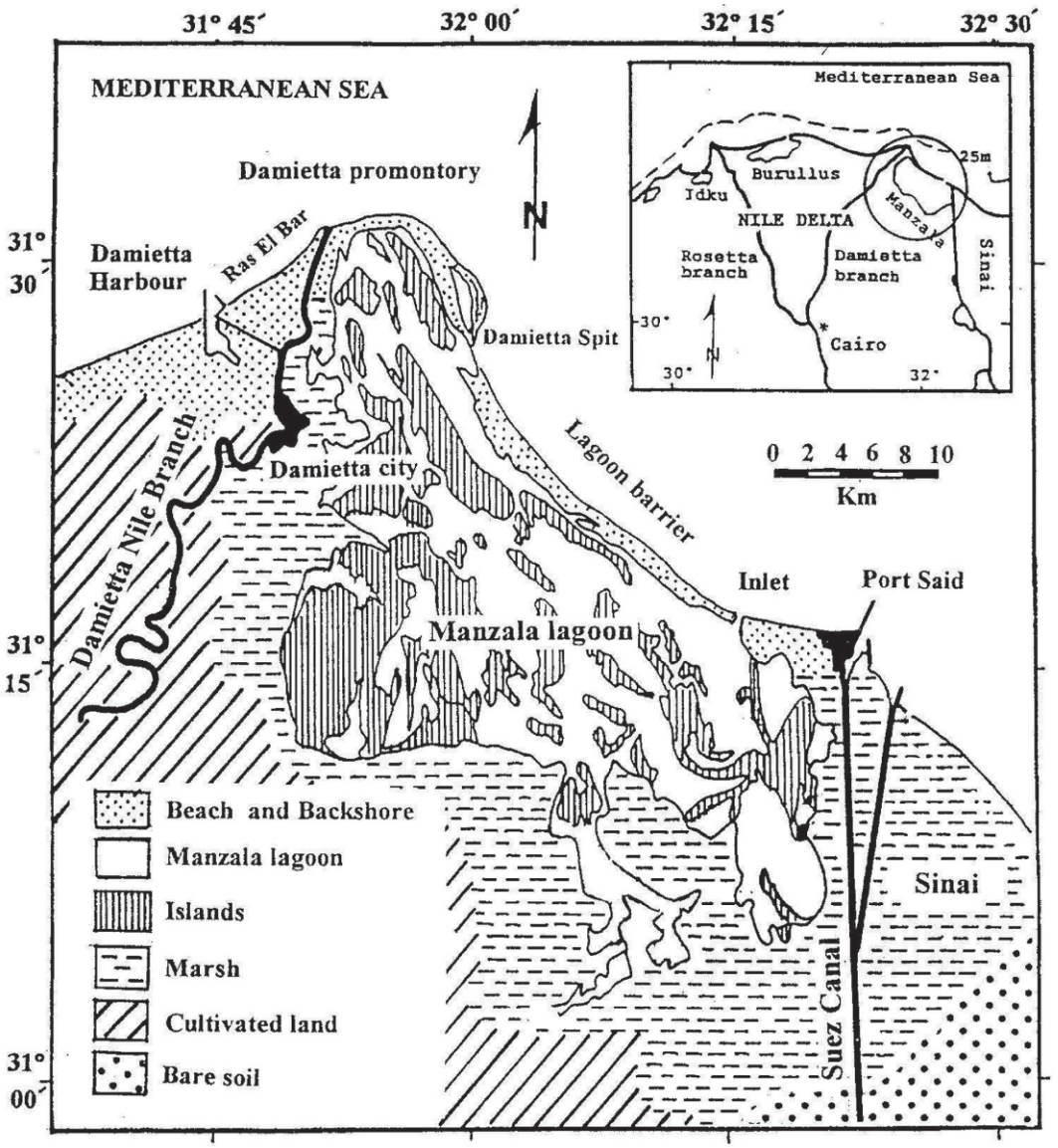
Figure 45.13: Contour maps of the coastal area including Rosetta City indicating high elevation areas where the old city was built on. Natural urban growth is progressing on adjacent the low land area. **Source:** El Raey, Fouda and Gal (2000).



45.3.1.5 Port Said

Port Said is located on the Mediterranean Sea east of the Damietta branch of the River Nile at the entrance or exit of the Suez Canal. In addition to its strategic position, it is the second largest tourist and trade centre of Egypt on the Mediterranean. Lake Manzala, the largest of the Nile delta lakes, is located just to the west of the city and receives a sizable amount of effluent pollution from various sources. Port Said Governorate has a total area of 1,851 km^2 and is divided into five districts: El Shark, El Monakh, El Arab, El Dawahi, and Port Fouad. The coastal zone of Port

Figure 45.14: The location of the city of Port Said on the tip of Suez Canal, surrounded by water bodies and indicating high vulnerability of the city to potential impacts of sea-level rise. **Source:** Sestini (1991: 547).

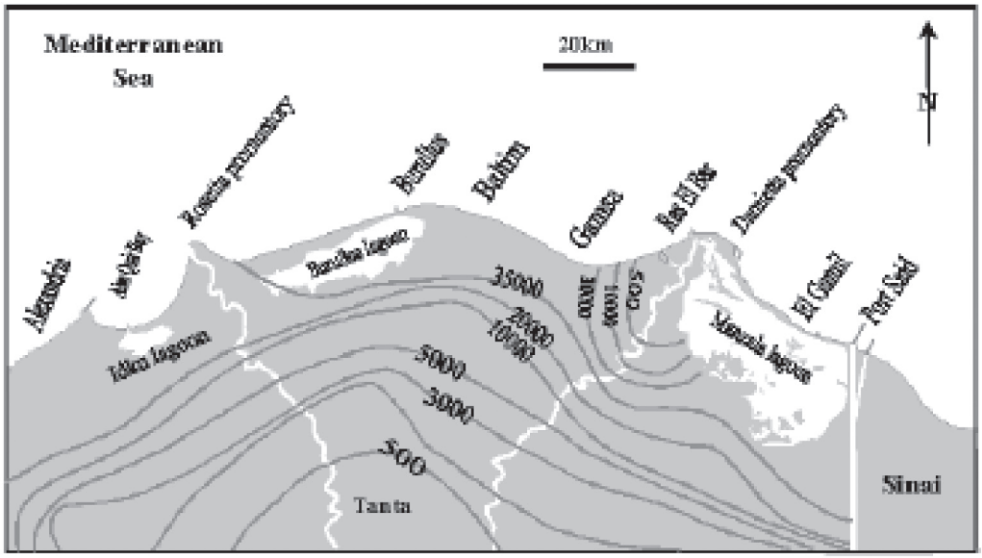


Said is critically important for tourism, which is primarily oriented at beach activities. Most tourism facilities are located within 200–300 metres of the coastline. Besides, there are important archaeological sites along the northern part of the Suez Canal.

The vulnerability of Port Said to sea-level rise is particularly high given the socio-economic importance of its coastline and the fact that it has one of the highest rates of local land subsidence in the Nile Delta (3.5 mm/a), which amplifies the effects of climate change induced sea-level rise. Sea-level rise is expected to cause a landward shift of the salt wedge and increase the rate of saline seepage in the top soil, which may have potentially serious implications for agriculture and drainage conditions as well as available groundwater resources in the upper Nile Delta. Large areas close to the coast near the Suez Canal will be lost if protection measures are not undertaken.

Changes in the salinity of the Lake Manzala may impact on the lake's ecology and fisheries. Further, given that the lake is unlikely to migrate inland, sea-level rise will lead to a decline in shallow wetland areas and less abundant reed beds. The most severely impacted sectors are expected to be industry (12.5 per cent) and transportation (11.7 per cent). In case of a SLR of 0.5 m, a loss of 6,700 jobs (5.3 per cent of the

Figure 45.15: Distribution of groundwater salinity in ppm in the Nile delta region in the year 2000. **Source:** Gaamea (2000) cited in Frihy (2003).



total work force) is expected. In terms of economic losses, the loss of beaches is likely to outweigh losses in other areas, given their high value for tourism. In addition, there are again no assessments to value the loss of historical sites.

It should be noted here that Alexandria, Rosetta and Port Said are not the only vulnerable areas along the coastal zone of Egypt. Beaches and tourist sites at other cities on the Mediterranean such as Matruh City to the west of the delta and Arish City to the east are also vulnerable to a rise of the sea-level. Water-logging and water bogging problems in low lying areas close to the coast have already emerged in many localities. Sand dune movement in the coastal zone is also expected to be more severe in the future. So far, declines in land productivity in the Nile delta region resulting from salt water intrusion as well as declines in fish catch resulting from ecosystem changes in the northern lakes have not been accurately estimated. Besides, the continuous degradation of coral reefs along the coasts of the Red Sea would severely impact biodiversity, fish catch and tourism in that region. The socio-economic impacts associated with these changes are far reaching and include migration, unemployment and possibly political unrest.

45.3.2 Direct Impacts of Salt Water Intrusion

The Nile Delta aquifer system is a complex groundwater system. It is a leaky one, with an upper semi-permeable boundary and lower impermeable boundary. The aquifer is recharged by the infiltration from the irrigation net work, excess of irrigation water and little precipitation through the upper clay layer. It may also be recharged by any possible flow coming from the Upper Egypt aquifer. The increase in demand in the Delta area was covered by intensive pumping of fresh groundwater, causing subsequent lowering of the piezometric head and upsetting the dynamic balance between the freshwater body and saline water body in the aquifer. Like any coastal aquifer, an extensive saltwater flux has intruded the Nile Delta aquifer forming the major constraint against aquifer exploitation.

Climate change and seawater rise will affect the groundwater quality in the Nile Delta aquifer in two ways. First, low lands along the shoreline will be submerged with seawater and the aquifer below these lands will be destroyed. Second, additional pressure heads will be imposed at the seaside causing more intrusion. A dynamic monitoring network for piezometric head and water salinity is needed for better assessment and mitigation of seawater intrusion in the Nile Delta aquifer (Sherif/Al Rashed 2001). A monitoring system must be established to collect data on rates of soil and groundwater salinization.

45.3.3 Direct Impacts of Extreme Events

The region is well known to be exposed to a number of extreme events of sand storms (e.g. Saharan dust and Khamasin which covers the whole region) and marine storms (e.g. Nawwat which hit mainly the coastal areas), as well as a number of heat waves.

These extreme events cause large damage to agricultural productivity, materials and health. Its impact may even cross the Mediterranean and cause damage on the European side. These extreme events are expected to increase in intensity and frequency due to climate changes (e.g. IPCC 2007). It is impossible to exclude the impacts of these storms on sea-level and circulation pattern in the coastal environment. Again a detailed assessment of the impacts of extreme events is still to be carried out. It should be noted here that a lot of data on extreme events is becoming available for downloading from satellites.

45.3.4 Indirect Impacts

Indirect impacts of sea-level rise on the Nile delta region include socio-economic and health impacts due to increased salinity and loss of productivity of the land and consequent migration of population to other areas looking for jobs. Considering scenarios for sea-level rise until 2100, it is estimated that about 6 million people will abandon the saline land in the northern delta and move to southern areas looking for jobs (e.g. Sestini 1991; Dasgupta/Laplante/Meisner/Wheeler/Yan 2007).

45.4 Gaps of Systems and Information

It is now obvious that there are a number of gaps in the institutional systems for identification, assessment and adaptation to climate change. These include:

a.) Shortage of monitoring systems, capacity for monitoring and data bases and redundancy of research;
b.) Shortage of institutional systems to integrate, assess, analyse and for setting up policies for adaptation;
c.) Shortage of capacity for enforcement;
d.) Shortage of awareness among decision-makers and the vulnerable community;
e.) No information is available on the integrated potential impacts of climate changes and extreme events on water resources cultural heritage, agricultural productivity;
f.) The shortage of data and indicators of monitoring of specific parameters such as ground water salinity, sea-level rise and soil salinity;
g.) The shortage of information on infrastructure that is needed to upgrade resilience of the vulnerable community.

45.5 Adaptation Options for Coastal Resources

A number of important economic and commercial centres in Egypt will be exposed to the adverse effects of climate change. Especially the coastal cities of the Nile Delta will be most affected. It is urgent that strategic adaptation policies and plans are put in place and strong institutions and systems of supervision are established to enforce environmental laws. Several criteria are important for the assessment of various options for adaptation in coastal zones, including: net benefits, environmental impacts, robustness and flexibility, chance of success, feasibility and fairness. Using this experience the following generic options have been identified as the most promising adaptation policies and measures for the protection of the coastal zones in Egypt.

Adaptation starts with identifying and assessing vulnerabilities of various sectors to potential impacts of climate change. It then involves determining and assessing available options to deal with the effects of expected climate change through a change in public policies and/or the erection of protective structures such as dams or the like (El Raey/Dewidar/El-Hattab 1999). The Stern Report (2006) stressed the importance of the provision of speedy assistance by the international community to developing countries seriously affected by climate change to help them in their adaptation efforts. The report pointed to the fact that the poorer countries will be the most severely affected even though they are least responsible for greenhouse gas emissions. It also stressed that while addressing climate change today would cost only 1 per cent of the GDP, waiting for the adverse effects to materialize in the future may represent a yearly loss of 10 per cent of GDP. For the Nile delta region the following adaptation measures should be adopted and strictly enforced:

1. A National Institute for Climate Change should be established to build capacity and train human resources, to design the required institutional systems, integrate and coordinate activities among the various sectors. This Institute would focus on the study of possible adaptation policies while also spreading awareness of climate change effects and publicizing success stories on the different sectors.
2. Establishing an institutional capability for coastal monitoring, assessment and follow-up of plans. Activation of the national committee on *Integrated Coastal Zone Management* (ICZM), build-

ing of geographic data bases, developing policies and programmes;
3. Upgrading resilience of the community through upgrading of infrastructure, building capacities and upgrading awareness;
4. Adopting of an *Integrated Coastal Zone Management* (ICZM) for coastal development and enforcing of *environmental impact assessment* (EIA) that take climate change into account:
5. Use of wind and solar energy for water desalinization must be promoted and adequate financing for scientific research in these areas must be provided;
6. Development of local human resource skills in the field of mathematical *Regional Circulation Models* (RCMs) to allow future projections with the high degree of accuracy that is required for policy formulation.
7. Studies should be undertaken to determine possible adaptation options and criteria for the selection of water, agriculture and coastal sectors, which would make use of simple and low cost technologies.
8. Environmental laws should be firmly enforced and environmental assessments of projects must be mandatory. National projects should take expected climate change effects into consideration.
9. A comprehensive institutional setup for the protection of the coastal areas must be established with the aim of coordinating the efforts of the research community and the implementation agencies.
10. Nongovernmental organizations should be encouraged to upgrade the awareness among decision-makers and the public on the dangers posed by climate change and of the necessity to reduce overconsumption.

45.5.1 Specific Adaptation Processes and Policies

According to results of El Shennawy (2009), these general processes and policies are proposed:

- Sand dunes systems should be treated as the first defensive line for the Nile Delta.
- Utmost consideration should be paid to coastal lakes as one of the most appropriate adaptive capacity systems against sea-level rise.
- Coastal international roads should be considered as the second protection measure and studies to support them are urgently required.
- Coastal protection construction need regular maintenance and should be considered in any management plan for coastal zones.
- Decision-makers in coastal governorates as well as concerned ministers should be aware of the importance of sand dunes systems and their role in protecting the coastal zone of the Nile Delta.

45.6 Conclusions and Recommendations

It is concluded that the Nile Delta region is highly vulnerable to potential impacts of climate change especially to sea-level rise and salt water intrusion. The potential impact on water, coastal and agricultural resources is formidable and losses of world cultural heritage cannot be estimated. This calls for immediate and serious action. In particular the following aspects need to be carried out:

1. It is necessary to establish a virtual centre for integrating research activities, carrying out integrated vulnerability assessment, building up a geographic data base of climatic indicators and establishing a regional circulation model.
2. An improvement of the resilience of the population should be carried out through upgrading of infrastructure, building capacities for monitoring and assessment and upgrading awareness of decision-makers, civil society and the population at large.
3. Proactive strategic plans of development should be identified and enforced for all sectors in view of potential impacts of climate change.
4. Introducing policies for adaptation to climate change in various developmental plans, especially in large scale national projects.
5. Recent suggestions of increasing scenarios of sea-level rise will make the situation even worse and call for even faster action.

46 Vulnerability of Tropical Montane Rain Forest Ecosystems due to Climate Change

Hans Juergen Boehmer

46.1 Introduction: Definitions and Key Concepts[1, 2]

Tropical montane rain forests provide important ecosystem services, such as supply, purification and retention of fresh water, regional water and air quality regulation, carbon sequestration, genetic and pharmaceutical resources, natural hazard and erosion regulation, recreation and ecotourism, etc.[3] This type of ecosystem is highly dependent on stable conditions of several climate variables and, therefore, highly sensitive to any changes in those variables. For that reason, these forests provide excellent monitoring sites for detecting threats by climate change and illustrate its potential consequences for natural ecosystems and ecosystem services in an impressive way (Loope/Giambelluca 1998; Foster 2001). Before discussing this topic, however, some principal terms used in this chapter have to be defined.

46.1.1 What is a Tropical Montane Rain Forest?

Like many terms in ecology, the term 'montane rain forest' has different connotations. Also, other terms have been used to describe forests that exist under the conditions outlined below (46.1.2, 46.1.3), like 'cloud forest', 'elfin forest', 'mossy forest', and 'dwarf forest' (Stadtmueller 1987; Richards 1996). This has caused some confusion; for instance, Beard (1955) juxtaposed 'montane rain forest' with 'cloud forest' (Mueller-Dombois/Ellenberg 1974, 2002), while Lamprecht (1977) used the terms synonymously. Bruijnzeel and Hamilton (2000) distinguish between lower montane forest, lower montane cloud forest, upper montane cloud forest, and subalpine cloud forest. 'Cloud forest' has been common for several decades,[4] and is still widely used with a particular focus on *tropical montane cloud forests*.[5] Like Whitmore (1998), the latest analysis of the world's forests[6] distinguishes between tropical upper montane forest and tropical lower montane forest.

This chapter uses the term 'tropical montane rain forest' (van Steenis 1935; Beard 1944; Richards 1996). Its broader connotation includes all types of rain forests in tropical mountain ranges, from naturally open upper montane rain forests at higher elevations (characterized by stunted growth, twisted trunks, and epi-

1 I wish to thank Hans Günter Brauch, Helene H. Wagner, Dieter Mueller-Dombois, Corina Niemand, Nadja Rueger and Catherine Reynolds for helpful remarks. The comments of three anonymous reviewers significantly improved an earlier version of this manuscript.

2 *Keywords:* biological invasions, catastrophe, cavitation, climatic anomalies, climatic fluctuations, cloud forests, cohort senescence, dieback, disaster, disturbance, disturbance regime, ecosystem services, extreme climatic events, foundation species, fragmentation, invasibility, long-term dynamics, natural disturbance, perturbation, population dynamics, resilience, tree demography, vegetation dynamics

3 See Bruijnzeel (2004); Millennium Ecosystem Assessment (2005); Gullison, Frumhoff, Canadell, Field, Nepstad, Hayhoe, Avissar, Curran, Friedlingstein, Jones and Nobre (2007); Martinez, Pérez-Maqueo, Vázquez, Castillo-Campos, García-Franco, Mehltreter, Equihua and Landgrave (2009).

4 See Beebe and Crane (1947); Ellenberg (1964); Troll (1968); Lawton and Dryer (1980); Sugden (1983); Stadtmueller (1987); Bruijnzeel and Hamilton (2000).

5 See *montane cloud forest* (MCF): Hamilton, Juvik and Scatena (1995); Cayuela/Golicher/González-Espinosa/Ramírez-Marcial/Rey Benayas 2006a; Cayuela/Rey Benayas/Echeverría 2006b); *tropical montane cloud forest* (TMCF): Bruijnzeel (2001); Foster (2001); Bubb, May, Miles and Sayer (2004).

6 See Schmitt, Burgess, Coad, Belokurov, Besançon, Boisrobert, Campbell, Fish, Gliddon, Humphries, Kapos, Loucks, Lysenko, Miles, Mills, Minnemeyer, Pistorius, Ravilious, Steininger and Winkel (2009).

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phytic mosses) to dense lower montane rain forests with tall trees and a closed canopy (Whitmore 1998; Foster 2001). The latter are highly dependent on the frequent presence of clouds, but not on a permanent cloud cover (Stadtmueller 1987). Despite the attempted terminological clarity, it has to be kept in mind that there is a considerable diversity of montane rain forests within the tropics (Vareschi 1980; Kitayama 1995; Bruijnzeel 2001).

Summing this up pragmatically, tropical montane rain forests are the predominating forest type in zones of maximum cloud condensation in mountain ranges of the tropics, and they frequently or permanently receive additional humidity through horizontal precipitation (direct canopy interception of cloud water, so-called cloud stripping).[7]

46.1.2 Structure and Biodiversity of Tropical Montane Rain Forests

Compared to tropical lowland rain forests, tropical montane rain forests have lower nutrient cycling rates and lower overall productivity (Grubb 1977; Whitmore 1989; Bruijnzeel 1998). Thus, trees have a lower stature with an average canopy height of about 15 to 35 meters, and increased stem density (Richards 1996; Whitmore 1998; Bruijnzeel 2001). Generally speaking, above-ground biomass decreases as elevation increases (Bruijnzeel/Hamilton 2000; Kitayama/Aiba 2002; Moser/Hertel/Leuschner 2007). At higher elevations, average canopy height can even be lower than 5 metres and trees have relatively small, thick and hard leaves (Richards 1996; Foster 2001).

The following factors contribute to lower productivity in upper montane forests: reduced photosynthesis due to lower radiation and air temperatures; periodic water shortage on shallow soils; saturated soils and impeded root respiration; high soil acidity and, thus, low decomposition rates, nutrient mineralization and overall fertility.[8]

The complex topography of high mountains provides a large variety of important site factors and disturbance regimes (Boehmer/Richter 1997), thus creating a highly diverse environment with numerous mechanisms that maintain montane forest biodiversity (Zang/Tao/Li 2005). As a result, tropical montane rain forests have high levels of species diversity and endemism[9] (Lewis 1971; Gentry 1995; Kessler 2001); long evolutionary time under relatively constant climatic conditions even made them biodiversity hot spots[10]. Gentry (1986, 1995) emphasizes natural habitat fragmentation and small-scale variation in climatic conditions as decisive triggers for high levels of endemism in tropical uplands. Regarding species composition and diversity, there are continuous elevational changes (Lovett 1998) as well as discrete compositional ecotones at certain altitudes (Martin/Sherman/Fahey 2007; Schmitt/Denich/Frijs/Demissew/Boehmer in press). Ecotonal[11] interactions, e.g. between lower and upper parts of watersheds, further stimulate species richness (Oesker/Dalitz/Günter/Homeier/Matezki 2008).

Due to the high availability of water (which results from high precipitation and high relative humidity), epiphytes[12] are usually the most frequent life forms aside from trees. Trees are covered by dense layers of vascular and non-vascular epiphytes (mosses, liverworts, lichens, ferns, orchids, etc.; Robins/Sugden 1979; Nadkarni 1984; Nadkarni/Matelson/Haber 1995). Moss coverage relative to that of lichens increases with elevation (Frahm/Gradstein 1991). High and largely non-seasonal annual rainfalls appear to be a driving force behind the diversity of epiphytes and terrestrial ferns (Gentry/Dodson 1987, Kessler 2001). Ferns and tree ferns (*Cyatheaceae*) are highly abundant and play an important role as understory species at all altitudes (figures 46.1, 46.2).

In most of the lower montane forests, tree ferns are more common, while the upper montane forests are characterized by high abundances of filmy ferns (*Hymenophyllaceae*), which profit from the relatively

7 Ataroff and Rada (2000), for instance, studied water fluxes in a Venezuelan montane rain forest (2300 m above sea level [a.s.l.] 3124 mm annual rainfall); there, 91 per cent of the incoming water was from rainfall, 9 per cent from cloudwater; in Holder's study (2004) of a Guatemalan montane forest (2550 m), fog perecipitation contributed more than 7 per cent of the total input to the water budget, but was 19 per cent during the dry season.

8 See Stadtmueller (1987), Bruijnzeel and Veneklaas (1998); Sollins (1998); Tanner, Vitousek and Cuevas (1998); Clark, Lawton and Butler (2000); Vitousek (2004).

9 *Endemic species* are restricted to a certain area or ecosystem (*endemism*).

10 See Terborgh (1977); Rohde (1992); Bush, Silman and Urrego (2004); Barthlott, Hostert, Kier, Küper, Kreft, Mutke, Rafiqpoor and Sommer (2008); Beck and Kottke (2008).

11 *Ecotone* refers to a transition zone between two structurally different (plant) communities.

12 *Epiphytes* refers to plants that grow attached to the stem and branches of trees.

Figure 46.1: Montane rain forest on the island of Hawaii, Kilauea area, ca. 1200m above sea level. **Source:** Photograph by Jutta Pscherer (2002).

cool, wet microclimate inside the stands (Richter 2008). In some montane rain forest types, lianas are characteristic features as well (Senbeta/Schmitt/Denich/Demissew/Vlek/Preisinger/Woldemariam/Teketay 2005). The overall richness of vascular plant species usually decreases substantially from lower to upper

elevations (Kitayama 1992; Vásquez/Givinish 1998; Kessler 2001). Tree species composition varies with altitude (Lieberman/Lieberman/Peralta/Hartshorn 1996), but tree species richness does not necessarily decline with elevation (Lovett 1998, 1999).

Tropical montane rain forests harbour highly diverse faunas with numerous co-existing animal species that are limited to certain habitat types within this zone.[13] Habitat specialization of birds, for instance, generates high diversity (Willis/Schuchmann 1993; Watson/Peterson 1999; Jankowski/Ciecka/Meyer/Rabenold 2009).

46.1.3 Distribution of Tropical Montane Rain Forests

The frequent or permanent presence of a dense cloud layer at certain elevation intervals along mountain ranges is a key condition for the existence of tropical montane rain forests;[14] they are strongly linked to regular cycles of cloud formation (Still/Foster/Schneider 1999). In tropical high mountains there is a general correlation between cloudiness and orographic rainfall (Sarmiento 1986). The average rainfall in those areas ranges from 1200 mm to over 7500 mm per year (Evenson 1983; Bush/Hanselman/Hooghiemstra 2007), with a mean annual temperature of 18–20 °C at the lower elevation limit and about 10 °C at the upper limit (Bruijnzeel 2001). However, short periods of drought (infrequent mild droughts) can be considered a normal element of the natural environment (Giambelluca/Nullet/Ridgley/Eyre/Moncur/Price 1991; Werner 2003) that affects or even determines population dynamics of certain foundation plant species.[15]

Exceptionally wet conditions have been described for a wide range of tropical mountains, causing reduced temperature oscillations, solar irradiation, and evapotranspiration of trees (Hedberg 1964; Sarmiento 1986; Stadtmueller 1987; Hamilton/Juvik/Scatena 1995). Here, seasonality is primarily based on fluctuations in horizontal and vertical precipitation (Richter 2008). In many places there are other extreme site factors like insufficient soil drainage (Hamilton/Juvik/Scatena 1995, Mueller-Dombois 2006), nutrient leaching (Vitousek 2004), or strong winds (e.g. along the trade wind belt; Lawton 1982; Sugden 1986).

The band of maximum cloud cover in the humid tropics is highly dependent on the topography of the principal mountain ranges (e.g. Bendix/Rollenbeck/Goettlicher/Cermak 2006). Generally it is located between 1200 and 2500 m *above seal level* (asl; Stadtmueller 1987). Nevertheless, in many regions the belt of montane rain forest begins at lower elevations. Lower extremes tend to be ca. 800 m asl, but can be lower than 500 m, e.g. Seychelles (Flenley 1974) or the tropical Pacific islands (Mueller-Dombois/Fosberg 1998), and, on the high end, Hueck (1978) mentions Andean cloud forests even at 3900 m asl.

A variety of factors affect the intensity, amount, and duration of upslope precipitation, including barrier width, slope steepness, and updraft speed. In addition, other climatic and geographic factors like the direction of the prevailing winds, micro relief, and disturbance regimes determine the distribution of montane rain forests and indicate their limits (Richter 2008). The position of the belt of maximum precipitation in the mountains also depends on the degree of aridity in the adjacent forelands. That means that severe changes in foreland ecosystems (deforestation) can affect nearby montane rain forests (Lawton/Nair/Pielke/Welch 2001, Nair/Lawton/Welch/Pielke 2003).

The distribution of tree ferns is a prominent indicator for the geographical boundaries of montane rain forests in the tropics (Kroener 1967; Troll 1970; Stadtmueller 1987; figure 46.1, 46.2). Troll (1956, 1968) developed a pioneering profile of altitudinal vegetation belts that includes a montane forest belt in the inner tropics, ranging from tropical temperate up to cold altitudes. Numerous case studies have helped to create a clearer picture of tropical montane rain forest distribution (Bruijnzeel 2001). Today, the horizontal extension of tropical montane rain forests is calculated at 924.000 km^2, approximately 15 per cent of the existing tropical rain forest. Among those, tropical upper montane rainforests cover 476.000 km^2, and tropical lower montane rainforests 448.000 km^2.[16]

In the American humid tropics, the principal areas of montane rain forest distribution include Mexico (Hastenrath 1968; Cayuela/Golicher/Rey-Benayas

13 See Orians (1969); Terborgh (1971); Hernández-Baños, Peterson, Navarro-Sigüenza, Escalante-Pliego 1995; Watson and Peterson (1999); Blake and Loiselle (2000); Brehm, Homeier and Fiedler (2003); Herzog, Kessler and Bach (2005).

14 See Grubb and Whitmore (1966); Huber (1976); Nair, Asefi, Welch, Ray, Lawton, Manoharan, Mulligan, Sever, Irwin, Pounds (2008).

15 A *foundation species* is a dominant species in an ecosystem that controls the populations of other species (and overall community dynamics) and modulates ecosystem processes (Ellison/Bank/Clinton/Colburn/Elliott/Ford/Foster/Kloeppel/Knoepp/Lovett/Mohan/Orwig/Rodenhouse/Sobczak/Stinson/Stone/Swan/Thompson/Von Holle/Webster 2005).

Figure 46.2: Treefern-dominated understory in a montane rain forest on the island of Hawaii, Puu Makaala area, ca. 1270m above sea leavel**. Source:** Photograph by Hans Juergen Boehmer (2003).

2006), Central America (Knapp 1965), particularly Guatemala (Holder 2005), Costa Rica (Zadogra 1981, Nadkarni/Wheelwright 2000), Panama (Myers 1969), Jamaica (Tanner 1977), Puerto Rico (Weaver 1972a, 1972 b), Ecuador (Gradstein/Homeier/Gansert 2008; Beck/Bendix/Kottke/Makeschin/Mosandl 2008), Venezuela (Veillon 1955, 1974), Colombia (Sugden 1982a, 1982b, 1982c), and Peru (Young/León 1995). The high mountains in Southeast Asia, Malaysia, the

16 See Schmitt, Burgess, Coad, Belokurov, Besançon, Boisrobert, Campbell, Fish, Gliddon, Humphries, Kapos, Loucks, Lysenko, Miles, Mills, Minnemeyer, Pistorius, Till Ravilious, Steininger, Winkel 2009a, [2]2009b).

Philippines and Indonesia, in particular, are centres of montane rain forest distribution (Hamilton/Juvik/Scatena 1995). New Guinea and the principal islands of the Pacific region (Hawaii, Samoa) have considerable amounts of tropical montane rain forests as well (Merlin/Juvik 1995; Mueller-Dombois/Fosberg 1998). In Africa, Mt. Cameroon and the high mountains of East Africa are worthy to mention (Hedberg 1951; Friis 1992, Hemp 2006). Even in relatively dry regions such as the Simien Mountains in northern Ethiopia, montane rain forests form a discrete belt on north-eastern escarpments at 2200 to 2500 m a.s.l. (Richter 2008), which again illustrates the major significance of horizontal precipitation in this type of ecosystem.

46.1.4 Climate Change and Specific Vulnerability

Climate change is one of several global processes (including rapid urban development, population growth, etc.) that require special attention because it is affecting the distribution of resources and increasing the vulnerability of ecosystems. In IPCC (2007: 30) terminology, climate change refers to "a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer." In short, "it refers to any change in climate over time, whether due to natural variability or as a result of human activity." According to Cardona (chap. 3 above), vulnerability of ecosystems is "intrinsically tied to different socio-cultural and environmental processes, but (...) is also related to the fragility, the susceptibility, or the lack of resilience of the exposed elements, both from society and environment" (for overviews on the concepts of 'vulnerability', 'risk', etc. see Brauch 2005a; Birkmann 2006; chap. 2 by Brauch). In the context of climate change, vulnerability is "a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards" (IPCC 2001).

Interestingly, the concepts of disaster, catastrophe, disturbance, perturbation, and resilience are applied differently in the scientific and political discussion on human and environmental insecurity from the way they are commonly understood in ecology (Harper 1977, White/Pickett 1985; Grimm/Wissel 1997; Brand/Jax 2007). This lack of interdisciplinary terminological clarity cannot be discussed here in detail; to give an example, Turner II, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Marybeth, Polsky, Pulsipher and Schiller (2003: 8074) define hazards as

> threats to a system, comprised of perturbations and stress (and stressors), and the consequences they produce. A perturbation is a major spike in pressure (e.g., a tidal wave or hurricane) beyond the normal range of variability in which the system operates. Perturbations commonly originate beyond the system or location in question. Stress is a continuous or slowly increasing pressure (e.g., soil degradation), commonly within the range of normal variability. Stress often originates and stressors (the source of stress) often reside within the system. Risk is the probability and magnitude of consequences after a hazard (perturbation or stress).

These concepts of perturbation and stress do not fit with the broadly accepted definition of the terms in the natural sciences. There has been a long discussion in ecology about the definitions of terms like perturbation, disturbance, stress, and catastrophe (Harper 1977; White/Pickett 1985; Boehmer/Richter 1997; White/Jentsch 2001; Kammer/Moehl 2002). Widely accepted is the definition of disturbance as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (White/Pickett 1985: 5ff.). An ecological event is an "abruptly occurring process which significantly affects variables of an ecological unit for a period longer than its own duration. It must have a clear beginning and end, and must be of relatively short duration in relation to the time scale of the organisms considered" (Grimm/Stillman/Jax/Goss-Custard 2007: 60). The term 'perturbation' describes a departure from an explicitly defined normal state, behaviour or trajectory (White/Pickett 1985).

Unfortunately, in the definition by Turner II, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Marybeth, Polsky, Pulsipher and Schiller (2003: 8074) the term 'perturbation' is used as a synonym for the ecological term 'disturbance', more precisely for what is defined in ecology as a catastrophic disturbance (*large infrequent disturbance* [LID] after Turner/Baker/Peterson/Peet 1998). In ecology, catastrophes or 'catastrophic events' are regarded as special cases of disturbance. Events of this nature are unpredictable and cannot be included in the prevailing regime of

regularly occurring disturbances (Boehmer/Richter 1997; Turner/Baker/Peterson/Peet 1998); accordingly, foundation species cannot become adapted to such events (Harper 1977; Boehmer/Richter 1997).

On the other hand, a 'disaster' recurs so frequently that it becomes relevant for the fitness of successive generations, because it can be expected to occur within the species´ life cycle: "The selective consequence of disasters is therefore likely to be to increase short-term fitness and the consequence of catastrophes is to decrease it" (Harper 1977: 627); so, disasters and catastrophes can – from the viewpoint of ecology – be interpreted as the ends of a continuum. In contrast, a disaster as discussed in the context of human and environmental insecurity implies "loss and damage, and consequential impacts that the affected community is unable to absorb or to cushion the effects and recover using its own resources and reserves" (chap. 3 by Cardona).

Furthermore, the distinction between ecological events (such as disturbance) and continuous processes (such as perturbation) as two fundamental types of ecological processes is central to any ecological research on ecosystem dynamics (Grimm/Stillman/Jax/Goss-Custard 2007). To avoid confusion, the terms 'disturbance' and 'perturbation' will be used here according to White and Pickett (1985), following the introduced and accepted terminology of ecology. 'Stress' is commonly defined as a limitation of dry matter production, while disturbance is connected to the destruction of biomass (Grime 1979; Kammer/Moehl 2002). Another problem with Turner II's definition is the boundary between disturbances originating from 'beyond the system' (commonly named 'exogenous disturbances', not 'perturbation') and those originating from 'within the system' (commonly named 'endogenous disturbances', not 'stress'). This boundary appears to be conceptually precise but is difficult to grasp in terms of structural content (Boehmer/Richter 1997).

The montane rain forests of the tropics are considered – as stated above – fragile exposed elements with a lack of resilience. Bioclimatic models suggest that major impacts to tropical forests will result from climate change (Hannah/Midgley/Andelman/Araújo/Hughes/Martinez-Meyer/Pearson/Williams 2007); complex synergetic effects on essential ecological factors should be expected (see 46.2). Vulnerability is considered for the purposes of this chapter as having the following aspects: 1) destruction of the established ecosystem 'tropical montane rain forest' through substantial changes in the determining climate variables; 2) impact of natural disturbances; 3) enduring disruption of ecosystem processes (irreversible modification of natural long-term dynamics); 4) loss of indigenous biodiversity; and 5) loss of ecosystem services.

Nevertheless, when emphasizing the importance of climatic factors for plant species distribution, it must not be forgotten that most species depend on a much more complex system of factors that describe their ecological niche (Heger/Boehmer 2005; Svenning/Kerr/Rahbek 2009). Non-climatic stresses affecting species survival, exacerbating problems caused by climate change, or limiting species' ability to respond to environmental changes should also be taken into account. Detailed studies of all ecological factors relevant for distribution and spread still do not exist for the vast majority of plant species. Reliable predictions of future distributions are, therefore, hardly possible (Grainger 2008), although attempted frequently (Thullier/Lavorel/Araújo 2005; Thullier/Lavorel/Araújo/Sykes/Prentice 2005). Even so, any assessment of ecosystem vulnerability should consider the full spectrum of possible impacts (Clark 2007; Feeley/Silman 2008), even those not yet quantifiable in detail (e.g. adverse effects of climate change, including climate variability and extremes).

46.2 Climate Change and Tropical Montane Rain Forest Dynamics

The availability of water determines the distribution of plants in terrestrial ecosystems (Larcher 1995). Climatic factors such as temperature, precipitation, and humidity play a fundamental role in the physiology and ecology of plant species (Harper 1977). Changes in those factors can, therefore, cause environmental stress and pose a threat to the regeneration and reproduction of numerous species. To survive such changes, species must be either resilient to climatic extremes, adapt to the new conditions, or migrate to other suitable areas (Davis/Shaw/Etterson 2005; Parmesan 2006). In plant communities, species react individually to climatic change (Hannah/Lovejoy 2007). Alterations in climate affect forest communities by changing the abundance and competitive capacity of different species in the forests (Hannah/Midgley/Andelman/Araújo/Hughes/Martinez-Meyer/Pearson/Williams 2007). Altered rainfall patterns, surface temperatures, and light availability lead to a change in carbon fixation by plants (primary production), higher mortality, and changing regeneration suc-

cess of many plant species (Holmgren/Scheffer/Ezcurra/Gutiérrez/Mohren 2001; Stenseth/Mysterud/Ottersen/Hurrell/Chan/Lima 2002).

Climate change threatens tropical montane rain forests particularly by altering precipitation, humidity, temperature, ultraviolet radiation, storm frequency and duration (Hamilton/Juvik/Scatena 1995, Foster 2001). In tropical high mountains, vascular plant species composition is associated with cloud frequency (Sklenár/Bendix/Balslev 2008). Bush (2002) hypothesized that the elevation of cloud formation will increase due to climate warming, caused by an upslope movement of the cloud base and resulting in a narrower elevational interval supporting the montane rain forest. A prolonged uplifting of the cloud layer can, for example, induce a decline in canopy trees (dieback, see below), enhanced seedling recruitment, population growth among understory plant species, and an increase in fruit production. Increases in air temperature can be linked to community changes of birds and amphibians in montane rain forests (Pounds/Fogden/Campbell 1999). Projected distributions of novel and disappearing climates by 2100 AD show that disappearing climates are concentrated in tropical montane regions (Williams/Jackson/Kutzbach 2007), thus indicating an increased extinction risk for species with narrow geographic distributions.

Climatic extremes, rather than mean values, have crucial impact on the dynamics of vegetation (Condit/Hubbell/Foster 1996). The increase of climatic extremes and fluctuations in recent decades has profound effects on the highly specific conditions outlined above, thus affecting species composition, structure, and dynamics of tropical montane rain forests. Climatic fluctuations such as extreme wet-dry oscillations can act as triggers of forest decline, particularly on marginal sites with shallow soils or poor drainage (e.g. Mueller-Dombois 2006; see below). Rapid changes in climate and atmospheric chemistry threaten sustainability of forests (Wargo/Auclair 2000). Droughts, for instance, have a severe impact on terrestrial vegetation dynamics, particularly in tropical rain forests.[17] Fortunately, tropical mountains are characterized by a variety of local climates; therefore, drought stress does not influence all parts of a montane rain forest in a given region in the same way.

Climatic extremes can arise from the shifts in tropical precipitation patterns, as in the case of El Niño anomalies[18] in the central and eastern Pacific, which have caused droughts in Indonesia (Werner 2003; Slik 2004) and inundated the South American west coast and the islands of the central Pacific with heavy rains (McPhaden/Zebiak/Glantz 2006). Remote effects of such changes are recorded in the North and South Pacific and beyond; strong El Niño and La Niña events have worldwide consequences (McPhaden/Zebiak/Glantz 2006). Severe ENSO-droughts have been increasing in recent decades.[19]

On a local scale, extreme weather events like tropical storms can damage trees by floods, defoliation, and windfall, thereby causing tree fall gaps that affect neighbouring trees as well as understory plants. Landslides, a typical geomorphic process in humid high mountain regions, create large-scale disturbances in montane forests, and become more frequent after extreme precipitation events. These disturbances may lead to a decrease in the connectivity of populations by fostering forest fragmentation.

Nevertheless, there is also evidence from palaeological records that tropical montane rain forests have been a continuous and constant feature, e.g., of the Andean environment throughout the Holocene (Bush/Hanselman/Hooghiemstra 2007). Here, rates of community change were low for thousands of years, despite considerable variability in the climate. Unfortunately, the warming expected in the near future has no physical and biotic analogues in the past (Hannah/Lovejoy 2007).

46.2.1 Climate-Induced Forest Decline

Future warming is expected to exacerbate regional tree species die-off [20] worldwide (Adams/Guardiola-

17 See Lowry, Lee and Stone (1973); Leighton and Wirawan 1986; Oren, Zimmermann and Terborgh (1996); Walsh and Newbery (1999); Nakagawa, Tanaka, Nakashikuza, Ohkubo, Kato, Maeda, Sato, Miguchi, Nagamasu, Ogino, Teo, Abang and Lee (2000); Potts (2003); Williamson and Ickes (2002); Werner (2003).

18 El Niño *or El Niño-Southern Oscillation* (ENSO): periodic change in the atmosphere and ocean temperature of the tropical Pacific; manifested in the atmosphere by changes in the pressure difference between Tahiti and Darwin, Australia, and in the ocean by warming or cooling of surface waters of the tropical Eastern Pacific Ocean

19 See McClure (1983); Loope and Giambelluca (1998); Boehmer and Niemand (2009); Boehmer, Niemand, Gerrish, Jacobi and Mueller-Dombois submitted for publication.

20 Die-off refers to a sudden sharp decline of a population (animals or plants).

Claramonte/Barron-Gafford/Villegas/Breshears/Zou/Troch/Huxman 2009) thereby affecting regional carbon budgets. The suppression or loss of foundation tree species in montane rain forests has acute and chronic impacts on fluxes of energy and nutrients, hydrology, food webs, and biodiversity.[21]

It is well known that climatic fluctuations like ENSO have strong effects on the dynamics of plant populations in a wide range of terrestrial ecosystems (Curran/Caniago/Paoli/Astianti/Kusneti/Leighton/Nirarita/Haeruman 1999; Holmgren/Scheffer/Ezcurra/Gutiérrez/Mohren 2001). El Niño events bring drier, warmer, and sunnier conditions to the wet tropics, resulting, e.g., in a prolonged uplifting of the cloud layer, thus causing stress, e.g., in trees growing on waterlogged substrates. For example, as a result of the 1982–1983 super-El Niño event, which brought record temperatures and severe drought to Indonesia (Leighton/Wirawan 1986), 71 per cent of the canopy trees (>60 cm diameter) died in forest plots on dry ridges and slopes (dieback). 'Dieback' is a special form of forest decline, which affects only canopy trees and is known from several of the world's forest ecosystems (Jane/Green 1983; White 1986; Lawesson 1988; Mueller-Dombois 1988; Stewart 1989; King/Neilson 1992; figure 46.3). The term has been defined as "progressive dying back from the tips of twigs, branches or tops" (Podger 1981; Manion 1981; Ciesla/Donaubauer 1994).

As far back as 1986, it was shown that forests are highly susceptible to dieback under ongoing climate warming (Solomon 1986, Mueller-Dombois 1987, 1988). After a dwindling of interest in the late 1980's, forest dieback resulting from climate change has started to become a major focus of ecological research again (Allen 2009). An important aspect is the assumption that in many forest ecosystems neither floods nor droughts lead to the death of canopy trees. Instead, the combination of both, due for example to more rapid precipitation and irradiation changes, seems to have lethal effects, especially on marginal sites (Auclair 1993; Mueller-Dombois 2006). The phenomenon of stand-level dieback in forests, formerly interpreted as a local symptom of a disease or a pest attack (Petteys/Burgan/Nelson 1972), is nowadays understood as a complicated combination of biotic and abiotic factors that includes generic levels as well as climatic triggers (Mueller-Dombois 1988). According to Auclair (1991), region-wide, persistent episodes of forest dieback are incited by extreme moisture stresses in the Pacific area.

While extreme precipitation events typically are local and short-lived phenomena, the dissolving of the cloud layer during ENSO anomalies may affect large areas over extended periods of time. It is thus assumed that large-scale dieback is triggered by a rapid succession of climatic extremes. For example, high radiation, followed by extreme precipitation and repeated high radiation (Auclair 1991, 1993), may cause lethal cavitation[22] in forest stands. Four types of climatic fluctuations can cause cavitation injury in tropical montane rain forests: 1) wet-dry oscillations; 2) intermittent high pressure or blocking high; 3) extreme rainfall; and 4) extreme drought. Dry-wet oscillations should be considered as dieback triggers as well. The frequency of such fluctuations has been increasing in recent decades.[23]

Usually, forest stands do not die while in full vigour, except from catastrophic disturbances, diseases or insect pests. In the absence of such influences, an endogenous predisposition to decline can be assumed, which may be related to the structure and dynamics of the tree population itself (Mueller-Dombois 1987). For instance, after intensive research on the forest decline on the Island of Hawaii in the early 1970's, it was shown that neither disease nor climatic stress actually caused the mass-dieback of the dominating tree species *Metrosideros polymorpha* (Papp/Kliejunas/Smith/Scharpf 1979; Hodges/Adee/Stein/Wood/Doty 1986). Instead, attention focused on a complex array of demographic factors, namely a uniform age and stand structure ('cohorts'; Mueller-Dombois 1983, Gerrish/Mueller-Dombois 1999), probably resulting from large-scale disturbances, e.g., through volcanic eruptions, leading to the simultaneous aging and finally death of the cohort ('cohort senescence'; Mueller-Dombois 1987).

The concept of cohort senescence, which claims that old cohorts of canopy trees are predisposed to die, due to their low energy potential for recovery from stress, has particular implications for climate

21 See Ellison, Bank, Clinton, Colburn, Elliott, Ford, Foster, Kloeppel, Knoepp, Lovett, Mohan, Orwig, Rodenhouse, Sobczak, Stinson, Stone, Swan, Thompson, Von Holle and Webster (2005).

22 *Cavitation* refers to a catastrophic hydraulic failure in the xylem (water transport tissue) of vascular plants when the tension of water within the xylem becomes so great that dissolved air within the water expands (bubbles), thus blocking the transport of stem water.

23 See Loope and Giambelluca (1998); Boehmer and Niemand (2009); Boehmer, Niemand, Jacobi, Gerrish and Mueller-Dombois (submitted for publication).

Figure 46.3: Dieback of the foundation species *Metrosideros polymorpha*, montane rain forest, Mauna Kea, island of Hawaii. **Sources:** a) aerial photograph by Dieter Mueller-Dombois (1972); b) Jutta Pscherer (2002).

change. It suggests that aging forests are susceptible to synchronized decline under certain demographic conditions (Boehmer/Wagner/Mueller-Dombois submitted for publication). Such weak stages in stand demography increase the vulnerability of forests. Extreme rainfall events or prolonged droughts, or combinations of these factors could generate a physiological shock that may trigger dieback among old,

stressed trees (Mueller-Dombois 1987; Gerrish/Mueller-Dombois/Bridges 1988, Gerrish 1990).

Santiago/Goldstein/Meinzer/Fownes/Mueller-Dombois (2000) propose that poor drainage causes roots to avoid hypoxic[24] soil horizons. This in turn could reduce the leaf area. Dieback symptoms may, therefore, represent an adjustment in leaf area to available resources, primarily in large trees that have a limited rhizosphere, while saplings and smaller trees are frequently established on nurse logs that provide more oxygenated sites. Further research is needed to test the relationship between the age of cohorts and the effect of climatic anomalies on their vitality.

46.2.2 Natural Disturbances

In recent decades natural disturbance has increasingly been recognized as a principal factor controlling the structure and dynamics of ecosystems.[25] Natural disturbances are a major driving factor behind vegetation dynamics in humid high mountain regions at different scales (Boehmer/Richter 1997; Boehmer 1999; Kammer/Moehl 2002). Tropical montane rain forests are subject to numerous natural disturbance factors (e.g. storms, landslides, fires, volcanic eruptions).[26] These factors cause a pattern of coexisting successional stages including moss carpets, herbaceous stands, fern thickets, scrubs, and mature forest. This habitat heterogeneity, e.g., in areas of frequent landslides, explains the high species richness of many tropical montane rain forest ecosystems.

This is especially true for mountain regions characterized by perhumid conditions and frequent earthquakes (Richter 2008). There is a critical threshold for inducing landslides that depends on the following factors in combination: mechanical and hydrological soil parameters and the destabilization of the water-soaked organic layer by the forest load (Asch/Deimel/Haak/Simon 1989). Extreme precipitation events destabilize slopes, particularly where montane forests are already fragmented by wind-induced tree fall or clearing. If larger areas are affected, a change in the local climate and an increase in the invasibility of the ecosystem can result.

Climate change is expected to cause an increase in natural disturbance impact, e.g., from tropical storms (Markham 1996; Elsner/Kossin/Jagger 2008) although there is at present no clear trend in the number of tropical cyclones (IPCC 2007). Such events can alter forest composition and structure for many years. Usually, storms cause more damage on ridges than in valleys and reduce the vegetation in upper height intervals significantly. Average maximum canopy height, for instance, decreased as much as 50 per cent in Puerto Rico's lower montane rainforest after Hurricane Hugo in 1989 (Brokaw/Grear 1991). Nevertheless, local variations in hurricane damage (or disturbance impact, respectively) can increase complexity of forest structure and, in doing so, provide habitats that are essential or favourable for a significant number of plant and animal species (Petraitis/Latham/Niesenbaum 1989). *Coarse woody debris* (CWD), produced when branches fall to the ground, provides important safe sites for seedling establishment on the forest floor (Santiago/Goldstein/Meinzer/Fownes/Mueller-Dombois 2000). In addition, the fine litter fall caused by tropical storms alters nutrient cycling in the forest system (Lodge/Scatena/Asbury/Sánchez 1991).

46.2.3 Range Retractions, Expansions and Biological Invasions

A warming of tropical mountains of 2 to 3 °C (IPCC 2001) might cause an upslope migration of species,[27] thus worsening conditions for the species in montane rain forests that are highly adapted to cloud water (Benzing 1998). Many plant species in the Amazon cloud forest, for instance, may not survive the climate changes forecast to occur within the next 100 years (Bush/Silman/Urrego 2004). Nadkarni and Solano (2002) showed that less cloud water generally has a negative effect on epiphyte growth and leaf production and radically alters the composition of canopy communities. As the mortality of montane rain forest species increases, the competition pressure induced by invasive indigenous lowland species is simultaneously heightened. Short migratory distances from low-

24 *Hypoxic soils* have a lack of oxygen as a result of poor drainage or during short-term flooding.

25 See Levin and Paine (1974); Connell and Slatyer (1977); Connell (1978, 1979); Sousa (1984); Pickett and White (1985); Boehmer and Richter (1997); Turner, Baker, Peterson and Peet (1998); White and Jentsch (2001).

26 See Clark (1990); Waide, Zimmerman and Scatena (1998); Whitmore and Burslem (1998); Chazdon (2003); Cochrane (2003).

27 See Pounds, Fogden and Campbell (1999); Peterson, Ortega-Huerta, Bartley, Sánchez-Cordero, Soberón, Buddemeier and Stockwell (2002); Raxworthy, Pearson, Rabibisoa, Rakotondrazafy, Ramanamanjato, Raselimanana, Wu, Nussbaum and Stone (2008); Sekercioglu, Schneider, Fay and Loarie (2008).

lands to the upper forest line make montane rain forests sensitive monitors of climate change (Bush/Flenley 2007). Such range expansions are widely expected, but have not yet been studied in detail (Colwell/Brehm/Cardelús/Gilman/Longino 2008).

Invasion by non-indigenous species is one of the most important issues in today's applied ecology (Convention on Biological Diversity; United Nations 1993). Some alien species are able to cause fundamental changes in indigenous ecosystems, including the local extinction of native species (SCBD 2001). The weakening of indigenous foundation tree species through climate change increases the invasibility of forests. Declining forests become more vulnerable to biological invasions, for instance, because dying trees can be replaced by invading alien tree species. These occupy available sites before the indigenous species can establish new individuals or a cohort (Boehmer 2005).

The increased invasibility of montane rain forests by canopy decline makes invasive alien species capable of completely changing structure and species composition (Asner/Hughes/Vitousek/Knapp/Kennedy-Bowdoin/Boardman/Martin/Eastwood/Green 2008). An impressive example of the negative potential for a synergetic effect presented by invasive species is Kahili Ginger (*Hedychium gardnerianum*), a 2 metre tall herb native to India's Himalaya region. It was introduced to many tropical regions as an ornamental plant; today it is listed as invasive in most of those regions (CAB International 2005). In its natural range, Kahili Ginger prefers open, well-lighted environments. Nevertheless, in tropical montane rain forests, it also occurs in semi- and full shade beneath the forest canopy (Stone/Pratt 1994). For instance, in Hawaii's montane rain forest, native species cannot compete in the infested sites; no regeneration of indigenous or endemic plant species within Kahili Ginger stands can be observed (Minden/Jacobi/Porembski/Boehmer in press). Furthermore, the colonization by Kahili Ginger provides favourable conditions for the spread of the invasive non-indigenous Strawberry Guava (*Psidium cattleianum*) tree. In the case of climate induced canopy decline, there will be no considerable regeneration of native rain forest plants; an almost total loss of native tree species (including the foundation species *Metrosideros polymorpha*) can be expected, and a new exotic rain forest type, dominated by two alien plant species, is likely to persist (Boehmer 2005; Minden/Hennenberg/Porembski/Boehmer 2009; Minden/Jacobi/Porembski/Boehmer in press).

46.2.4 Negative Synergetic Effects of Human Impact

Humans have inhabited tropical forests for thousands of years (Piperno/Bush/Colinvaux; Roosevelt 1999). Consequently, many tropical montane rain forests have witnessed multiple human impact too (Bruijnzeel/Hamilton 2000), although they did not become subject to intense human disturbance until the mid-20th century (Kellman/Tackaberry 1997). Human disturbances like forest clearing and selective logging directly affect forest structure, leading to widespread fragmentation (Wilder/Brooks/Lens 1998; Laurance 2007; Hemp 2009), thereby entailing complex edge effects[28] within the forest fragments.[29] Recent analyses show a continuous decrease in the area covered by montane rain forests, with a simultaneous increase in fragmentation, e.g., in Mexico between 1976 and 2003 (Cayuela/Golicher/González-Espinosa/Ramírez-Marcial/Rey Benayas 2006a; Cayuela/Rey Benayas/Echeverría 2006b) and East Africa (Schmitt/Denich/Friis/Demissew/Boehmer in press; Hemp 2009).

Even in areas of intact forest cover, indigenous people may have harvested forest products (figure 46.4), introduced useful species, or hunted, thus affecting abundance of important seed dispersers and seed predators.[30] Considerable effects may also have resulted from changes in coffee cultivation from shaded to non-shaded systems (semi-forest coffee systems; Senbeta/Denich/Boehmer/Woldemariam/Demel/Demissew 2007). The complex consequences of such human activities in montane tropical forest areas are still not well understood.

Lawton/Nair/Pielke/Welch (2001) showed that regional deforestation of upwind lowland forest influences cloud patterns in nearby mountains. In a tropical mountain region of southern Mexico, for instance, the agricultural conversion from orchards to dry farming in the coastal lowlands during the 1970's and 1980's resulted in an upward flux of overheated air masses and less cloud frequency in the mountains, thus causing a regional climate change (Richter 2008).

28 *Edge effects* are environmental changes (greater desiccation stress, wind turbulence, litter fall, etc.) associated with the abrupt, artificial boundaries of forest fragments.

29 See Laurance, Nascimento, Henrique, Laurance, Andrade, Ribeiro, Giraldo, Lovejoy, Condit, Chave, Harms and D'Angelo (2006).

30 See Senbeta and Denich (2006); Dietz, Hölscher, Leuschner, Malik and Amir (2007); Gradstein, Kessler and Pitopang (2007).

Figure 46.4: Managed montane rain forest with indigenous coffee shrubs (*Coffea arabica)*, Kayakela Forest, Kafa zone, south-west Ethiopia. **Source:** Photograph by Manfred Denich (2004).

Significant increases in stand precipitation, potential evaporation, and infiltration rates are contrasted by a significant decrease in water holding capacity. One of the consequences is a hundred- to thousand-fold rise in soil loss (compared to land under traditional cultivation) and a dramatic change in stream drainage. The most damaging result is a higher runoff rate during the wet period, with exuberant river discharges, as demonstrated by the floods during hurricane Stan in September 2005. This event led to extended sedimentations in the foreland of the mountain chain and is one of many examples of the consequences of the destruction of the water and soil reservoirs of tropical mountain forest ecosystems. Neither protecting the impacted lowland area by artificial dams and retention ponds, nor securing the slide areas by wire nets can solve the problem in the long term (Richter 2008).

Disturbance and deforestation, in combination with climate change, threaten the regional distributions of endangered tree species in tropical montane forests (Golicher/Cayuela/Alkemade/González-Espinosa/Ramírez-Marcial 2008). Strong forest fragmentation leads, for instance, to disruptions of mutual relationships between plants and animals, of seed disperser-seed interactions (reduced avian visitation of bird-dispersed trees), thus possibly posing long-term effects on tree species abundance and population dynamics (Lehouck/Spanhove/Colson/Adringa-Davis/Cordeiro/Lens 2009). Conservation concepts should, therefore, consider a multi-site approach with several protected areas at different altitudinal levels to cover the diversity of species and communities (Kessler 2001; Schmitt/Denich/Friis/Demissew/Boehmer in press). On abandoned land, regeneration of montane rain forests and de-fragmentation is possible as long as primary forest fragments still exist close to the disturbed sites (Karlowski 2006; Muñiz-Castro/Williams-Linera/Rey Benayas 2006).**t**

46.3 Conclusions

Climate change increases the vulnerability of tropical montane rain forests e.g. by intensifying the frequency of climatic anomalies and extreme weather events, and increasing natural disturbances. A variety of human impacts additionally cause complex synergetic effects. The numerous consequences of these transformations include: changes in species abundances; canopy loss; reduction in wildlife habitat; increased invasibility; the displacement of native species by invasive species; the formation of novel plant and animal communities; biodiversity loss; alterations to the hydrologic cycle; a decrease in water holding capacity; and temporal disruptions or permanent loss of fundamental ecosystem goods and services like regional water and air quality regulation, carbon sequestration, genetic and pharmaceutical resources, and natural hazard regulation. In addition to having a direct impact on montane ecosystems, severe changes in foreland ecosystems (e.g. deforestation) can affect nearby montane rain forests. However, many questions regarding the potential effects of climate change on ecosystem dynamics and species ranges remain unanswered and require further research.[31] Since several key concepts (e.g. of disaster, disturbance, resilience) are applied differently in the discussion on human and environmental insecurity from the way they are understood in ecology, a clarifying interdisciplinary discussion is urgently needed.

31 See Bruijnzeel (2001); Bush, Hanselman and Hooghiemstra (2007); Feeley and Silman (2008); Svenning, Kerr and Rahbek (2009); Boehmer, Niemand, Jacobi, Gerrish and Mueller-Dombois (submitted for publication).

47 Securitizing Land Degradation and Desertification: A Proactive Soil Security Concept

Hans Günter Brauch and Úrsula Oswald Spring

47.1 Introduction[1]

This chapter addresses manifold interactions between the natural environment and humankind affecting the land[2] (or often used synonymously as ground[3] and soil[4]) as the provider of ecosystem services, water storage and food for living organisms (plants, animals, micro-organisms, and human beings). As a result of human activities and increased demand due to population growth and climate change desertification has progressed, the land and the quality of the soil have degraded, and the impact of drought has increased.[5] On this background this chapter will:

a.) discuss to which extent the human-nature interactions pose *objective security dangers* and *subjective security concerns* for human beings, the state and the world of states, of the society and of the economy;
b.) introduce the new concept of '*soil security*' – in contrast to the established concept of 'territorial security' – and review the factors contributing to '*soil insecurity*';
c.) review the 'securitizing moves' by international organizations, nation states, and civil society to analyse the three distinct processes of 'land degradation', 'desertification', and 'drought' as issues of 'utmost importance' that 'require extraordinary

1 This chapter emerged from a policy-oriented study for UNCCD that was funded by the Spanish Ministry of the Environment and Rural and Martine Affairs and that was published in English (Brauch/Oswald Spring 2009; at: <http://www.unccd.int/knowledge/docs/dldd_eng.pdf>) and in Spanish (Oswald Spring/Brauch 2009; at: <http://www.unccd.int/knowledge/docs/dldd_sp.pdf>). This chapter, written from a social science perspective, reflects the critique of prominent natural scientists of the combined political concept of DLDD, the UNCCD Secretariat and its officials, as well as diplomats and state representatives have used in many policy documents. The authors are grateful for the recommendations by three reviewers from different scientific disciplines.

2 The term 'land' has multiple meanings. According to the *Shorter Oxford English Dictionary* (McKechnie ^{5}2002: 1534) the noun 'land' stands for "1. the solid part of the earth's surface, as distinguished from the sea or water, or from the air;" it is used synonymously for "2. a) ground or soil, esp. with ref. to its use or properties, b) the land, the (cultivable) earth regarded as a repository of natural resources and the chief source of human sustenance or livelihood, c) an area of ground under cultivation, a field." The second major meaning of 'land' refers to "3. a part of the earth's surface marked off by natural or political boundaries, a country, a nation, a state, also a realm, a domain;" and to "4. ground or territory held as public or private property, landed property ... In pl. territorial possessions; 5. the country, as opp. to the town; 6 a) a strip of arable land or pasture divided from other similar strips by furrows, b) chiefly engineering ...; 7. a tenement building ...; 8. a stretch of country of undefined extent." According to *Webster's New Universal Unabridged Dictionary* (McKechnie ^{2}1983: 1018) 'land' refers to "1. the solid part of the earth's surface: distinguished from sea; 2. a specific part of the earth's surface ...; 3. (a) a country, region, etc.; (b) the inhabitants of such an area; a nation's people;" but it is also used as a synonym for "4. ground or soil in terms of its quality, location; as rich land, high land; 5. ground considered as property; estate...; 6. [pl] specific holdings in land; 7. rural regions as distinguished from urban regions...;" and in economics it refers 10. to "natural resources." As a political concept 'land' refers to territory, besides the people and the system of rule one of three components of national sovereignty. But as a concept in the natural sciences land embraces the soil, its water and its vegetation cover. Many dictionaries in the social sciences do not define 'land' (Kuper/Kuper ^{2}1996: 449 refer to "landscape"; Krieger 1993: 523 to "land reform"). In Schmidt's (^{2}2004: 401) dictionary on 'Politik', the use in political science is limited to the contrast of urban and rural areas, as a synonym for the territory of the state and in German as a 'state' of the federation.

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measures' (Wæver 1995; 2008) for coping with its consequences to avoid that they result in people's movements, crises, and conflicts.

First the three key scientific concepts of *land degradation, desertification and drought* and the policy-focused DLDD concept[6] – that has recently been used by the UNCCD Secretariat – will be briefly conceptualized (47.2), then the three phases of their evolution will be reviewed (47.3), the securitization of the ground will be discussed (47.4), the causes and impacts of land degradation and desertification will be diagnosed (47.5), a proactive policy for coping with land degradation and desertification will be outlined (47.6), and finally, recommendations will be offered (47.7).

47.2 Conceptualization of Land Degradation, Desertification, and Drought

According to a recent definition in an OSCE Background paper: "Land degradation means loss of the biological and economic productivity of rainfed or irrigated cropland, or range pasture, forests and woodlands resulting from various factors, including climatic variations and human activities such as unsustainable land uses." Within this wider concept "desertification means the land degradation in arid, semi-arid and dry-subhumid areas", where land is defined as "the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes" (Daussa 2009: 7–8). Accordingly, "combating land degradation requires an integrated approach that takes into account water management and also addresses agricultural and industrial issues. Being a common threat in the region, land degradation calls for transboundary solutions".

For the understanding of 'desertification' the role of nature and human-induced factors has remained controversial. The linkage of human activities, such as the inadequate management of natural resources, and droughts affected in the 1970's many countries in the Sahel. In response, the UN General Assembly organized the *UN Conference on Desertification* (UNCOD) in 1977. During the Earth Summit (1992) desertification was defined as "resulting from various factors, including climatic variations and human activities" (UNEP 1992) and the *United Nations Convention to Combat Desertification* (UNCCD) of 17 June 1994 stated: "desertification is caused by complex interactions among physical, biological, political, social,

3 According to the *Shorter Oxford English Dictionary* ([5]2002: 1158) the term 'ground' has three key meanings: as "I) the lowest or deepest part..."; as "II) base, foundation", and as "III) the earth, land" referring to "8. the earth as distinguished from heaven ...; 9. the earth as distinguished from the sea; dry land...; 10. the earth's surface, on which human, animal, and plant life exists ...; 10. (The) soil, earth, mould, a kind or variety of the soil; 12. a region, a land, a country; ... 14. area or distance ... on the face of the earth; land..." According to *Webster's New Universal Unabridged Dictionary* (McKechnie [2]1983: 804) in American English 'ground' refers to "bottom, foundation, soil" as synonyms for "3. the soil of the earth, earth, land" and as "2. the solid surface of the earth." It is hardly used as a concept in the social and natural sciences.

4 The term 'soil' according to *Webster's New Universal Unabridged Dictionary* (McKechnie [2]1983: 1725) refers either to "any soiled spot, stain, smirch;" or to "1. the surface layer of earth supporting plant life; 2. figuratively, a place for growth or development of any kind; 3. land, country, territory; as native soil; 4. ground or earth, as barren soil." According to the British *Shorter Oxford English Dictionary* ([5]2002: 2910) the term 'soil' points to: "1. the face or surface of the earth, the ground, esp. considered as the source of vegetation or with ref. to composition, quality; 2. a piece or stretch of ground, a site; 3. a land, a country, a region ... now also national territory 4. the material comprising the thin top layer of much of the earth's land surface, composed of fragmented rock particles with humus, water and air, esp. such material as will support the growth of plants, as contrasted with subsoil; b) fragmentary or unconsolidated material occurring naturally at or near the surface of the earth ..." As a scientific concept 'soil' is widely used in the natural and in the soil sciences, especially with regard to specific properties and functions and the sources of erosion and degradation. Wild (1993: 3) defined soil as "the loose material composed of weathered rock and other materials, and also partly decayed organic matter that covers large parts of the land surface of the Earth" that "supports crop growth and can be tilted." He discussed soil "as a component of ecosystems," through geological times and its cultivation by humankind. According to Young (1998: 27) basic stages in soil survey are the description and identification of soil types, classification, and mapping. Soil responds to and influences environmental processes and conditions that is vital for plant growth and food supply (Ellis/Mellor 1995: 1). In soil science, the "term 'soil degradation' denotes a decline in soil quality as a result of anthropogenic factors. .... The concept of soil quality is in turn, based on the soil's capacity to produce biomass and perform environmental services" (Lal 2003: 17).

cultural and economic factors." According to Art. 1 (b) "*combating desertification*" aims at:

> (i) prevention and/or reduction of land degradation; (ii) rehabilitation of partly degraded land; and (iii) reclamation of desertified land." *Drought* is used for "the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.

The UNCCD defined four strategic objectives to combat desertification:

1. to improve living conditions of affected populations;
2. to improve the condition of affected ecosystems;
3. to generate global benefits through effective implementation of the UNCCD; and
4. to mobilize resourses to support the implementation of the Convention through building effective partnerships between national and international actors (UNCCD 1994: 36).

Desertification is a highly contested scientific concept (Reynolds/Smith 2002; Mainguet 2003; Safriel 2009), where the controversy focuses "on the causes and consequences of land degradation." For Reynolds and Smith (2002: 3), this problem is

> often attributed to a myriad of human activities, particularly overgrazing, it may be triggered or exacerbated by climate variability... [and] not all such ecological, biogeochemical, and hydrological changes have an immediate or direct economic impact on human activities.

Within their analytic framework they combine meteorological, ecological, and human dimensions and distinguished among the farm or household, the community, regional and international levels as well as social (rural livelihoods) and biophysical factors (state of the ecosystem). They suggested that

> it is crucial to work through the causal links of drylands land degradation, from climate dynamics to ecological impacts to policy response strategies, and to span a wide range of temporal and spatial scales, from small geographical units to larger regions (Reynolds/Smith 2002: 19).

Controversies exist between the different desertification concepts that have been employed in the natural sciences and the *political* DLDD concept[7] as used by the UNCCD Secretariat and some UNCCD member states. Whether desertification occurs only in drylands is a matter of definition. The UNCCD text declares that "desertification is land degradation in ..." and then cites three types of drylands (out of existing four). Thus, the question is not whether or not desertification also occurs outside the drylands, because by definition it can not. However, land degradation surely occurs also outside the drylands but has adverse direct and indirect effects on other ecosystems, such as dust storms due to wind erosion. Land degradation applies to about 33 per cent of the global land surface (UNEP 2008); the productivity loss per year is estimated at 0.5 to 1 per cent, or an accumulated loss of at least 20 per cent during the last 40 years.

In a classification of drought typology Smith (1992) distinguished among four types:

1. Meteorological drought due to precipitation shortage but with no lasting ecological or economic impact and no effective behavioural response.
2. Hydrological drought which depletes water resources and leads to more rigorous management control of supply and demand.
3. Agricultural drought where widespread impact affects farming production and may lead to government compensation,
4. Famine drought, confined mainly to less-developed countries, often wipes out subsistence agriculture and leads to catastrophic mortality and massive international relief programmes (Whittow 2002: 641).

While the first three types have also affected developed nations (e.g. the Dust Bowl in the USA during the 1930's), since 1950 the fourth type has had the highest impact and death toll in developing countries that lack the scientific, administrative, and economic coping capacities. Prince (2002: 24–26) noted that

5 See in this volume: chap. 48 by Safriel; chap. 49 by Adeel; chap. 50 by Galil Hussein; chap. 51 by Arredondo Moreno and Huber-Sannwald; chap. 53 by Mainguet, Dumay, Kabiri and Rémini; chap. 52 by Laureano; with a special focus on the Mediterranean see Mendizábal and Puigdefábregas (2003); Nasr (2003); Kepner, Rubio, Mouat and Pedrazzini (2006); Rubio, Safriel, Daussa, Blum and Pedrazzini (2009); López Bermúdez (2009).

6 The UNCCD Convention (1994) refers to: "Combating desertification and land degradation and mitigating the effect of droughts." More recently, the DLDD concept has been widely used by the UNCCD Secretariat; see at: <http://www.unccd.int/search/search_results.php?query=DLDD>. The DLDD term was criticized by soil scientists, e.g. Safriel (2009). From the perspective of social science theory, 'securitization' is a political process where the vocabulary applies that is used in the policy-focused discourse.

7 Its use is relatively recent and did not exist during the first years of UNCCD in force.

desertification "can be caused either by drought or inappropriate intensity or type of land use, or both" even though both may have different effects due to the fact that some landscapes may be more susceptible than others. While drought events may be temporal, desertification processes may become irreversible.

According to the *Global Drought Monitor* by the Meteorological Hazards and Seasonal Forecasting group at the Benfield UCL Hazard Research, "drought is a deficiency in rainfall over an extended period of time. It is a recurrent feature of climate, which happens almost everywhere." The *Global Drought Monitor* offers a summary of current hydrological drought conditions worldwide where "hydrological drought conditions are displayed based on the two leading drought indices" called the *Standardized Precipitation Index* (SPI) and *the Palmer Drought Severity Index* (PDSI), "a soil moisture algorithm which includes terms for water storage and evapotranspiration".[8]

Loss of yield productivity could produce food scarcity obliging people to migrate from the drylands to better agricultural land, to urban areas or to industrialized countries, but they can also induce inadequate governance, hunger riots, and conflicts. Thus, the three distinct scientific components that were linked in the political DLDD concept[9] pose multiple global, regional, and national security issues related to food, water, climate, livelihood, health, urban, rural and transportation security (Brauch 2003, 2003c, 2006).

A political consensus emerged that land degradation and desertification is primarily a human-induced and drought a natural process with negative effects on land affecting the function of an ecosystem for storing and recycling water, for generating energy, and recycling nutrients. Short-term crop yield increases may threaten the long-term conservation of the agricultural land, which is the main cause of deterioration together with overgrazing, land clearing, deforestation, land-use change, mining, urban conversion, poor irrigation processes, and pollution. All of them create major physical stressors on land such as wind and water erosion, removal of nutrients, increase in acidity, salinization and alkalinization, destruction of soil structure, and loss of organic matter (USDA 2009). Based on these conceptualizations, the political DLDD concept has gradually evolved in three phases from a scientific problem to a policy question and a security danger and concern.

47.3 Evolution of the Scientific Terms of Land Degradation and Desertification, and of the Political DLDD Concept

Three stages of the evolution of the three distinct scientific concepts that were combined by the UNCCD Secretariat in the policy-focused DLDD concept can be distinguished: a) of scientific agenda-setting and research (*scientizing*), b) of political agenda-setting and action (*politicizing*), and c) of upgrading it to a security issue (*securitizing*).

47.3.1 Scientizing by Creating Awareness for Desertification

Global environmental change (GEC) has emerged as a multidisciplinary scientific field of study since the 1970's that has focused on climate change, desertifica-

8 The PDSI "facilitates the quantitative comparison of drought incidence at different locations and at different times of the year," but it "may lag emerging droughts by several months. The empirical relationships used to define the PDSI were determined by observations taken from just nine US climate stations. The limited nature of the original PDSI source training data brings the general applicability of the PDSI into question" (Palmer 1965; Alley 1984).

9 A recent 6-page UNCCD document on "Policies for addressing desertification, land degradation and drought (DLDD) with a focus on strengthening the role of the United Nations Convention to Combat Desertification (UNCCD)" referred 29 times to the DLDD concept; at: <http://www.unccd.int/meetings/global/hlpd/docs/Policy_paper_eng.pdf>. See also the presentation by the UNCCD Executive Secretary, Luc Gnacadja, 4–5 June 2009 in Bonn on: "Framing the issue DLDD into Sustainable Development"; at: <http://www. unccd.int/publicinfo/undp/docs/DLDD%20Priorities%20and%20Principles%20-%20June%2009%20-%20UNDP-UNCCD%20Retreat-%20rev%20LG.pdf>. However, neither UNCCD's 10 year Madrid strategy; at: <http://www.unccd.int/cop/officialdocs/cop8/pdf/16add1eng.pdf> nor the report on the 17th session of the UNCSD in May 2009 used the DLDD concept, what may be an indication that it has not been adopted by UN and UNCCD members. See: United Nations Commission on Sustainable Development Report on the seventeenth session (16 May 2008 and 4–15 May 2009), Economic and Social Council, Official Records, 2009 Supplement No. 9 at: <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N09/355/72/PDF/N0935572.pdf?OpenElement> (20 December 2009).

tion, water and biodiversity, as well as on the human factors, of population growth, urban and rural systems, and the economic process (figure 47.1). Since the 1990's, scientific networks and projects on global change as well as policy-focused scientific epistemic communities (Haas 1989, 1990, 1992, 1993; see IPCC) have evolved that assess scientific research results, and explain them to the global policy community (*scientific agenda-setting*).

The scientization of 'desertification' started in the 1950's when UNESCO published 30 volumes on drylands in which 200 research institutes were involved.[10] In response to the Sahelian droughts of the 1970's three institutions were established a) the *Inter-States Committee for the Fight against Drought in the Sahel* (CILSS; chap. 63 by Bikienga); b) the *Club du Sahel* within OECD; and c) the *United Nations Sahelo-Sudanian Office* (UNSO) (Mainguet 2003: 645). In 1977, the *United Nations Conference on Desertification* (UNCOD) proposed a *Plan of Action to Combat Desertification* (PACD), and UNEP was tasked to develop it further.

In addition to the work of the *Consultative Group on International Agricultural Research* (CGIAR)[11], specific scientific and policy-focused activities related to land degradation and desertification[12] include:

- The *Global Assessment of Human Induced Soil Degradation* (GLASOD) by the *International Soil Reference and Information Centre* (ISRIC) in 1990 produced a world map of soil degradation for the 1992 *United Nations Conference on Environment and Development* (UNCED) based on expert assessments and input from more than 250 soil and environmental scientists (Kniivila 2004: 4–5).
- The *Global Assessment of Land Degradation and Improvement* (GLADA) identified a programme on *Land Degradation in Drylands* and studied the status and trends of land degradation and established hotspots "suffering extreme constraints or at severe risk", but also areas that have been reversed.[13]
- The Desertification Synthesis of the *Millennium Ecosystem Assessment* (MA 2005) offered an overview of the state of the knowledge and of the knowledge gaps of desertification only, but not of 'land degradation' in general and not of drought.[14]

Besides these scientific assessments several issue-specific scientific networks have evolved:

- *TerrAfrica* is a partnership that aims to address land degradation by scaling up harmonized support for effective and efficient country-driven *sustainable land management* (SLM) practices in Sub-Saharan African countries and NEPAD (Bai/Dent/Olsson/Schaepman 2008).[15]
- *DesertNet* improved research on combating and preventing desertification in Europe and at a global scale, and to support communication with policy-makers and other stakeholders.[16]
- *ARIDnet* is addressing the interaction of meteorological, ecological (*biophysical* factors), and the human dimensions (*socio-economic* factors) of desertification.[17]

Safriel (2009: 36–39) reviewed both the scientific and the conceptual political debate of UNCCD on the linkages between these three concepts of desertification as a "geographical subset of land degradation" or as "extreme land degradation" as well as an "associate of drought and climatic variations". He argues that droughts "constitute an extreme expression of this strong spatio-temporal climatic variability of the drylands" that can be interpreted as "a subset of 'climatic variability'" and that the UNCCD definition implies that drought "is more a driver of desertification than an independent phenomenon to be somewhat associated with desertification", what further implies that "'mitigating the effects of drought' becomes a subset of 'combating desertification', rather than an added action".

10 For a review of the conceptual debate and detailed sources see Mainguet (1994, 1995, 2003).

11 See for details at: <http://www.cgiar.org/>.

12 However, none of these specifically dealt with drought.

13 See for details; at: <http://www.isric.org/UK/Aut+ISRIC/Projects/Current+Projects/GLADA.htm>.

14 See also the publications by two of its lead authors: Adeel, Safriel, Niemeijer, White, de Kalbermatten, Glantz, Salem, Scholes, Niamir-Fuller, Ehui and Yapi-Gnaore (2005); Adeel and Safriel (2008); Safriel and Adeel (2005, 2008); Adeel (2009); Safriel (2004, 2006, 2006a, 2007).

15 See for details at: <http://www.terrafrica.org/> and at: <http://www.isric.org/isric/webdocs/docs/Report%202008_01_GLADA%20international_REV_Nov%202008.pdf>.

16 See for details at: <http://www.european-desertnet.eu/index.php>.

17 See at: <http://www.biology.duke.edu/aridnet/>. ARIDnet is funded by the U.S. National Science Foundation) with the goal to develop and test a new synthetic Drylands Development Paradigm (DDP).

Within the framework of the *Earth System Science Partnership* (ESSP; chap. 74 by Leemans/Rice/Henderson-Sellers/Noone) and the four related major research programmes[18] issues related to land degradation, desertification, and drought were researched but no specific scientific programme compared with climate change (e.g. WCRP and the *Intergovernmental Panel on Climate Change:* IPCC) and water (e.g. *Global Water Partnership:* GWP) has been set up for land and soil issues (Vlek 2005: 25). So far, the communication of scientific research on land degradation and desertification to policy-makers has been "inadequate" (Bauer/Stringer 2009: 249).

Each of the three key conventions on climate change (UNFCCC), biodiversity (CBD), and desertification (UNCCD) has created a scientific and technological advisory body, with the *Subsidiary Body for Scientific and Technological Advice* (SBSTA) for UNFCCC, the S*ubsidiary Body on Scientific, Technical and Technological Advice* (SBSTTA) for CBD, and the *Committee for Science and Technology* (CST) for UNCCD. With the adoption of UNCCD's 10-year Strategy (2007) at UNCCD's COP 8 the role of the CST was upgraded.

At COP 9 in Buenos Aires (22–24 September 2009) the first UNCCD Scientific Conference[19] addressed "biophysical and socio-economic monitoring and assessment of desertification and land degradation, to support decision-making in land and water management". [20] The participants discussed the wide range of methodologies and underlined the need for *sustainable land management* (SLM). They suggested "an independent, international, interdisciplinary scientific advisory mechanism" for new knowledge creation to DLDD/SLM.[21] While the gap between science and politics was not overcome in Buenos Aires, the *conference of the parties* (COP 9) approved a second Scientific Conference for 2012 to deal with economic factors of desertification, technologies of sustainable land management and the increase of resilience for DLDD regions, including the participation of civil society organizations and the use of traditional technology. But they failed to adopt an "accompanying methodology and data collection strategy".[22]

47.3.2 Politicizing Land Degradation, Desertification, and Drought

Since 1992, international environment policy has resulted in new forms of global governance (climate change, biodiversity, desertification, water regimes) that have moved to the centre of political concerns (*politicization*, e.g. Dessler/Parson 2006, 2008) in the framework of the COPs of UNFCCC, CBD, UNCCD, and the triennial World Water Fora.

With the entry into force of the UNCCD (1996) desertification became an international political issue.[23] At COP 5 the *Committee for the Review of the Implementation of the Convention* (CRIC) was set up[24] and at COP 8 the *10-Year Strategic Plan and Framework (2008-2018)* was adopted. At COP 9 (2009), the existing institutional and "political divisions that the UNCCD has faced since its conception,

18 The four component research programmes are DIVERSITAS (chap. 76 by Walther/Larigauderie/Loreau), the *World Climate Research Programme* (WCRP); chap. 78 by Church/Asrar/Busalacchi/Arndt), the *International Geophysical and Biological Programme* (IGBP; chap. 77 Noone/Nobre/Seitzinger), the *International Human Dimensions Programme* (IHDP; chap. 75 by von Falkenhayn/Rechkemmer/Young).

19 The conference was prepared by the *Drylands Science for Development* (DSD) Consortium consisting of five research institutions and networks: the European DesertNet, the International Center for Agricultural Research in Dry Areas, the International Crops Research Institute for the Semi-Arid Tropics, the European Commission Joint Research Centre - Institute for Environment and Sustainability and United Nations University International Network on Water, Environment and Health. In preparing this SC-1 the DSD consortium convened three global working groups of scientists to analyse and summarize the leading scientific knowledge on the priority theme in order to generate practical recommendations.

20 See: "Summary of the Ninth Conference of the Parties to the UN Convention to Combat Desertification: 21 September – 2 October 2009", in: *Earth Negotiation Bulletin*, 4,229 (5 October 2009): 1, 10–1

21 See: UNCCD: "Report of the UNCCD 1st Scientific Conference", ICCD/COP(9)/CST/INF.2, 25 September 2009; at: <http://www.unccd.int/cop/cop9/menu.php>

22 See: *Earth Negotiation Bulletin*, 4,229 (5 October 2009): 16.

23 COP 1: Rome (1997); COP 2: Dakar (1998); COP 3: Recife (1999); COP 4: Bonn (2000); COP 5: Geneva (2001); COP 6: Havana (2003); COP 7: Nairobi (2005); COP 8: Madrid (2007); COP 9: Buenos Aires (2009).

24 Until September 2009, seven CRIC meetings have occurred: 1) in Rome (November 2002); 2) in Havana (August-September 2003); 3) in Bonn (May 2005); 4) in Nairobi (October 2005); 5) in Buenos Aires (March 2007); 6) in Madrid (September 2007) and 7) in Istanbul (November 2008).

particularly with regard to the relationship between the Global Mechanism and the Secretariat",[25] could not be overcome.

As a suggestion of the *World Summit on Sustainable Development* (WSSD) in 2002 in Johannesburg, the *Global Environment Facility* (GEF) adopted land degradation as a 'focal area' and launched an 'operational programme' on *sustainable land management* (SLM). The *International Year of Deserts and Desertification* (IYDD) in 2006 stressed the urgency of combating desertification and the 17th session of the UN Commission on Sustainable Development (UNCSD) recommended integrating agriculture and rural development with land degradation and desertification.

47.3.3 Securitizing Desertification

With four international conferences and workshops in Almería in 1994 (Puigdefábregas/Mendizábal 1995) and in 2006[26] on desertification and migration and in Valencia in 2003 and in 2007 on desertification in the Mediterranean as a security issue (Kepner/Rubio/Mouat/Pedrazzini 2006; Rubio/Safriel/Daussa/Blum/Pedrazzini 2009)[27], the Spanish government launched a process of securitization of desertification. The security link was taken up by UNCCD at its CRIC 3 meeting (2005)[28] and in UNCCD Issue Paper No. 2 (Brauch/Oswald Spring 2009; Oswald Spring/Brauch 2009). In June 2007, in a workshop on "Desertification: A security threat?", the German development (BMZ) and foreign ministries (AA), and UNCCD reinforced the link between an extended security concept and desertification affecting human and food security at the global, regional, national, and local level. During the *International Year of Deserts and Desertification* (2006) the security linkage was occasionally addressed,[29] but contrary to the intensive securitization of climate change no similar policy debate has emerged on securitizing desertification, and UNCSD 17 referred to 'food' and 'land tenure security' but not to 'soil security', while COP 9 addressed only 'land and food security'.

47.4 Securitization of the Land as Territory and as Soil

47.4.1 Security Concepts, Approaches, and Securitization Theory

Security is a key *concept* in the social sciences and a value and goal of activity of nation states and of supra- and sub-state actors, referring to protection, lack of risks, certainty, reliability, trust and confidence, predictability in contrast to danger, risk, disorder, and fear (Brauch 2003, 2005, 2005a, 2008, 2009).

'Security in an objective sense' refers to specific *security dangers*, *dimensions* and *referent objectives* as well as *sectors* (social, energy, food, water, health, livelihood and also soil), while 'security in a subjective sense' refers to *security concern*s by government officials, media representatives, scientists or 'the people' who securitize[30] perceived 'dangers' as security 'concerns' being existential for the survival of the referent object. Security legitimizes extraordinary measures and means to face and cope with these concerns. Thus, *security concepts* have been used as tools to analyse, interpret, and assess past actions or to legitimize present or future activities in meeting the specified security dangers and concerns.

25 See: *Earth Negotiation Bulletin*, 4,229 (5 October 2009): 15.

26 See: II International Symposium: "Desertification and Migration", Almería, Spain, 25–27 October 2006; at: <http://www.sidym2006.com/eng/eng_ponencias_conclusiones.asp>.

27 See the conference programme at: <http://www.osce.org/documents/eea/2007/11/27982_en.pdf>.

28 See for a brief report at: <http://www.afes-press.de/pdf/UNCCD_journal_050511.pdf> and a documentation of the CRIC-meeting at: <http://www.afes-press.de/pdf/Earth_negot_bulletin_04_175.pdf>; see also the speech by Oswald/Brauch; at: <http://www.afes-press.de/pdf/Oswald_Brauch_lang.pdf>.

29 See the presentations of Brauch in Cairo and in Rome in 2006, in Florence and Fuerteventura in 2007 that can be accessed at: <http://www.afes-press.de/html/download_hgb.html>.

30 The scientific concept of 'securitization' – as used below – was coined by Wæver (1995) as a specific theoretical concept in political science and international relations. It differs fundamentally from the term 'securitization' as used in the banking sector. While *Webster's New Universal Unabridged Dictionary* (McKechnie ^{2}1983: 1641) does not yet list this term, the *Shorter Oxford English Dictionary* (^{5}2002: 2734) refers to the verb 'securitize' with a different meaning in commerce to "convert (an asset, esp. a loan) into securities, usually for the purpose of raising cash by selling them to other investors. Banker Assets will be growing more slowly ... as the bank securitizes more of its loan." For this different meaning of securitization as a financial technique "that pools assets together and, in effect, turns them into tradable security" see: Fabozzi and Kothari (2008).

The *Copenhagen School* (Buzan/Wæver/de Wilde 1998) posed the attention to the *widened* use of security from the narrow military and political scope to the wider economic, societal, and environmental security 'sectors'. But in their *deepening* of the security concept they focused primarily on state-centred referent objects (international, regional, national), but they did not use or were sceptical (Buzan 2004) of the human security concept. In his conceptual mapping of contemporary security concepts, Brauch (2008, 2009) added the extensive use of sectoral security concepts (*sectorialization*) and integrated the many different meanings of *human security* in policy debates and scientific discourses (Brauch 2009b) while Oswald (2001, 2009) proposed both a combined *human, environmental, and gender security* (HUGE) concept and a related policy strategy.

The 'securitization theory' developed by Wæver (1997) offers a theoretical approach for the analysis of policy declarations ('speech acts') on the security impacts of climate change, food and water issues (Oswald Spring/Brauch 2009) as well as of the three distinct scientific concepts of land degradation, desertification and drought, and of the composite political DLDD concept.[31] By declaring a process a security problem or as an existential threat to sovereignty, the 'state' has been the major securitizing actor.[32] But environmental issues could also be enacted by non-state actors. The emerging policy debate on climate change and land degradation and desertification as well as on the political DLDD concept represents a new subjective security concern whereby the 'securitizing actor' is not solely the nation state but also a transnational epistemic community of natural scientists (e.g. the IPCC). The referent objects are primarily human beings and humankind who are both the cause of global warming and the victims of climate change and land degradation and desertification as well as of the political DLDD concept. However, both actors (those who cause these effects and the primary victims) are not identical, what has created major equity problems (Adger/Paavola/Huq/Mace 2006).

From a narrow national security perspective the 'securitizing actor' and the 'referent object' remains the nation state, while from a 'people-centred' societal or human and gender security outlook the scientific community has become a new securitizing actor, and the referent object are not any longer the state but the vulnerable people that will be hurt by these newly emerging security issues related to climate change and land degradation and desertification as well as to the political DLDD concept.

47.4.2 Two Sides of Securitizing the Land: Territory vs. Soil

Securitizing the 'land' refers to two distinct aspects of 'land' as 'territory' and 'land' as 'soil'. Land as territory covers a key feature of national sovereignty and refers to the protection of the state (territory, people, political institutions); and the land as 'soil' produces the key environmental services, among them the food for living organisms. While 'territorial security' points to the traditional national security concept, the new sectoral 'soil security' concept applies primarily to the economic, environmental, and societal dimensions of security. 'Soil security' can be analysed from both the perspectives of human and gender security and from state-centred perspectives of local, national, regional, and international security.[33]

The 'soil security' concept claims that land degradation and desertification processes relate to a lack of precipitation during periods of drought and an exhaustion of ground water reserves severely challenges the livelihood and often oblige people to migrate to better agricultural land, to urban centres within their country (urbanization) or abroad. 'Soil security' is threatened by a) the degradation of soils and related fertility and biodiversity losses due to processes of geophysical, wind, and water erosion, and b) drought resulting in bad harvests and crop yield declines that have often triggered in developing countries severe and extended periods of famine that affected several hundred millions of people in the 20th century and caused thousands of deaths. In the Sahel drought human factors were involved, and they were decisive.

31 The concept of 'securitization' as used here refers to a specific theoretical approach in political science and international relations. Fabozzi and Kothari (2008) lack any reference to the different earlier use by Wæver (1995).

32 Much of the elaboration of this theory (Wæver/Buzan/Kelstrup/Lemaitre 1993; Buzan/Wæver/de Wilde 1998; Wæver/Buzan/de Wilde 2008) has occurred through exploring the particular dynamics and characteristics of security. Introductions to the theory are at: <http://polforsk.dk/download/securitytheory2006/homepage>."

33 The concept of 'soil security' refers to 'ecosystem' or 'environmental services' offered by the land. It also includes those services that are provided by the 'land', namely through the interaction between the biota, within and on the soil, and the soil and the atmosphere.

But the claim of a spatial expansion of existing deserts is disputed among soil specialists who argue that desertification does not result in the expansion of deserts.[34]

'Soil insecurity' challenges basic ecosystem services, especially due to land degradation but also due to drought,[35] inadequate food production and supply, especially for the poor and marginalized population that cannot afford to purchase food. Since 2008 drastic food price rises increased the number of hungry people by 100 million in 2009, and in the same year one billion people were hungry in countries lacking financial resources and agricultural policy to meet the food demand of their growing population or the capacity to effectively distribute the food aid to the people most in need and affected by famine (FAO 2009; IFPRI 2009).

'Securitzing the land as soil' implies that both policy-makers in national governments and in international organizations, programmes (FAO, WFP, UNDP, UNEP) and environmental regimes (UNFCCC, UNCCD, CBD), networks and knowledge-based epistemic communities succeed in upgrading land issues from environmental, societal, economic and food issues to problems of 'utmost importance' for the highest political level that require 'extraordinary measures' to face their societal and political impacts and cope with their natural and anthropogenic causes.

47.4.3 Securitizing the Land as Soil: Causes and Societal Effects

'Securitizing the land' as soil and 'grounding security' point to different problems:

- *securitizing the land* as soil refers to a process of creating a wider global political awareness for land degradation and desertification by making it a key international issue and upgrading it to the security realm;
- *grounding security* – as we argue below – refers to reactive vs. proactive short-, medium- and long-term strategies for coping with soil insecurity and its consequences.

Addressing both aspects of soil (in)security through a political process of securitization of land degradation and desertification as well as on the political DLDD concept and of the development of effective international strategies, national policies, and local measures requires a diagnosis of the complex interaction between natural and societal causes.

47.5 Diagnosing Land Degradation, Desertification, and Drought

47.5.1 Models on Human-Nature Interactions

Various models were developed to analyse the nature-human interactions. The model of OECD (2001) assumes that human activities put pressure on nature that leads to environmental changes (climate change, water and soil degradation, biodiversity loss) to which the state, the society and the economic sector respond with multiple activities.[36] The PEISOR model (figure 47.1) was developed to securitize GEC issues. This model combines five stages:

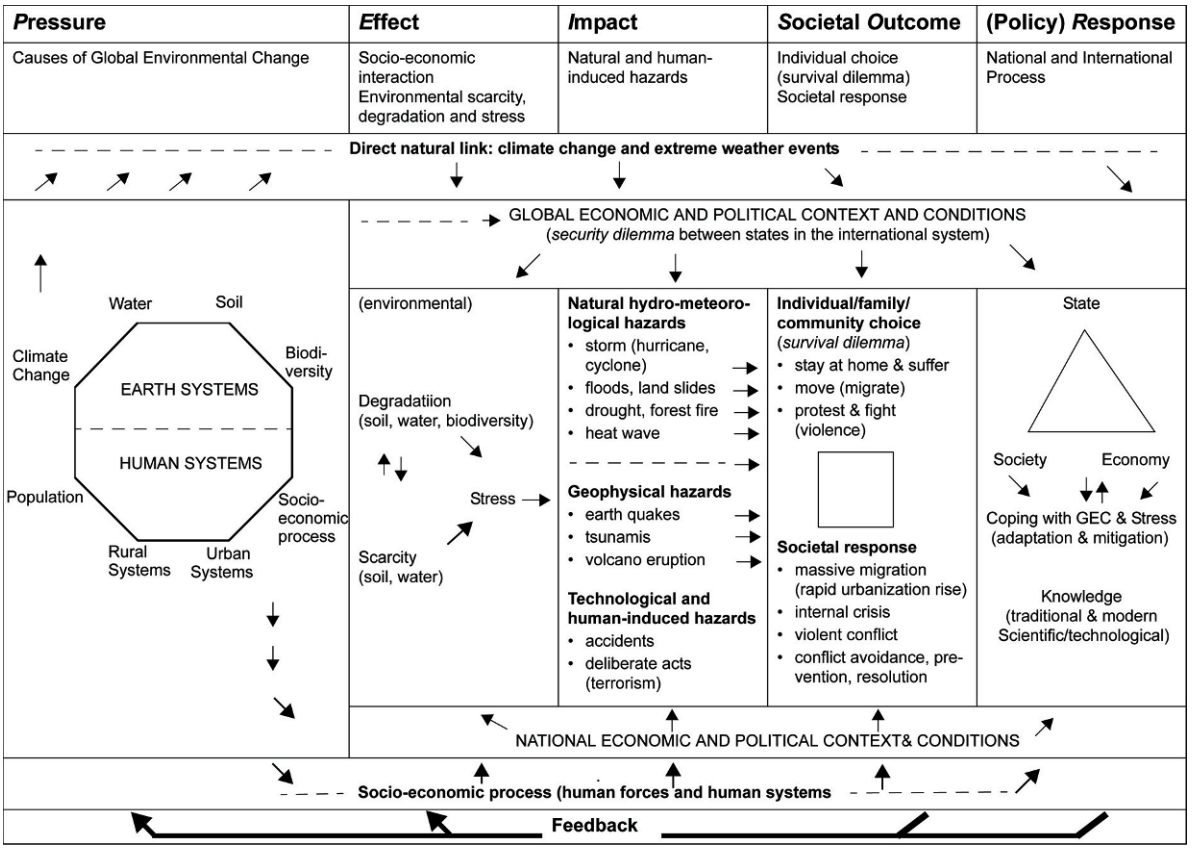
- *P* (*pressure*) refers to eight drivers of global environmental change;

34 The IPCC claimed that anthropogenic climate change may cause an expansion of deserts, but so far we do not really see it yet. Droughts do not expand deserts, because once drought terminate everything gets to where it had been before, unless the drought is linked with human activities. In spite of the UNCCD definition of desertification, 'climatic variations' alone do not cause desertification, which is caused by 'human activities' when there are no climatic variations, or when 'human activities' are coupled with 'climatic variations'.

35 Safriel argued that the soil stores some water as part of its services. But the water stored in the soil, Allen (2009) calls 'brown water', is not available for drinking, sanitation, and irrigation. Also, one gets the impression that the soil is simply a physical entity, but it would not have stored water unless it has a lot of organic matter, and the organic matter is contributed by the above soil biota. Therefore Safriel sees some problems in attributing the flow of ecosystem services to the 'soil', in his view it is the ecosystem, organic matter, microorganisms, evapotranspiration, etc.

36 For details see Brauch (2009a). The *UN Commission for Sustainable Development* (UNCSD) used its DSR (*Driving Force – State – Response*) model and the *European Environment Agency* (EEA 1998) distinguishes *D*riving Force – *P*ressure – *S*tate – *I*mpact – *R*esponse (DPSIR) as a mechanism for analysing environmental problems and for developing environmental indicators. The framework of the *Millennium Ecosystem Assessment* (2003, 2005a) considers security as a key element of human well-being (Leemans 2009).

Figure 47.1: PEISOR-Model. **Source:** Developed further based on Brauch (2005, 2009a) and Brauch and Oswald Spring (2009).



- *E* to the *effects* of the interactions on environmental scarcity, degradation, and stress;
- *I* to extreme *impacts* of human-induced and climate-related natural hazards;
- *SO* to *societal outcomes*: forced migration, slums, crises, conflicts or state failure;
- R to the *response* of all stakeholders.

47.5.2 Environmental and Human Pressures (P)

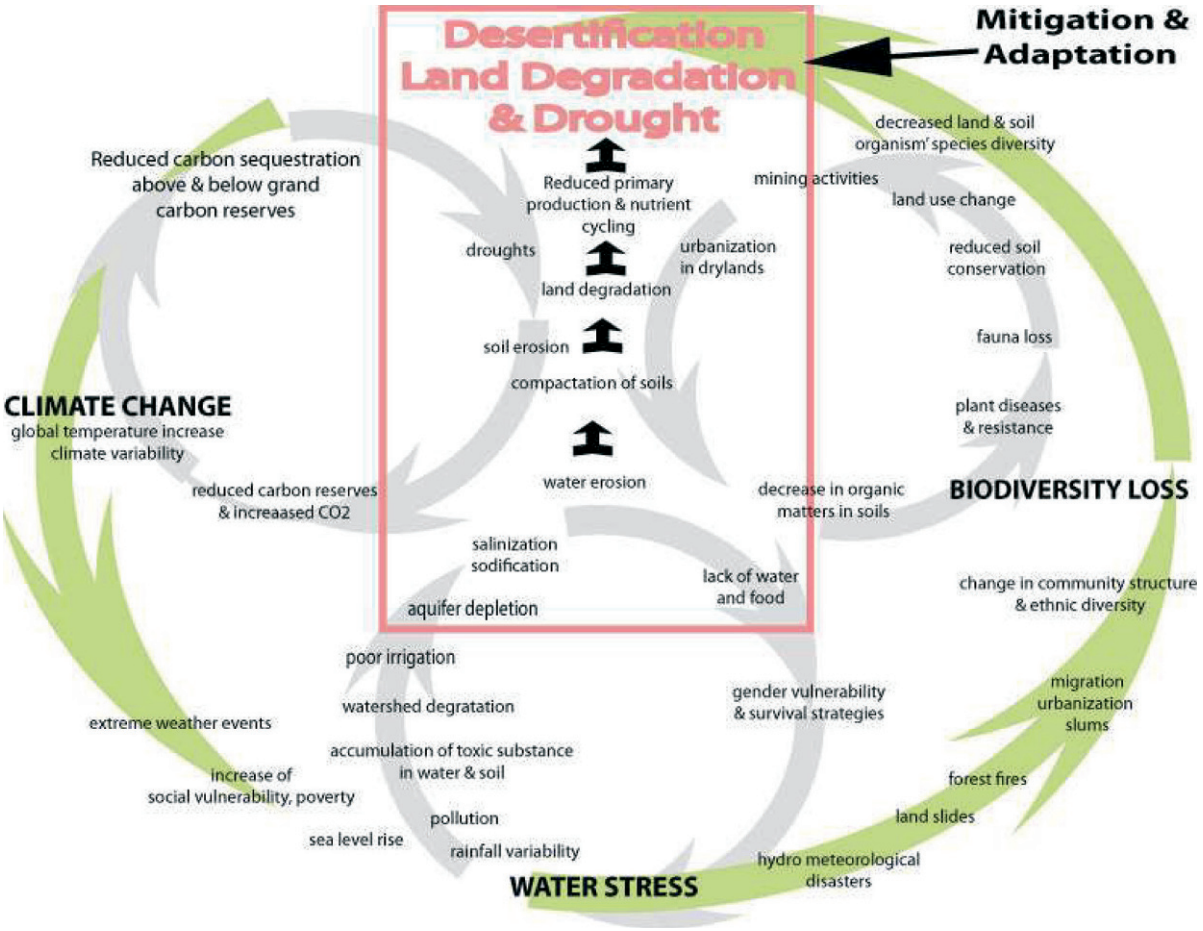
The PEISOR model refers under *pressure* to four supply or environmental factors (land, air, water, and biodiversity) and four demand or human factors (population growth, rural or urban systems and their economic processes). Figure 47.2 illustrates the interactions among the components of the environmental quartet in a non-linear way that pose pressure on the political and societal context where they may cause anthropogenic e*nvironmental degradation* (of water, soil, air, biodiversity) or *scarcity* (water, soil) that may result in environmental stress.

The three small cycles with the factors determining climate change, water stress, and biodiversity loss have each different effects on land degradation and desertification as well as on the political DLDD concept. The wider cycle representing GEC relates the interrelations between the earth and human systems with unpredictable consequences on land degradation and desertification and their societal outcomes.

Biodiversity loss directly affects major drylands services. The inner loops connect desertification to biodiversity loss and climate change through soil erosion. The outer loop interrelates biodiversity loss and climate change. On the top section of the outer loop, reduced primary production and microbial activity reduce carbon sequestration and contribute to global warming. On the bottom of the outer loop, global warming increases evapotranspiration, thus adversely affecting biodiversity; changes in community structure and diversity are also expected because species will react differently to elevated CO_2 levels and its sequestration.

While droughts have existed, especially in drylands, prior to anthropogenic global warming, the IPCC (2001: 4–5) noted that from 1900 to 1995:

Figure 47.2: Environmental Quartet: Land degradation and desertification and the political DLDD concept, Climate Change, Water Degradation and Biodiversity Loss. **Source**: Inspired by MA (2005: 17) and further developed by Brauch and Oswald Spring (2009: 10).



> There were relatively small increases in global land areas experiencing severe drought or severe wetness. In many regions, these changes are dominated by inter-decadal and multi-decadal climate variability, such as the shift of ENSO towards more warm events. In some regions, such as parts of Asia and Africa, the frequency and intensity of droughts have been observed to increase in recent decades.

On the interactions between climate change, land degradation and desertification, the IPCC (1996a: 173) argued that both processes must be considered in parallel. Often it would be impossible to separate the impact of unsustainable land management and climate change but often they interact and produce negative cumulative effects on soil.

- Fundamental soil properties and processes ... will be influenced by changes in climate.
- Desertification arises both from human abuse of the land and from adverse climate conditions. Climate related factors such as increased drought can lead to an increase in the vulnerability of land to desertification and to the escalation of the desertification process.
- Reversing the effects of desertification is not always possible and is more difficult for drier environments with shallower soils.
- Changes in the frequency and intensity of precipitation will have the greatest direct effect on soils via erosion by water. ... Future erosion risk is likely to be related more to increases in population density, intensive cultivation of marginal lands, and the use of resource-based and subsistence farming techniques than to changes in precipitation regimes. ...
- Where conditions become more arid, salinization and alkalization are likely to increase because evapotranspiration and capillary rise will be enhanced. ...
- Predicted warming may give rise to higher evaporation rates, leading to drier soils and more frequent episodes of severe wind erosion.
- Because arid and semi-arid land ecosystems have little ability to buffer the effects of climate variability ... they are particularly vulnerable to climate change. ...

- Adaptation to desertification will rely on conventional strategies (IPCC 1996a: 173).

The fourth IPCC (2007a: 186) assessment report noted that a "warmer climate, with its increased climate variability, will increase the risk of both floods and droughts". Distinguishing among meteorological, hydrological, agricultural and environmental drought, the IPCC claimed:

> The socio-economic impacts of drought may arise from the interaction between natural conditions and human factors, such as changes in land use and land cover, water demand and use. Excessive water withdrawals can exacerbate the impact of drought.

There may also be impacts of climate change resulting in an increase and severity of hydro-meteorological hazards. This aspect has so far only marginally been addressed by the environmental security research (Dalby/Brauch/Oswald 2009) but it is key to the debate on the *securitization* of climate change and land degradation and desertification. While natural hazards (drought) cannot be prevented, processes of land degradation and desertification can be mitigated by proactive human activities. Also, the impact of land degradation and desertification and most particularly of droughts resulting in deaths, affected people, economic and insured damages, can be reduced by linking 'protection' with 'empowerment' of the people (CHS 2003) to become more adapted and resilient. Environmental stress increases the impact of hazards (especially for those with a high degree of social vulnerability (Birkmann 2005) and causes or contributes to internal displacement, urbanization, and forced migration.

Whether these factors result in domestic crises, disasters, and in a few worst cases in violent conflicts, or whether these can be avoided, depends on specific factors and activities resulting from the interaction between the state, the society, and the business community, and on knowledge-based response strategies by governments and international organizations and transnational societal and economic organizations at all levels employing both traditional and modern technical and organizational knowledge (participative governance).

Of the earth system factors, climate change and water have been widely securitized since the year 2000, e.g. by the Ministerial Declaration on Water Security (The Hague 2000) and by the debate on climate change as a security issue in April 2007 in the UN Security Council, in June 2009 in the UN General Assembly, and in the report of the Secretary-General of September 2009.[37] The process of securitization of land degradation and desertification is also emerging, while biodiversity problems have not yet reached the level of securitization.[38]

With regard to the human system, the population has been widely discussed as a key property of national sovereignty. Aspects of socio-economic processes are being analysed in the frame of economic and financial security. The economic, societal, and environmental dimensions of security cover both the productive and consumptive patterns in rural and urban systems.

The *pressure* side are influenced by both *human-induced demand factors* (population change, production, consumption and habitat in rural and urban systems, and the economic process) and *nature-induced supply side factors* (climate change, land, water and biodiversity). Climate change produces at least four impacts: temperature and precipitation changes, rise in sea level, and extreme weather events. Its drivers – the MA (2005) defined these as direct drivers – resulting in an increase in greenhouse gases are influenced by the specific socio-economic development – the MA (2005) defined these as indirect drivers – that affect the direct drivers and their impacts (for ecosystems, water, settlements, human health) that are also affected by the degree of social vulnerability. Besides natural climate variability, human factors have influenced the speed of anthropogenic climate change, especially since 1950. Climate change, land, water, and biodiversity form an 'environmental quartet' with many interactions calling for synergies among the three environmental regimes dealing with climate change (UNFCCC), biodiversity (CBD), and desertification (UNCCD) to which water is an integral part (figure 47.2).

While the sea-level rise and the shrinking of the coastal land and the disappearance of islands due to climate change has a direct impact on 'territorial' and 'national security', the other three effects of climate change (temperature and precipitation change and extreme weather events) directly affect 'soil security'.

37 See: "Climate change and its possible security implications. Report of the Secretary-General" (New York: UN, 11 September 2009); at: <http://www.un.org/esa/dsd/resources/res_docugaecos_64.shtml>.

38 The MA defined security as one of several elements that comprise human well-being. The MA explained how ecosystem services affect human well-being, namely also security. The MA also asserted that biodiversity is actively involved in the provision of ecosystem services, mostly directly but sometimes indirectly. Therefore, loss of biodiversity negatively affects security.

Anthropogenic climate change will directly impact on the precipitation level. The IPCC (2007a, 2007b) concluded that there will be significant precipitation declines in the American Midwest, in Mexico, Central America, Venezuela, Chile and Argentina, in the Mediterranean, in Central Asia, Southern Africa, and in Australia while precipitation levels will increase in most tropical and in higher latitudes in the Arctic Circle (2007c: 47). According to the Fourth Assessment Report, climate change will have many effects on water (IPCC 2007b: 49), and those also directly impact on land degradation and desertification as well as on the political DLDD concept. Climate change will also have multiple negative impacts on biodiversity that will have repercussions on land degradation and desertification (IPCC 2007: 48).

On the social side, population growth and the increasing demand for energy affect global climate change, but most of the additional 2.3 billion people in 2050 are coming from poor countries. According to the 2006 UN Populations Revision, between 2005 and 2010 the population growth will be the highest for Mali and Niger, Congo and Afghanistan (above 3 per cent), and between 2–3 per cent for all countries in the Sahel and for most countries in West and East Africa and for Saudi Arabia, while in all Latin American and in the remaining African countries it was between 1–2 per cent. Thus, the population growth is the highest in drylands. According to the 2008 UN Population Revision many countries with high net emigration rates are also in drylands or are affected by severe drought (Mexico, China, India, Pakistan, and Bangladesh).

Besides desertification, the degradation of soils is a major challenge due to natural developments and anthropogenic factors. WG II of the IPCC (1996a: 95–324, 161) assessed the implications of climate change impacts on forests, rangeland, deserts, land degradation and desertification, mountain regions, non-tidal wetlands, and on coastal zones and small islands. Often it would be impossible to separate the impact of unsustainable land-management and climate change but often they interact and produce negative cumulative effects on soil.

Climate change will impact differently on the five continents and thus also different effects have been projected for the land (territory) and for the ground (soils). The concepts of land and soil degradation and their geographic scope differ significantly from the drylands and the more limited areas that are already desertified. Given the limitations of existing data sets, "the actual extent of the desertified area may lie between 10 and 20 per cent of the drylands that are already degraded (medium certainty). Based on these estimates, the total area affected by desertification is between 6 and 12 million square kilometres" (MA 2005: 7). Due to the number of people threatened, desertification is one of the greatest environmental problems.

Worldwide about one third of the land is threatened by processes of land degradation and desertification due to complex interactions of nature and human activities. Increase in soil temperature dries out the soil and favours wind erosion. Inadequate agricultural and irrigation practices create water losses and erosion, affects soil microbiology by reducing micro-organisms that reduces the natural fertility of the soil, thus increasing soil vulnerability. The high salinity, alkalinity, and sodicity of irrigation water simultaneously change the electrical conductivity and the residual alkalinity. As a result the soil exchange capacity with water can deteriorate and create even more fragile soils. Further, high evaporation draws the salt from the ground and irrigation with brackish groundwater contributes to a salinization process on agricultural land. Land degradation and salinization are the expressions or the symptoms of land degradation.

Some of the most widespread soil depletion occurs in tropical zones with low mineral content of soils. The combined effects of growing population densities, large-scale industrial development, deforestation due to slash-and-burn agriculture, and extensive ranching have depleted soils. The increasing use of sewage waters for irrigation, chemical fertilizers, and pest management increase the contamination of soils and water, which is aggravated by industrial, urban, and human waste. Pollutants may incorporate in the soil, and thus drastically reduce soil fertility. The reduced time for recuperation of the savannah due to overgrazing and the utilization of wood for fuel strengthen land degradation and desertification trends. The thresholds of non-linear response occur beyond the carrying capacity of soils, affecting the yields in almost all grains, threatening the food security of the most vulnerable.

The interactions between the 'environmental' and the 'social quartet' may be non-linear, complex, and dissipative. Human activities have had a major influence on the natural and human interface and trigger environmental tipping points (Marten/Brooks/Suutari 2005).

Societal factors intensify these negative natural outcomes. Rapid population growth and rising water and food demand foster an overexploitation of the

soil. The negative interrelationship between natural and societal factors may produce irreversible effects on soil that may reinforce each other in a chaotic and unpredictable way. Soil deterioration results in processes of salinization, sodification, alkalinity, compactation, surface sealing, and erosion.

47.5.3 Environmental Effect (E): Scarcity, Degradation, and Stress

The interactions between the earth and human systems and among the four factors of the 'environmental quartet' have resulted in environmental scarcity of agricultural land (fertile soils), water, and food. In drylands, the scarcity of land and water often led to an overgrazing and overuse of marginal land. Both brought about environmental stress which further accelerated the processes of desertification.

The possible linkages between environmental scarcity, degradation, and stress and conflicts were analysed during the 1990's by research teams in Toronto (Canada) and in Zürich/Bern (Switzerland) (Homer-Dixon 1991, 1994, 1999; Homer-Dixon/Delingiannis 2009; Bächler/Spillmann 1996, 1996a; Bächler 1999; Mason/Hagmann/Bichsel/Arsano 2009). These environmental security studies applied the concepts of environmental scarcity, degradation, and stress to issues related to land degradation and drought, but they did not consider the impact of climate change. The approaches of both groups influenced the policy debate, e.g. on the environmental dimension of US national security during the Clinton administration (Matthew/McDonald 2009).

After a decade of research a consensus emerged that environmental stress is rarely considered to be the sole factor in precipitating conflict both within and between nations. A major effect of several types of environmental stress is economic decline that will affect the poor more than the rich groups and countries. Environmental stress coupled with rapid population growth contributes to soil insecurity, internal displacement, socially precarious slum formation, and often larger-scale migration sometimes in life threatening conditions. A second pathway from environmental stress to conflict is through forced migration that may also be caused by floods, droughts, loss of natural soil fertility, locusts or famine linked to deteriorated land. Additional related push factors are water and air pollution and deforestation due to lack of wood for fuel. All these phenomena often trigger urban and rural violence. Direct internal conflicts have occurred due to environmental stress, e.g. in the Sudano-Sahelian region where many nomads clashed with peasants.

The human-induced environmental stress has a direct impact on the components of the earth and human systems and reinforces the anthropogenic drivers of GEC. With the progressing 'securitization' of climate change, water, and soil a new policy-focused scientific discourse has emerged that addresses the security implications of climate change and land degradation and desertification from the vantage point of international, national, and human security.

47.5.4 Impact (I) of Climate Change and Stress: Natural Hazards

The pressure posed by global climate change and the local, national, and regional environmental stress have resulted in an increase in intensity and perhaps number of hydro-meteorological hazards, such as drought, heatwaves and forest fires as well as storms, flash floods, and landslides. While drought, forest fires, and heatwaves have contributed to wind erosion, intensive storms (e.g. hurricanes or cyclones), and flash floods have intensified water erosion that directly impact on land degradation and desertification.

On a global level, the impact of extreme weather events differs according to the social, economic, and political system that influences the social vulnerability of the affected people. The largest number of hydro-meteorological hazards and the highest number of killed and affected people occurred in Asia, Africa and in Latin America, while the highest economic damages are recorded in OECD countries (chap. 40 by Guha-Sapir/Vos). While in industrial countries a significant part of the damage is insured, in developing countries poor people cannot afford insurance and lose all their few belongings and are often forced to leave their homes. This ambiguity becomes obvious for India that experienced the highest number of deaths and affected people from drought (table 47.1), but was not even listed among the ten countries that experienced the highest economic damages.

Between 1974 and 2003, about 44 per cent of the reported deaths (2,066,273) and 36 per cent of the affected people (5,076,494,541) from natural disasters were the victims of drought (Guha-Sapir/Hargitt/Hoyois 2004). Thus, drought has become the most deadly and least noted hazard killing some 909,160 people and affecting 1,827,538,000 persons in thirty years, where nearly all 'silent' casualties occurred in developing countries.

Table 47.1: The most severe droughts (1900-2008). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain - Brussels – Belgium; at: <www.em-dat.net> (5 January 2009, data version: v12.07).

By the number of people killed on the country base			By the number of people affected on the country base			By the economic damage on the country base		
Country	**Date**	**Killed**	**Country**	**Date**	**Affected (million)**	**Country**	**Date**	**Damage (US$ 1000)**
China P R.	1928	3,000,000	India	1982	300	China P.R.	Jan 1984	13,755,200
Bangladesh	1943	1,900,000	India	2002	300	Australia	1991	6,000,000
India	1942	1,500,000	India	1972	200	Spain	Sep. 1990	4,500,000
India	1965	1,500,000	India	1965	100	Iran	Apr.1999	3,300,000
India	1900	1,250,000	India	Jun 82	100	USA	July 2002	3,300,000
Soviet Union	1921	1,200,000	China P. R.	Jun 94	82	Spain	Apr. 1999	3,200,000
China P R.	1920	500,000	China P. R.	April 2002	60	Canada	Jan 1977	3,000,000
Ethiopia	May 83	300,000	India	April 2000	50	China	May 2006	2,910,000
Sudan	April 83	150,000	China P. R.	June 1988	49	Zimbabwe	Oct. 1982	2,500,000
Ethiopia	Dec 73	100,000	China P. R.	Jan. 2003	48	Brazil	1978	2,300,000

Of the ten most severe droughts since 1900 three occurred in India (4,250,000 deaths), two in China (3.5 million deaths) and Ethiopia (400,000 deaths), and one in Bangladesh (1.9 million deaths), the Soviet Union (1.2 million deaths) and in the Sudan (150,000 deaths). Among the 10 cases with the highest number of persons affected six occurred in India (1,050 million people) and four in China (239 million persons). Of the 10 droughts that caused the highest economic damage since 1900, two occurred in China and Spain, and one in Australia, Iran, in the USA, Canada, Zimbabwe, and in Brazil (table 47.1).

The projected changes in average temperature, precipitation levels, sea-level rise, and in hydro-meteorological hazards directly impact on crop yield and thus on the food security in the 21st century and may lead to an increase of climate related food crises and conflicts. Thus, drought, heatwaves and forest fires directly contribute to soil insecurity, not only in drylands.

The *Potsdam Institute for Climate Change Impacts* (PIK) has visualized drought as well as flood and food security for the past (1975–2004) and has projected these trends into the 21st century to highlight those regions that will be affected most by droughts.[39] While drought and flash floods contributed to wind erosion, intensive precipitation had a major impact on water erosion. Some climate impact models have projected a decline in crop yields due to an increase in temperature and evapotranspiration for some regions for 2020 and 2050, based on different assumptions on a global CO_2 stabilization.

By 2020 a potential decline (-2,5 to -5 per cent) in food security is projected for the USA, Russia and East Central, East European and Central Asian countries and for Nigeria, while an increases in food production are projected for Canada, Bolivia and Argentina, China, Mongolia and Australia, and for countries in North and Central Africa. By 2050 a potential decline in food is projected for the USA, Ecuador, the Balkan countries, Mexico, Brazil, South American countries, Russia, most East Central, East European and Central Asian countries, Pakistan, and for several countries in West, South and East Africa. Increases in food security are projected for Bolivia, Argentina, China, Mongolia and several ASEAN countries, Australia, Spain, France, Germany, and Algeria. Various projections indicate that food security declines in different degrees for Africa and for India, two regions that are at present highly affected by undernourishment that will also experience a high population growth until 2050.[40]

39 These data were prepared for the report on *Security Risk Climate Change* (WBGU 2007, 2008) by Mr. Wodinski. They were used by Brauch (2006c, 2007f); at: <http://www.wbgu.de/wbgu_jg2007_ex01.pdf>.

40 This statement is based on GIS data by Mr. Wodinski that were used by Brauch (2007f).

47.5.5 Societal Outcomes (SO): Famine, Crises, and Conflicts

Land degradation and desertification may trigger different societal outcomes, depending on the level of economic development and the degree of environmental and social vulnerability. The resulting decline in water and food, together with the use of food for biofuels and speculations, has increased hunger and famine primarily in developing countries.

Hunger and famines are among the most extreme outcomes of drought and land degradation, precipitation alteration, failed agricultural policy, but also of conflicts and wars. Famines are documented for the past 4,500 years where climatic factors (droughts and floods) resulted in crop failures that triggered the deaths of people due to hunger. The most severe famines due to droughts in modern history occurred in 1769–1770 in Bengal (10 million deaths), in 1876–1879 in Northern China (19 million deaths), in 1943 in India and Bengal (3 million deaths), and since the late 1970's primarily in Africa (the Sahel, Ethiopia, Somalia, Mozambique).[41]

In many cases crop failures and famines contributed to social unrest, mass protests, hunger riots, and in some cases they even created a revolutionary situation prior to major revolutions in 1789 in France, in 1848 in several European countries, in 1911 in Mexico. Since World War II the most severe food crises occurred in the USSR, Ethiopia, China, India, Biafra, the Sahel region, in Cambodia, Uganda, Somalia, Sudan/Darfur, in the Northeast of Brazil, during the Second Congo War (1998-2004), in Myanmar, North Korea, Afghanistan, Bangladesh, East Africa and Tajikistan; most of them in drylands in Africa, Asia, and Latin America.

The *Global Hunger Index* (GHI) combined three indicators: a) proportion of people who are calorie deficient, or undernourished; b) prevalence of underweight children under the age of five; and c) under-five mortality rate (all in per cent). According to the GHI of October 2009 (IFPRI 2009) the situation was extremely alarming in thirty-three countries among the 84 reviewed developing and transitional countries.

> Of the ten countries that have seen percentage *increases* in their GHI scores since 1990, the Democratic Republic of the Congo has made the least progress in reducing hunger, followed by Burundi, the Comoros, Zimbabwe, Liberia, Guinea-Bissau, North Korea, the Gambia, Sierra Leone, and Swaziland (IFPRI 2009). The Syrian Arab Republic has the best score (lowest level of hunger) on the 2009 GHI, followed by Trinidad and Tobago, Paraguay, Suriname, and China.[42]

Several of these countries (figure 47.3) have also been affected by land degradation and desertification. In a few cases, periods of drought and famines have resulted in public protests, food riots, hunger revolts, small scale clashes between nomads and resident farmers, or between ethnic and religious groups. Most of these small-scale conflicts do not meet the criteria of wars. Since the 1970's several cases of the linkage between drought and food riots have been reported for North Africa (Morocco, Tunisia and Egypt; see Seddon 1986, 1988; Benjelloun 2005), but the reasons may have been the increase of food prices due to requests of IMF to cut food subsidies.

During 2007 and 2008, besides natural (storms, floods, drought) and political (internal conflicts, civil and international wars) causes, several economic factors contributed to an increase in food scarcity, to dramatic food price increases that triggered many events of food unrest with nearly 200 deaths during 2008. Declining global grain reserves and supply due to a shift from food to biofuels, as well as increasing demand due to changing diets, have contributed to massive price increases that were also influenced by crop price speculation at the stock market.[43]

The linkage between the 'environmental quartet' and severe societal outcomes has been addressed for possible security impacts of climate change in a report by the German Advisory Committee on Global Environmental Change (WBGU 2007, 2008: 1) that claimed "climate change could exacerbate existing environmental crises such as drought, water scarcity and soil degradation, intensify land-use conflicts and trigger further environmentally induced migration" as one of several conflict constellations (chap. 41 by Bauer). A more recent report by the UN Secretary-General (UNSG 2009: 10: 1–2) noted:

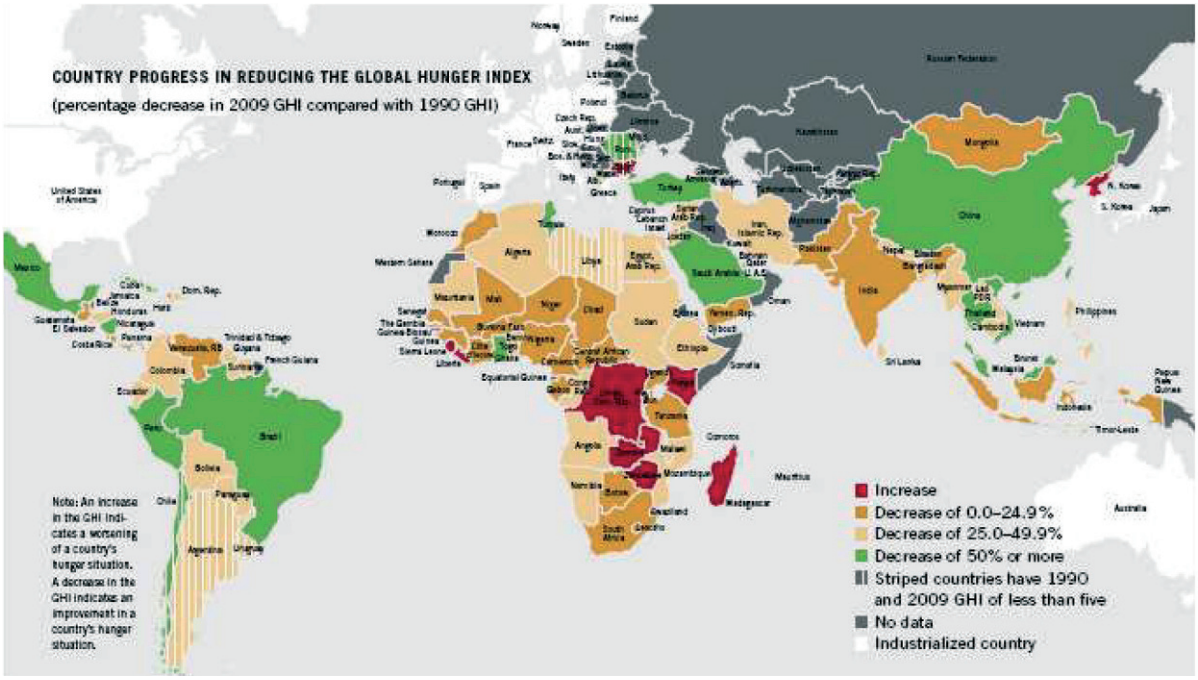
> Climate change is often viewed as a 'threat multiplier', exacerbating threats caused by persistent poverty, weak institutions for resource management and conflict resolution, fault lines and a history of mistrust between communities and nations, and inadequate access to information or resources. This report identifies several 'threat minimizers', namely conditions or actions that are desir-

41 See: "Hungersnot", in: *Brockhaus Enzyklopädie* (Leipzig – Mannheim: Brockhaus, [21]2006), Vol. XII: 805.

42 See: factsheet at: <http://www.ifpri.org/sites/default/files/publications/ghi09keyfacts.pdf>.

43 See: IISS: "The simmering food crisis", in: *IISS Strategic Comments*, 14,9 (9 Nov. 2008): 2.

Figure 47.3: Country progress in reducing the global hunger index (percentage decrease in 2009 GHI compared with 1990 GHI. **Source**: IFPRI (2009: 12).



able in their own right but also help lower the risk of climate-related insecurity.

Climate change affects human well-being through food security that is "linked to water scarcity, land degradation, and desertification, ... drought and tropical storms" (UNSG 2009: 10). A principal cause of land and soil degradation has been the increased use of drylands for agricultural production that was either poverty-driven in many developing countries or market-driven in several industrial countries (Mendizábal/Puigdefábregas 2003).

The area of Sub-Saharan Africa that has been affected most frequently by extended periods of drought, famine, migration and conflicts has been the Sahel zone (figure 47.3). Besides this high environmental vulnerability of the Sahel zone due to climate change and land degradation and desertification, this region has many weak and fragile states that are among the least developed countries and it experienced many crises, violent internal and international conflicts. The Sahel has also been a major hotspot due to a climate-induced decline in food production and an increase in environmentally-induced migration. Between 1980 and 2006, land and soil and often water related conflicts prevailed in Central America, in the Andean region, in the Amazonas, in Uruguay, Argentina, Mexico and in the Caribbean; in eastern and southern Africa, the Middle East, Central, South, Southeast and East Asia. These regions overlap with the countries that have been prone to the effects of drought, hunger and famine.

The regions and many countries that have been most affected by desertification, drought, hunger, famines, and conflicts, are also the regions that have experienced net emigration rates. Migration is a process that covers different features of people's movements from a) rural to urban livelihoods (*migration from the land to town* or *urbanization*), b) temporary '*internal displacements*' due to a natural hazard, conflict or a complex emergency or c) permanent internal, regional or international South-North migration. Such migration may be *forced* (push factors) or *voluntary* (pull factors). Environmental factors due to GEC (water scarcity, soil degradation, climate change) may force people to leave their homes and traditional livelihoods to survive or to have better prospects for life and economic and human well-being. However, environmental factors are only one of several push factors (economic and political reasons) that contribute to global net migration trends and environmental causes may not be used for granting a refugee status.[44]

The *International Organization of Migration* (IOM 2007) distinguished among four scenarios on the propensity to migrate due to: a) less advanced stages of gradual environmental change (temporary work migration, support of family with remittances);

b) advanced stages of gradual environmental change (permanent often irregular migration, e.g. due to sea-level rise); c) extreme weather events (temporary or permanent movement); d) large-scale development and land conservation (temporary or permanent resettlement). So far, environmental causes have not yet been systematically covered in migration statistics and they are normally interrelated with socio-economic factors.[45]

The trends of the global population, of estimated international migrants and refugees, of the growth of migrants, of international migrants as a percentage of the population and of refugees as a percentage of migrants have been compiled. While the world population and international migrants have increased since 1960, the estimated number of refugees jumped between 1985 and 1990 and has since declined again. With regard to the future, the key findings of the 2008 Revision of the World Population Prospects are:

> In terms of annual averages, the major net receivers of international migrants during 2010–2050 are projected to be the United States (1.1 million annually), Canada (214,000), the United Kingdom (174,000), Spain (170,000), Italy (159,000), Germany (110,000), Australia (100,000) and France (100,000). The major countries of net emigration are projected to be Mexico (-334,000), China (-309,000 annually), India (-253,000), the Philippines (-175,000), Pakistan (-161,000), Indonesia (-156,000) and Bangladesh (-148,000).[46]

Among the key countries of emigration Mexico, China, India and Pakistan are drylands. But a report of the *Global Commission on International Migration* (GCIM) on: *Migration in an interconnected world: New directions for action* as well as a report by the UN General Assembly on migration and development of 18 May 2006 for a high level meeting in September 2006 did not mention environmental factors as a driver. So far no major statistical source (UN, OECD, IOM) has included "environmentally-induced migration" in their database. Thus, no reliable global statistics exist on environmentally triggered migration and even less on people who opt or are forced to leave their livelihood due to land degradation, desertification, drought or famine.

To overcome this deficit and to address coping with environmentally- and climate-induced migration as part of an adaptation strategy, the *International Organization for Migration* (IOM), the *United Nations Environment Programme* (UNEP), *United Nations University* (UNU) and the *MunichRe Foundation* (MRF) have formed the *Climate Change, Environment and Migration Alliance* (CCEMA).[47] Bogardi and Warner (2008) suggested "to identify adaptation pathways that prevent or at least reduce environmental migration flows" with the goal "to mainstream environmental and climate change considerations into the migration management policies and practice, and to bring migration issues into the world's environmental and climate change as well as development discourse."[48]

Nevertheless, environmental change (due to natural and man-made causes) is a recognized cause of migration while migration has also become a cause of environmental change.[49] There are case studies on

44 For details on the issue of environmental and forced migration, see: El-Hinnawi (1985); UN Terminology. 2006, in: UN Population Division; at: <http://www.un.org/esa/population/unpop.htm>; see also the glossary on migration by IOM: <https://unp.un.org/details.aspx?entry=E04401&title=Glossary+on+Migration#>; Swain (1996); IOM (2006, 2007: 1–2); UNHCR/IOM/RPG (1996); Suhrke (1993, 1994, 1996, 1997); Ketel (2005); Myers (1993, 1995, 2002a: 214–218); Black (2001); Castles (2001); Flintan: at: <http://www. ucc.ie/famine/GCD/Paper%20for%20Wilton%20Park. doc>.

45 See: *International Migration Report 2002* by the Population Division of the UN; at: <http://www.un.org/esa/population/unpop.htm>; <http://www.un.org/esa/population/publications/ittmig2002/ittmigrep2002.htm>; the 2005 revision see at: <http://www.un.org/esa/population/publications/migration/UN_Migrant_Stock_Documentation_2005.pdf>; *International Migration Report 2006: A Global Assessment* (UN 2006), at: <http://www.un.org/esa/population/publications/2006_MigrationRep/report.htm>; UNFPA, at: <http://www.unfpa.org/> and at: <http://www.unfpa.org/publications/index.cfm?filterPub_Type=5>; OECD: *Trends in International Migration* (e.g. SOPEMI 2001b, 2008, 2009); U.S. Committee for Refugees in: *World Refugee Survey*; at: <http://www.refugees.org/>; and at: <http://www.refugees.org/worldmap.aspx>.

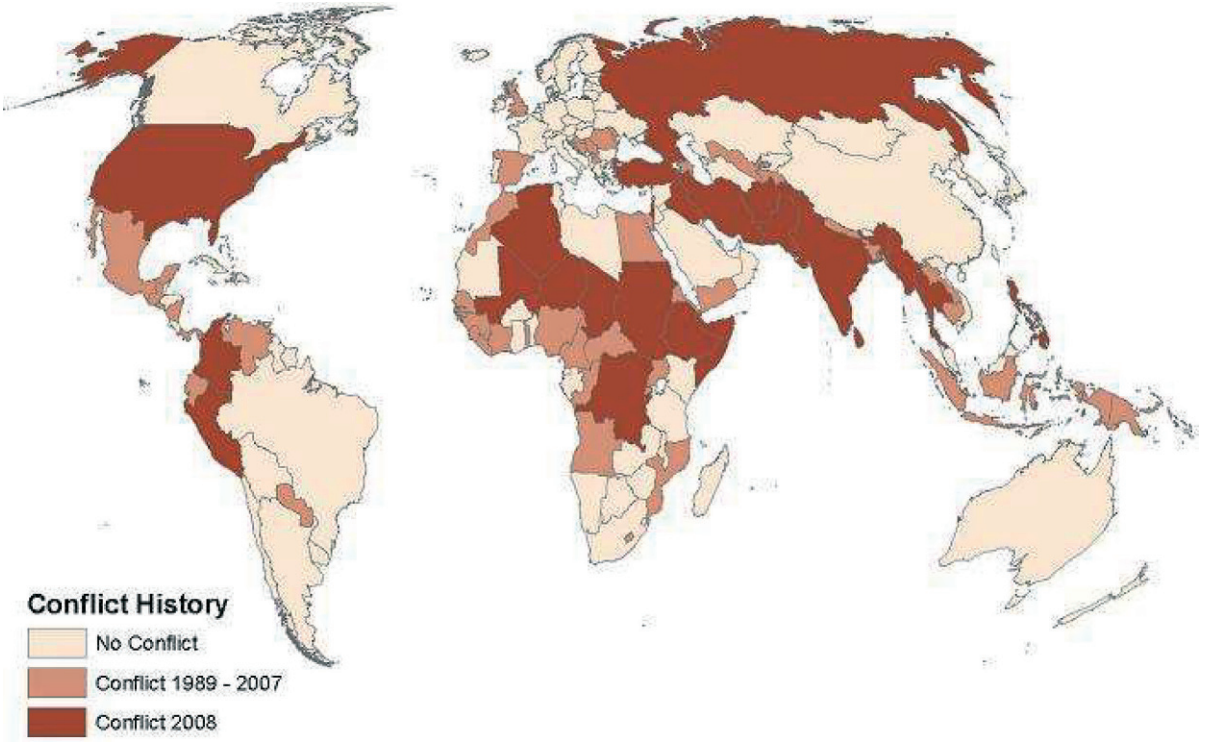
46 See: UN: *World Population Prospects - The 2008 Revision Highlights* (New York: UN, DESA, ESA/P/WP.210); at: <http://www.un.org/esa/population/publications/wpp2008/wpp2008_highlights.pdf>: xiii.

47 See details at: <http://www.ccema-portal.org/>.

48 Janos Bogardi, Koko Warner: "Here comes the flood – Commentary", in: *Nature Reports Climate Change*, 11 December 2008; <doi:10.1038/climate.2008.138>; at: <http://www.each-for.eu/documents/2008_Nature_Here_comes_the_flood.pdf> (20 September 2009).

49 For a most recent overview on the evidence on the linkages between: *Migration, Environment and Climate Change: Assessing the Evidence*, see: Laczko and Aghazarm (2009); Bilsborrow (2009); see also IOM (2009, 2009a); UNDP (2007, 2009) and World Bank (2009).

Figure 47.4: Armed conflicts (1989-2008). **Source:** UCDP/PRIO Armed Conflict Dataset v5-2009; at: <http://www.prio.no/CSCW/Datasets/Armed-Conflict/UCDP-PRIO/>.



specific events (including desertification) that have forced people to leave their livelihood. Case studies on Mexico and on West Africa (Cour 2006) have analysed the specific linkages between land degradation, desertification, and migration.[50]

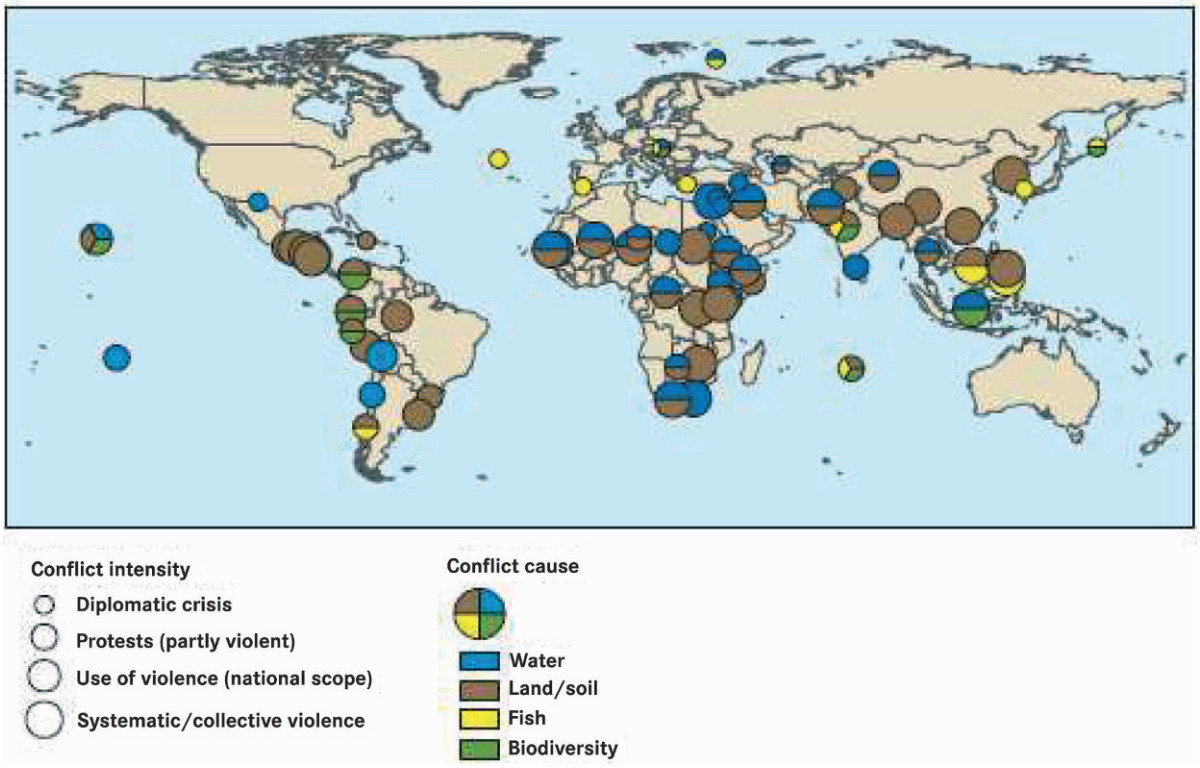
To summarize, there is an emerging consensus that soil degradation, erosion, desertification, and also drought contribute to distress migration, and that disasters cause, trigger or contribute to migration, while migration may intensify disasters due to a high social vulnerability. There is also agreement that environmental factors, such as desertification, land degradation, and drought are not the sole push factors influencing the decision of people to leave their home and livelihood. Demographic, socio-economic, and ethnic push factors as well as pull factors (family networks) have contributed to people leaving the rural areas. In the Sahel, for centuries, the nomads have moved with their herds to the lands of resident farmers with higher precipitation what has in many cases resulted in violent pastoral clashes between the migrant herders and the farmers (Kahl 2006; Meier/Bond 2007).

Small-scale local and national land and water conflicts are not listed in the war data bases of SIPRI (figure 47.4), HIIK (Heidelberg), and AKUF (Hamburg) as they do not meet their war criteria. In these datasets, environmental factors and hazards (drought) are not listed as causes of conflicts. The conflict definition of the UCDP/PRIO dataset included only the most severe forms of organized violence, and excluded violent clashes between herders and resident farmers, e.g. in the Sahel zone (Kahl 1988, 2002, 2003, 2006; Suliman 1993, 1999, 1999a).

However, the map of armed conflicts (1989–2008) indicates an overlap of countries suffering conflicts and regions highly affected by land degradation and desertification (figure 47.5). The WBGU distinguished four conflict formations defined "as typical causal linkages at the interface of environment and society, whose dynamic can lead to social destabilization and, in the end, to violence". Two conflict constellations are directly related to land degradation and desertification on "climate-induced decline in food production" and on "environmentally-induced migration"

50 See Leighton Schwartz and Notini (1994); Natural Heritage Institute (1997, 1997a); Leighton (1997, 2006); Oswald Spring (2008); Alscher (2001, 2009); Sánchez Cohen; Oswald Spring; Díaz Padilla; Cerano Paredes; Inzunza Ibarra; López López and Villanueva Díaz (2010).

Figure 47.5: World map of Environmental Conflicts (1980-2006). **Source:** WBGU (2008: 32).



whiles the other two on: "climate-induced degradation of freshwater resources" and on "climate-induced increase in storm and flood disasters" have an impact on water, soil, and food security. Migration is an old coping strategy for dealing with changeable environmental conditions; e.g. in response to periods of drought (Suliman 1994).

Whether climate-triggered, environmentally-induced and forced migration leads to environmental conflicts in the countries of impact or origin depends on many intervening factors, such as the individual attributes, on the specific vulnerability, on the functioning institutions and government structures, and on environmentally-induced conflicts. As a result of migration from region A to B migration-induced conflicts may occur due to many additional factors such as the competition for resources, the change in the ethnic balance, as a result of migration and Diaspora networks, of the reaction of the host country, of the governance capability and the political stability. A political destabilization in regions A and/or B may result in different forms of violent conflicts that may impact on existing conflict constellations in other regions.

Systematic theory and comparative empirical research is needed that collects data on environmental and pastoral conflicts, and analyses the possible linkages between desertification, land degradation, and drought and environmentally-induced peoples movements (rapid and chaotic urbanization processes) and international migration, as well as with small scale violent clashes, e.g. between herders and resident farmers, and often urban food riots due to rapidly growing food prices. It is too early to draw systematic generalizations from the case study literature in anthropology that has been ignored by political scientists and security and peace specialists.

The above nature- and human-induced pressures, their effects, impacts, and societal outcomes require a political strategy to manage the complexity of nature-human interactions in an era of globalization. Such a policy response necessitates the involvement of the state, the society, and of the local, national, and international business community. But a key factor for proactive response strategies, policies, and measures is knowledge development and its use.

47.5.6 Policy Response (R): Three Key Actors and Knowledge

The last aspect in the PEISOR model refers to the policy response by the state, the society, and the economic sector where traditional and modern knowl-

edge and scientific research can lead to new policy solutions that require problem awareness for the new environmental dangers by the people and in the media that can pose multiple security concerns. Scientific recognition and public awareness require processes of anticipatory learning and proactive policies to mitigate against, adapt to, and cope with the impacts of the probable societal effects of these nature-human interactions to prevent that the projected trends become a future reality. The interrelation between the 'environmental' and the 'social' quartet poses many threats to international, national, and human security that may overstretch the security policy and the capacities of the global governance system. The development and transmission of knowledge through policy-relevant research, education, and training of experts and of the population at large become crucial. Thus, science- and knowledge-based policy strategies are an utmost priority for coping with land degradation and desertification.

UNCCD's 10-year strategy that was adopted at COP-8 in Madrid (2007) adheres to the vision: "to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability". According to this strategy three of UNCCD's five operational objectives are knowledge-based. The implementation of these goals requires a combination of *top-down* strategies, policies and measures that must be linked with *bottom-up* local initiatives that empower the people affected most by land degradation and desertification.

The state remains the key actor due to its financial and administrative resources to plan, initiate, monitor, and implement knowledge-based strategies to cope with land degradation and desertification and its societal impacts. The specific system of rule and the governance structures matter, but many states in the most affected countries are 'weak' and lack financial and administrative resources to control their territory and to implement the adopted policies and measures. An active involvement of *societal* groups, of social movements, and NGOs matters.

These efforts must be implemented at the local level with the active participation of women to enhance their resilience for coping with drought and for mitigating soil degradation. Women not only suffer harder from land degradation, water scarcity and pollution, crop yield reductions and food shortage, but in poor countries they produce most of the food and care for the livelihood of their families. Special attention must be given to the recovery of fragile drylands, namely salinized, deforested, and eroded land and overexploited aquifers.

Gender programmes are often added to combat land degradation and desertification. A transversal gender line combining all political, institutional, social, and scientific programmes would change the outcomes. Policies on land degradation and desertification, water, and food should take into account that women and men play different social and economic roles, and give more emphasis to small-scale agricultural and survival strategies, basically in the hands of women, such as small business and microcredits. Their income benefits the whole family, above all the children. Their involvement takes advantage of their abilities in resource management and conflict prevention. Climate change and loss of access and control over natural resources through megaprojects reduces their ability to cope with adverse situations. Gender mainstreaming should be included in the planning, legislation, and policies on drylands to consolidate the livelihoods of everyone in the community. Water and energy policies should be gender sensitive and trained women can be excellent agents of change, above all when 'soil security' is declining. For the realization of the Madrid strategy for coping with land degradation and desertification, the involvement and active participation of the most affected economic sectors (agriculture, services, and industry) and of the local business community is crucial. This requires an ethical commitment for a longer-term sustainable management of land and water resources and no exclusive orientation at short-term profits (Oswald Spring 2009b).

47.6 Towards Proactive Policies to Enhance Soil Security

47.6.1 Soil Security in the Anthropocene

The goal of the securitization of land degradation and desertification is to upgrade its political importance. It occurs in other ecological areas beyond subhumid, semi-arid, and arid drylands. Droughts due to a lack or major drop in precipitation lead to a decline in crop yields, in bad harvests that often cause hunger and famine. Among socio-economic factors, droughts result in rising food prices that poor people cannot afford. Also land degradation and desertification often lead to famine and distress migration that cause envi-

ronmental, human, food, health, livelihood and gender security issues.

Relevant policy questions are: How can processes of soil erosion, degradation, and desertification be successfully contained, countered, delayed or stopped? How can the societal consequences of famine, distress migration and conflict constellations be curbed, and the impact be reduced by early warning, rapid action and humanitarian aid? How can the policy implementation be improved and corruption be curbed that the humanitarian aid reaches the most affected people fast whose survival is at stake? And finally, how can local populations and women get involved to mitigate and adapt to land degradation and desertification?

This poses questions of the instruments and actors for dealing with desertification as a security issue, i.e. to reduce violent societal consequences. An early recognition and perception of the urgency of the desertification challenge and its consequences (drought, famine, migration) as security issues partly depends on the mindset and worldview of the observer. This poses different responsibilities for *political* and *military security*: conflict avoidance and prevention with tools of *development* and *environment* to enhance resilience by sustainable development to achieve environmental, human, soil, food, health, and livelihood security.

The dual task is to both focus on the causes and triggers and on violent outcomes. This requires a mainstreaming of activities of coping with environmental hazards and conflict prevention and avoidance. There is no simple strategy to counter desertification and its outcomes but a complex set of strategic components in different action plans by national and international, societal, and economic actors. Knowledge creation and anticipatory learning are crucial tools.

Desertification poses no direct military threats, but as a regional environmental challenge, land degradation and desertification and famine severely undermine the well-being of people. In severe cases desertification may even threaten the survival of individuals of affected local communities, what may in the worst case undermine national and regional stability. From a subjective perspective degradation and desertification and famine contribute to environmental and human, food, health, livelihood, and gender insecurity.

If desertification forces people to leave their home, village and country, internal displacement, urbanization and trans-border migration may contribute to social insecurity with social and ethnic groups as the referent where national identity may be perceived as being at risk and immigrants are often seen as threats that challenge the distribution of scarce resources of water, soil, and food. Whether and when severe social and societal insecurity pose a threat to internal, domestic, national or regional security depends on specific national political circumstances.

National security may be threatened by general strikes and hunger riots, and the value at risk may be regime stability and the survival of governments. The severe droughts and famine in the Sahel during the 1970's and 1980's have repeatedly resulted in violent clashes between nomadic tribes and resident farmers that have also been associated with large trans-boundary environmentally-induced migration what has often triggered ethnic clashes.

In the early 21st century, land degradation and desertification as well as famine and distress migration have been perceived as human security threats by the *Commission on Human Security* (CHS) that have only recently been addressed by the *Human Security Network* (HSN). Drought and famine have been seen as challenges to food security by FAO, the WFP and IFAD, as well as to health security by WHO. Desertification is increasingly being recognized as a critical environmental and human security challenge by academic experts and many UN organizations, but not yet by all governments. Nevertheless, the political agenda-setting has just started.

In the report of the 17th Session of UNCSD (3–15 May 2009) there were 63 references to 'security', but primarily to 'food security' (57), and a few references to land 'tenure security' (4) as well as to 'peace and security' (2) but not yet to 'soil security'.[51] The ENB final report on the COP-9 of UNCCD in Buenos Aires referred 7 times to 'food security' including its 'importance for human security' and once to 'land and food security'.[52] Thus, the concept that was initially introduced by FAO (Oswald Spring 2009b) was widely used in UN deliberations on land degradation and desertification but there were no references to 'water', 'soil', and 'health security' in these two recent documents. In a UNCCD Issue Paper in May 2009 both authors launched the new concept of 'soil' security

51 See: United Nations Commission on Sustainable Development: Report on the seventeenth session (4–15 May 2009), Economic and Social Council, Official Records, 2009, Supplement No. 9 (New York: UN); at: <http://daccessdds.un.org/doc/UNDOC/GEN/N09/355/72/PDF/N0935572.pdf?OpenElement>.

52 See: *ENB*, 4,229 (5 October 2009: 16).

(Brauch/Oswald Spring 2009b; Oswald Spring/Brauch 2009) that is achieved when efforts to combat desertification succeed, when land degradation is successfully contained, and when the consequences of drought are being reduced and famine is being avoided due to countermeasures by governments, and the aid community in close cooperation with the affected people.

A report on *Global Trends 2015* (NIC 2000) only referred to population growth and water scarcity as issues that pose U.S. national security concerns. The most recent update of *Global Trends 2025* recognized 49 times climate change as a 'newer security issue' but it did not yet even mention the concepts of desertification and land degradation (NIC 2008: xi).

The systematic securitization of desertification started with a conference in December 2003 in Valencia (Kepner/Rubio/Mouat/Pedrazzini 2006),[53] and meetings in Almería (1994, 2006) discussed links between desertification and migration as a security issue.[54]

47.6.2 Towards a Proactive Security Policy on Land Degradation and Desertification

Grounding security refers to reactive and proactive short-, medium-, and long-term strategies for coping with 'soil insecurity' and the societal, environmental, and economic security implications of land degradation and desertification on the one hand and drought on the other. The *Desertification Synthesis* of the MA (2005) distinguished four scenarios with a clear preference for proactive global and regional strategies for combating desertification with irrigation, poverty reduction, and coping with climate change (table 47.2). The *MA Desertification Synthesis Study* (2005) noted that

- Understanding the impacts of desertification on human well-being requires that we improve our knowledge of the interactions between socio-economic factors and ecosystem conditions. ...
- There are considerable scientific challenges in detecting thresholds beyond which drylands systems would reach a critical or effectively irreversible change. ...
- The impact of poverty reduction strategies on ecosystem services and desertification has not been fully explored by governments and the international community. ...
- The contribution of drylands urban areas to desertification may be significant but is not known.

Table 47.2: Four scenarios for combating desertification. **Source:** MA (2005: 11).

Ecosystem management	Globalized world	Regionalized World
Reactive	Global orchestration (1)	Order from Strength (2)
Proactive	TechnoGarden (3)	Adapting Mosaic (4)

But the MA did not analyse the impact these complex processes have on political and societal outcomes, whether they triggered and intensified processes of migration, of domestic economic and political crises and conflicts.

UNEP's fourth *Global Environmental Outlook* (UNEP 2007a: 400–401) distinguished in its perspectives towards 2015 four scenarios with different priorities: a) *Markets First*, b) *Policy First*, c) *Security First*, and d) *Sustainability First*. Only the *Sustainability First* scenario offers prospects for reducing global income gaps. The *Security First* scenario comes closest to a neo-realist worldview that focuses on a narrow national military security concept and to a neo-Malthusian standpoint on environmental issues. In contrast, the *Sustainability First* scenario reflects a liberal, pragmatist worldview on security issues based on a widened and deepened security concept including the environmental dimension of human security where cooperation matters and an equity-oriented environmental standpoint where cooperation contributes to solve problems peacefully.

For the needed knowledge-based and scientifically-induced policy response for coping with land degradation and desertification and its potential societal impacts on migration, crises, and conflicts a combination of two scenarios appear to be most promising: of UNEP's *Sustainability First* scenario with the two proactive strategies of MA's *Desertification Synthesis* of a regionalized 'Adaptation Mosaic' with a globalized 'TechnoGarden'. These scenarios pose tasks for the policy response.

53 At the Valencia conference Brauch (2003e, 2006) provided a systematic overview of the manifold conceptual linkages between processes of desertification and their impacts in terms of water, food, and health security that may have repercussions for national and regional security. Other contributions by Kepner (2006), Rubio/Recatala (2006); Yousef/Hegazi (2006); Safriel (2006) discussed security aspects from the perspective of the natural sciences, while López-Bermúdez/García-Gómez (2006) referred to the links with food security.

54 See for the conference documents at: <http://www.sidym2006.org/eng/eng_ponencias_conclusiones.asp>.

Besides these top-down scenarios of the MA and of UNEP the success of these strategies, policies, and measures requires an active involvement of the people affected by land degradation and desertification. Such bottom-up initiatives necessitate an active involvement of all stakeholders, most particularly women, peasants, fishermen, and indigenous people with their traditional knowledge and their expertise of the local soil conditions. To optimize the combat against land degradation and desertification and to guarantee the long-term conservation of fragile soils, an increased representation of women is needed at all decision-making levels and for the prevention, management, and resolution of ground and water conflicts.

Poverty, diseases, and the transformation from marginality into social violence and conflicts cross gender lines and are linked with poor economic achievements, low degrees of economic participation and limited opportunities, a lack of political empowerment and difficult health and survival conditions. There is an inherent link among poverty, disease, and violence that reduce human, gender, and environmental security (HUGE). But proactive and preventive measures are much cheaper than reactive ones. Once the combat against land degradation and desertification has started and impacts on a larger region, small projects can improve the soil conditions and contain the process of deterioration, of which many were developed by women to restore and to recover the environment, as they need these resources for their own survival and that of their families.

47.7 Conclusions: From Knowledge to Action

47.7.1 Proposals by the United Nations Organizations

Several United Nations agencies (FAO, UNESCO, WHO, WMO, UNDP, UNEP, UNU, UNSO, CGIAR) have been involved for decades in the maintenance and recovery of drylands. Many international financial institutions (World Bank, regional development banks, UNDP, IFAD), facilities (GEF), and mechanisms (*Global Mechanisms* for *Sustainable Land Development*) can supply in cooperation with regional organizations (EU) and national donors the financial resources for land and water projects. These international sponsors and national agencies should involve regional and local societal actors in the design, planning, and implementation of concrete measures to combat desertification and land degradation to enhance soil security. Based on its experience a new epistemic community on land degradation and desertification issues may evolve under the leadership of UNCCD. All these activities may contribute to proactive policies to enhance soil security, taking the recommendations of the MA into account.

47.7.2 Proposals by the Millennium Ecosystem Assessment

The *Millennium Ecosystem Assessment* (MA) noted major research and knowledge gaps on the geographical scope of desertification. Its *Desertification Synthesis* suggested "to focus on prevention, because attempts to rehabilitate desertified areas are costly and tend to deliver limited results", while extreme poverty and hunger limits the MDGs. It proposed "major policy interventions and management approaches" what requires "a change in governments' and peoples' attitudes through improved incentives" (MA 2005: 14–15):

- Integrated land and water management are key methods of desertification prevention.
- Protection of vegetative cover can be a major instrument for prevention of desertification.
- In the dry subhumid and semi-arid zones, conditions equally favour pastoral and cropping land use. Rather than competitively excluding each other, a tighter cultural and economic integration between the two livelihoods can prevent desertification.
- Use of locally suitable technology is a key way for inhabitants of drylands at risk of desertification to work with ecosystem processes rather than against them.
- Local communities can prevent desertification and provide effective drylands resource management but are often limited by their capacity to act.
- Desertification can be avoided by turning to alternative livelihoods that do not depend on traditional land uses, are less demanding on local land and natural resource use, yet provide sustainable income.
- Desertification can also be avoided by creating economic opportunities in drylands urban centres and areas outside drylands.

Several of these measures have been taken up in the 10 year strategy of the UNCCD (2008–2018).

47.7.3 Proposals of the UNCCD 10 Year Strategy

In September 2007 at COP-8 the UNCD state parties adopted a 10-year strategy that aims at the following four 'strategic objectives':

- To improve the living conditions of affected populations;
- To improve the conditions of affected ecosystems
- To generate global benefits through effective implementation of the UNCCD;
- To mobilize resources to support the implementation of the Convention through building effective partnerships between national and international actors.

For the implementation of this strategy, UNCCD's *Committee on Science and Technology* (CST) was tasked to implement the first operational objective. With "clear priorities based on the strategic plan" the CST adopts "a focused work programme". Its meetings should "produce sound scientific outputs and policy-oriented recommendations based on the analysis and compilation of peer reviewed and published literature that inform policy formulation and dialogue at the COP". Among its tasks are "to bolster the scientific and technical basis of the UNCCD". Furthermore, it "creates and steers knowledge-management systems aiming to improve the brokering of scientific and technical information from and to institutions, parties and end users". Among its priorities are to develop "tools and methods, biophysical and socio-economic baselines on desertification/land degradation at the national level", and "methodologies and guidelines for monitoring and assessment of desertification/land degradation trends". At COP-9 in Buenos Aires, the debate on the implementation of this 'strategy' did not achieve further advances.[55]

47.7.4 From a Scientization towards a Securitization of Land Degradation and Desertification

The implementation of the UNCCD strategy requires three major activities of *scientization*, *politicization*, and *securitization*.

47.7.4.1 Scientization of Land Degradation and Desertification

The Madrid strategy emphasizes its aim "to become a global authority on scientific and technical knowledge pertaining to desertification/land degradation and mitigation of the effects of drought". The decisions on the CST indicate a new task of assessing peer-reviewed high quality scientific knowledge and to widely disseminate its results. Towards a scientization of land degradation and desertification, the UNCCD secretariat and its CST and CRIC are cooperating with leading universities and research institutes in monitoring research and in disseminating traditional and modern knowledge, the results of scientific research, and adapted technologies to combat land degradation and desertification.

47.7.4.2 Politicization of Land Degradation and Desertification

Since its entry into force in 1996, the UNCCD secretariat and its decision-making fora (COP, CRIC, and CST) have increased political awareness and raised resources for implementing its goals in the most affected countries. In the new context (MDG, WSSD, MA), the Madrid strategy adopted a *policy framework* to achieve five outcomes:

> a) to asses policy, institutional, financial and socio-economic drivers of desertification, land degradation and barriers to sustainable land management, and recommend appropriate measures to remove these barriers; 2) to revise national action programmes (NAPs) into strategic documents with integrated investment frameworks; 3) to integrate the NAPs and sustainable land management and land degradation issues into development planning and relevant sectoral and investment plans and policies; 4) for developed countries to mainstream sustainable land management interventions into development cooperation programmes; and 5) to introduce or strengthen mutually reinforcing measures in desertification, land degradation action programmes and biodiversity and climate change mitigation and adaptation.

Through this strategy resources should be mobilized to increase effective partnerships between national and international actors. Three objectives are to contribute to a political upgrading of land degradation and desertification issues on the policy agendas of affected countries, of IFIs, donors, and of international governmental organizations. The fourth operational objective addresses the need for capacity-building, and the fifth deals with "financing and technology transfer".

47.7.4.3 Securitization of Land Degradation and Desertification

The Spanish government has securitized land degradation and desertification and related migration processes in workshops on desertification and migration in Almería (1994, 2006), and on desertification and security in Valencia (2003, 2007). This chapter introduces the 'soil security' concept besides 'climate' (Ma-

55 See *ENB*, 4,229 (5 October 2009: 15–16); Bauer/Stringer (2009).

bey 2008), 'water' (Oswald/Brauch 2009), 'food' (Oswald 2009a; Salih 2009), 'health' (Rodier/Kindhauser 2009; Leaning 2009), and 'livelihood security' (Bohle 2009). There are many references to land degradation and desertification in policy documents on climate change and international security.

The Report by the UN Secretary-General on *Climate change and its possible security implications* (11 September 2009) refers to 'desertification' as an impact of climate change:

> Climate change's impacts on human well-being can work through several pathways, including impacts on: food production and food security, e.g., linked to water scarcity, *land degradation, and desertification*; health and the incidence of various vector-borne diseases; the frequency and intensity of extreme weather events, including flooding, drought and tropical storms; and sea-level rise. The last two types of impact have particularly severe consequences for human settlements and population displacement. The more dependent are people on climate-sensitive forms of natural capital, the more at risk are they from climate change [emphasis added by the authors].

The UN Secretary-General argued that climate change "can cause a number of economic disruptions" and that "through its effects on nutrition and health, it may diminish human and animal productivity. It may also contribute to land degradation". And in the context of adaptation the report noted that "Critical actions to enhance food security in vulnerable environments include: developing new drought- and heat-tolerant crop varieties; conserving and better managing scarce water resources; combating land degradation and soil erosion; reducing loss of biodiversity and ecosystem services."

In March 2008, a paper by the European Commission and the Council referred to land degradation and desertification among the "conflicts driven by climate change". In the context of land loss and border issues "desertification could trigger a vicious circle of degradation, migration and conflicts over territory and borders that threatens the political stability of countries and regions". The EU paper argued that "in drier areas of Latin America climate change will lead to salinization and desertification of agricultural land and to decreasing productivity of important crops and livestock. This will have adverse consequences for food security. ... In North Africa and the Sahel, increasing drought, water scarcity and land overuse will degrade soils and could lead to a loss of 75 per cent of arable, rain-fed land". It argued that those people "that already suffer from poor health conditions, unemployment or social exclusion are rendered more vulnerable to the effects of climate change, which could amplify or trigger migration within and between countries." The EU paper claimed that "migration may increase conflicts in transit and destination areas. Europe must expect substantially increased migratory pressure".[56]

A paper by the U.S. National Intelligence Council *The world by 2025* (NIC 2008) ignored land degradation and desertification, but it referred 11 times to migration as a security issue, but all NIC reports (2000, 2004, 2008) ignored environmental causes of migration.

47.7.5 Extraordinary Policy Measures for Enhancing Soil Security

The political move by international organizations and governments to securitize land degradation and desertification may upgrade policy measures to enhance 'soil security' that will affect the livelihoods and survival of millions of affected, poor, and marginalized people in developing countries that lack individual means and financial and administrative capacities of a strong state. In this regard specific proposals are suggested below.

47.7.5.1 Demand Side Management and Efficiency Improvements

Combating land degradation and desertification and enhancing soil security is a complex process that involves different activities from river basin management to reforestation. Soils on high slopes tend easily to erode after deforestation. Thus, recovering mountain ecosystem, its trees, shrubs and grasses is crucial for erosion control, water harvesting, and flood protection, but also for maintaining soils and biodiversity upstream. This helps avoiding disasters, landslides, and the destruction of urban infrastructure in the lower-lying areas. In the river plains, where agriculture, livestock, and urbanization are pressuring on

56 In its "Report on the Implementation of the European Security Strategy" of 11 December 2008 (S407/08), the European Council argued that "natural disasters, environmental degradation and competition for resources exacerbate conflict, especially in situations of poverty and population growth, with humanitarian, health, political and security consequences, including greater migration." It requested the Commission and member states "to improve analysis and early warning capabilities" and to "step up our work with countries most at risk by strengthening their capacity to cope" for which "international co-operation, with the UN and regional organizations, will be essential".

soils, a sustainable and participative land planning is required to optimally use existing resources and to avoid further deterioration.

Remote sensing and *geographic information systems* (GIS) have revolutionized data collection on natural resources including land degradation and desertification. They cannot substitute field studies on specific human, societal, cultural, and historic conditions. The lack of reliable information on desertification can increase land degradation and thus the cost of land degradation and desertification. Monitoring desertification indicators is a long-term activity that offers information on land and water degradation trends, but it should not be limited to technical items and it should always analyse the complex interrelationships between human activities and nature. The different sustainable indicators of the UN should be combined: the *Human Development Index* (HDI) and the *Gender Equity Index* (GEI) of UNDP, and the GINI index on income inequality, to monitor in a holistic way the development process, the applied policies and the response of affected people (chap. 91 by Jesinghaus).

As desertification is both a human- and a climate-induced process that may be reversed by human activities, action must counter land degradation and desertification and give nature a chance to recover. Drylands must become a high priority of governments, because the removal of natural vegetation and inappropriate irrigation and cultivation methods are rapidly degrading the limited biological, soil, and water resources. In drylands controlling wind and water erosion, the destruction of infrastructure and farmland and the advance of the dunes are important. Flash floods may be limited by conserving vegetation soil cover. Dried out river basins may be cultivated with terrace systems and flat lake basins could be recovered with traditional or modern protection measures that permit the infiltration of water into the aquifers and the retention of water in small storages. Rain harvesting technologies help also to maintain the vegetation cover of drylands (chap. 59 by Harish/Mullackal).

47.7.5.2 More Environmental Services and Food with Less Resources

On the supply side a major goal is to produce more environmental services and food with fewer resources by an efficiency enhancement that must be implemented at the local level. In semi-arid and subhumid areas, groundwater substitutes the irregular rainfall when plants are growing. Containing and spreading flood water is a key to desertification control in many parts of the world. Infiltration techniques of rainwater reinforce the artificial recharge of groundwater. Adequate soil and watershed management help to enhance or restore the soils for growing food, grass, and fuel wood.

Salinity, sodicity, alkalinity, and water-logging problems are other key issues of land degradation and desertification in irrigated land resulting in crop yield decline. The extension of irrigated lands through dams and water storage, but above all inadequate irrigation processes, can rapidly deplete the aquifer. Through capillary action, water from saline or brackish groundwater may destroy arable lands. Thus, adequate soil drainage, water-saving irrigation techniques (such as drip irrigation, micro tunnels, micro-aspersion, etc.) may avoid a further deterioration of the land and aquifer and also increase crop yields. Improper land use and drought are principle agents of desertification. Reduced groundwater recharge is related to the over-exploitation of a limited natural resource.

To produce enough food for the increasing population with scarce and polluted water requires manifold efficiency enhancement activities in agriculture. This is the most important and first political and societal action. By using more cereals in the human diet, instead of feeding animals, and producing biofuels and industrial products, the reduction of animal proteins cannot only save water and reduce the negative impacts on climate change, but it can also feed more people with less resources.

The second item is related to sustainable agriculture that integrates crop and animal production, appropriate resource management practices with the needs and capabilities of the human population. Some of the needed actions are rangeland rehabilitation, grazing management, farming system development, water harvesting, and on-farm water husbandry practices. Others are related to the increase of crop yields with bio-fertilizers and micro-organisms that are able to fix the nitrogen from the air to the soil or methods for composting organic waste that improve soil quality. A mixed agriculture, policultivation, crop rotation, and enhanced biological productivity are mechanisms to conserve and maintain natural fertility of soils and achieve high crop yields.

The plastic greenhouse technology (chap. 54 by García Lorca) conserves residual humidity, uses dew for irrigation and reduces plagues, while organic fertilizer may enhance crop yields. An interesting aspect of this model is the social organization of cooperatives

at the local level that creates a horizontal and vertical integration of agriculture with the transformation and transportation of the produced crops.

Combating desertification in the field is a local and a regional effort. It must be socially and economically acceptable for indigenous people and peasants, and overcome the interest in short term benefits. Successful approaches combine traditional and modern knowledge accepted by villagers and adapted to local microclimatic conditions (Laureano 2001 and chap. 52).

Many densely populated desertified drylands rely on an agricultural and livestock economy, where land and water rights are privately owned and often divided in small plots, what technical proposals must also consider. While desertification is a regional phenomenon, the control of wind and water erosion, of moving sand dunes involves a mixture of trees, shrubs and grasses, together with improved irrigation and soil management techniques.

To improve the quality and quantity of water, energy efficiency and renewables from solar, wind and waste play a crucial role (Kurokawa 2003; Faiman 2004, 2009; Trieb/Krewitt/May 2009; Safriel 2010). The tropical deserts have the highest solar insolation and could generate in centralized and decentralized systems energy for desalinization of brackish groundwater or sea water. The model suggested by the DESERTEC foundation offers a promising perspective especially for those countries in the sunbelt that lack both fossil fuels and water (preface essay by HRH Prince Hassan of Jordan).[57]

Throughout history, the natural climate variability has resulted in severe droughts, crop failures, bad harvests and famines. Some authors interpreted these events as a systemic ecological collapse[58] resulting from deforestation, siltation, and decline of biological diversity. Due to anthropogenic climate change the number and intensity of extreme weather events is projected to rise (IPCC 2007). Thus, affected governments must ask for timely food aid. Its transparent distribution by international and national humanitarian organizations can avoid famine and social unrest.

47.7.5.3 Transition to Alternative Livelihoods and a Sustainable Economy

Women, peasants and indigenous grassroots movements play an important role in the poor rural areas of developing countries. Their expertise, developed during centuries, may strengthen their strategies for controlling desertification. New technologies that are integrated into traditional management techniques require a prior assessment of natural and social impacts for the population involved. The consolidation of the traditional leadership in the village of old men and women and the integration of young people with technical training and of returning migrants can support the combat against desertification.

Clergymen as spiritual leaders, doctors, and lawyers may play a crucial role as leaders in the efforts to combat desertification. Schools are also important for training and teachers are sources of new knowledge who educate young people, the future labour force for the development of rural society. As the desertification process evolves relatively slowly, these trained young people are the future actors to fight from the grassroots against desertification who understand the complex interaction between human beings and nature. They may also be trained in energy efficiency and renewables to generate a sustainable energy and transport system that may promote drylands ecotourism with low environmental impact and thus generate the financial resources for recovering degraded land and maintaining the soils of fragile drylands. Besides these concrete proposals for coping with the causes of land degradation and desertification and their direct effects and impacts, additional measures are needed to respond to societal outcomes, such as migration.

47.7.5.4 Coping with Environmentally-induced Migration

The *I*IOM (2007: 5–7) suggested as "the most cost-effective and humane" policy response to migration to avoid "the need for environmental migration by intervening at the earliest stage possible. Sustainable development assistance is required to strengthen the coping capacity of communities affected by environmental degradation. Programmes need to engage the most vulnerable". Among them community stabilization initiates should fully involve "diasporas and returning migrants" to optimize the financial resources of migrants and "to prevent further environmental degradation in the migrant sending area" (chap. 53 by Mainguet/Dumay/Kabiri/Lahcen).

57 See for details at: <http://www.desertec.org/> and on alternative livelihood see Adeel and Safriel (2008).

58 Drew (2000); Weiss (1982); Weiss and Bradley (2001); Coe (1999); Webster (2002); Demerest, Rice, and Rice (2004); Sabloff (1990); Gill (2000); Zhang, Cheng, Edwards, Chen, Wang, Yang, Liu, Tan, Wang, Liu, An, Dai, Zhou, Zhang, Jia, Jin and Johnson (2008).

Urban authorities should prevent inflows of environmentally-induced migrants and avoid or limit the negative impact on humans and environment. In the early stages of environmental degradation, efforts to facilitate international labour migration may offer temporary relief. However, if land degradation and desertification reaches an irreversible stage, "permanent migration can be better managed und sustainable resettlement schemes carried out incrementally." With regard to "mitigating forced displacement" policy efforts for "improved disaster preparedness and management" including effective early warning systems, humanitarian assistance and relief efforts are needed that avoid negative environmental impacts of camps and temporary shelter. The expected additional flow of such migrants requires capacity building to reduce irregular migration, and prevent human trafficking and smuggling.

Renaud, Bogardi, Dun and Warner (2007) suggested five steps in implementing a precautionary principle for the relationship between environmental degradation and change and forced migration: 1) the need for a strong scientific basis; 2) increasing awareness; 3) improving legislation; 4) providing means for adequate humanitarian aid; and 5) strengthening institutions and policies.

The WBGU (2008: 193) suggested "the establishment of a transsectoral, multilateral Convention to regulate the legal position of environmental migrants", by adopting supplementary measures outside the existing legal regime (Brauch 2000–2001; Bogardi/Warner 2008). This proposal was developed in detail by Frank Biermann and Ingrid Boas (2008: 51) who suggested a "separate, independent legal and political regime created under a Protocol on the Recognition, Protection, and Resettlement of Climate Refugees to the United Nations Framework Convention on Climate Change".[59]

In his report on the possible security implications of climate change, the UN Secretary-General Ban-Ki Moon had referred 33 times to migration, especially on "population displacement and involuntary migration".

The *Human Development Report 2009* on *Overcoming barriers: Human mobility and development* referred only once to 'desertification' and four times to 'drought' but lacked any reference to 'land degradation' and desertification as a cause of migration. In looking ahead, the UNDP's HDR 2009 referred to three drivers for human mobility a) the economic crisis and the prospects for recovery, b) demographic trends and c) environmental factors. This part concluded on the global trends of human movements:

> First, movement largely reflects people's need to improve their livelihoods. Second, this movement is constrained by policy and economic barriers, which are much more difficult for poor people to surmount than for the relatively wealthy. Third, the pressure for increased flows will grow in the coming decades in the face of divergent economic and demographic trends. Ultimately, how these structural factors will affect the flow of people in the future depends critically on the stance taken by policy-makers (UNDP 2009: 46).

As was argued above, so far no agreement exists on the definition of environmentally-induced migration of which land degradation and desertification has become a major trigger, on the statistical scope and on a legal regime to award to these migrants a refugee status.

47.7.5.5 Preventing Environmentally-induced Conflicts

As issues related to land degradation and desertification may cause, trigger or contribute to societal crises and to low level conflicts by proactively addressing its causes, effects, and impacts the potentially violent societal outcomes may be avoided. A first step is public awareness to recognize the future challenges, and thus to contribute to a process of political learning and cooperation with the goal to revise the projections by jointly defined counteractions. Anticipatory learning as a tool of crisis prevention is more ambitious than crisis management. It remains the domain of long-range and interdisciplinary discourses of academics and of foreign policy planning staffs. As these long-term structural challenges do not require urgent responses, sufficient time exists for conceptually focused and policy-oriented epistemic communities of which UNCCD is a part, and its CST and CRIC offer a framework for dialogue and policy debate.

59 For comments see: Mike Hulme "Commentary - Climate Refugees: Cause for a New Agreement?", in: *Environment*, November-December 2008; at: <http://www.environmentmagazine.org/Archives/Back%20IssuesNovember-December%202008/hulme-full.html>; Dan DaSilva: "'Climate Refugees' Gatecrash the Agenda"; in: *Towards Recognition*, posted on 26 June 2009; at: <http://www.towardsrecognition.org/2009/06/climate-refugees-gatecrash-the-agenda/>; Kayly Ober: "Finding a (Legal) Home for Climate Migrants"; in: *Towards Recognition*, posted on 31 August 2009; at: <http://www.towardsrecognition.org/2009/08/finding-a-legal-home-for-climate-migrants/>.

Joint North-South and South-South anticipatory learning requires a debate on longer-term challenges and a mutual understanding of their relevance, and then a multidisciplinary search for complex strategies to cope both with the root causes and their socio-economic implications. Anticipatory learning must be addressed on three levels: across the boundaries of scientific disciplines; across the North-South divide and between conceptually oriented academics and action-oriented decision-makers. Partnership requires mutual trust and confidence.

47.7.5.6 Ten Conceptual Proposals for Coping with Land Degradation and Desertification

For coping with land degradation and desertification ten conceptual proposals are offered in conclusion:

1. *Partnership building measures* (PBMs) as political tools in the economic and ecological realm may have a positive impact on the societal and cultural level (Brauch 2000). Functional PBMs should aim at:
   - creating awareness on these challenges among decision-makers and in the public;
   - analysing in detail the complex interrelationship among the factors of the environmental and human quartet (figure 47.1);
   - initiating regional climate impact studies and mitigation strategies against land degradation and desertification.

   The global and regional challenges should lead to more active policies of cooperation on sustainable development in agriculture, industry, tourism, and transport. What can PBMs contribute conceptually as a new political tool to a complex anticipatory learning process? In the medium-term, PBMs could become important instruments of preventive diplomacy and of a post-conflict peace-building in parts of the globe with violent conflicts.
2. One example for a *partnership building project* (PBP) to mitigate several impacts of land degradation and desertification could be a 'survival pact' that links 'virtual water' (food exports) with 'virtual sun' (renewable energy exports) based on a longer-term interdependence. Linking both commodities that are crucial for life: cereals and energy requires a high degree of trust and predictability. Such a 'survival pact' could start now with the training of experts for the respective countries in the area of renewable energy (solar and wind power), but above all involving the people that own the land thus increasing their income from exporting renewable energy (Brauch 2002, 2002b, 2006a).
3. The fight against desertification is the task of the parties of UNCCD and of the development programmes of many countries. Sustainable agriculture and food security are a concern of FAO, of the World Bank, of development agencies and national and local governments.
4. Urbanization and urban pollution are the new threats for the majority of the population. Many of these concerns were reflected in the *Declaration by the Millennium Summit* (2000) that relies on a wide security concept, including environmental challenges, and that stresses cooperation on effective countermeasures, but also governance and transparent urban governments, able to create a resilient and participative community.
5. These goals require a longer-term strategy of implementation in a multilateral cooperative framework based on partnership. The societal impacts of climate change, land degradation, and desertification may trigger conflicts that may be negotiated peacefully but they may also escalate into violent clashes. But they are unlikely to produce militarily relevant 'threats' that can be deterred or countered by military means. But the price for not acting now may pose human catastrophes for the victims of climate change and environmental stress (Stern 2006, 2009).
6. The consequences of distress migrants from Central America will impact first on Mexico, and these environmental migrants will certainly have implications for the USA and Canada. Droughts in the Sahel countries will impact on North African countries first and later also on Europe.
7. Active and efficient implementation of climate policies and of measures to cope with land degradation and desertification could become the best security strategy to prevent environmental conflicts from occurring and to contribute to a 'sustainable peace' that combines non-violent conflict resolution, equitable economic relationships, and sustainable policies in the North and South.
8. Long-term oriented proactive policies of sustainable development combating desertification require functional cooperation and non-agricultural employment in rural areas.
9. These initiatives may become the most effective policy of conflict prevention that will enhance both human and societal security in the affected regions but they may also reduce the costs for cop-

ing with the consequences of the missed opportunities that exist for multilateral cooperative policies in the early 21st century.

10. All these measures should enhance water, soil, and food security that will also improve health security of the people most affected by land degradation and desertification. By forward-looking multidisciplinary and policy-relevant research, anticipatory learning and proactive policies, many of the extreme and potentially violent outcomes of GEC and land degradation and desertification may be avoided.

48 Alternative Livelihoods for Attaining Sustainability and Security in Drylands

Uriel N. Safriel

48.1 Introduction[1]

Claims linking desertification with poverty and loss of security are often not supported by hard data (Dobie (2001). This is partly due to loose definitions and indiscriminate use of 'desertification'[2], 'poverty'[3], and 'security'[4] – a result of meagre communication between natural and social scientists addressing phenomena driven by tightly interlinked biophysical and social processes, as well as due to disagreements within each of the two disciplines. As a result, the extent to which conflicts (often resulting in violence) are driven by poverty and poverty is driven by desertification, is controversial and poorly known.

Three issues are addressed in this chapter: (a) the inherent low productivity of drylands can generate low human well-being, with no desertification involved; (b) in the drylands resource sustainability, human well-being, and its security component may represent locally stable states, destabilized by nonlinear, threshold-crossing transition to alternative locally stable states of desertification, poverty and conflicts, respectively; (c) the 'desertification paradigm' (human pressures leading to misuse of land resources, desertification, poverty, and reduced security) and its 'counter paradigm' (challenged by adversity local people mobilize their inherent ingenuity, which generates adaptations and innovations that keep them ahead of desertification, poverty, and conflict) fail to realize that as pressure on resource continues, a point in time is reached when neither technology nor ingenuity would maintain sustainability. This can be avoided by reducing or abandoning land resource use through adoption of dryland 'alternative livelihoods'.

These are of minimal dependence on land primary productivity and generate higher income than traditional drylands livelihoods, even higher than these livelihoods generate when practised outside the drylands. *Dryland afforestation* (48.4), though dependent on the dryland biological productivity, is a potential alternative livelihood, producing fuel wood, biofuel, and sequestered carbon, projected to be of increasing demand. *Controlled-environment protected agriculture* (48.5) is an alternative livelihood dependent on primary productivity, but not on land resources; in spite of high investments, it yields a competitive edge over agriculture within and even off the drylands. *Dryland aquaculture* (48.6), based on biological productivity (though mostly not primary productivity), is of low land use and high water use efficiency and is driven by increasing demands for aquatic, especially marine, food. Increasing *dryland urban growth* (48.7.1) provides urban livelihoods, while *dryland tourism* (48.7.2) as an alternative livelihood is based both on rural and urban dryland resources and is driven by increasing demand. Projected global demands for renewable energy are likely to generate *dryland alternative livelihoods associated with solar energy production* (48.7.3).

Alternative livelihoods can be practised in most drylands, but afforestation has higher prospects in the non-desert drylands, while all other - in desert ones[5].

1 This chapter is partly based on a lecture delivered at the conference "Desertificacion y Seguridad Ambiental: consecuencias y prevención", 9–11 March 2006 under the auspices of Cosmo-Caixa, in Madrid, Spain that was publishe as: "Alternative livelihoods for attaining dryland sustainability", in: Rubio, Jose L.; Andrew, Vincent (Eds.): *Human and socioeconomic consequences of desertification* (Las Palmas: Universidad de Las Palmas de Gran Canaria, Servicio de Publicaciones y Difusion Cientifica de la ULPGC, 2009): 161–190.

2 'Desertification' is defined here as a persistent reduction in dryland productivity (e.g. Adeel/ Safriel/ Niemeijer/ White 2005).

3 Pleases see section 48.2.4 for discussion of poverty indicators.

4 In this chapter 'security' refers to a component of 'human well-being', which includes personal safety, secure resource access, and security from disasters (e.g. MA 2005; Leemans 2009).

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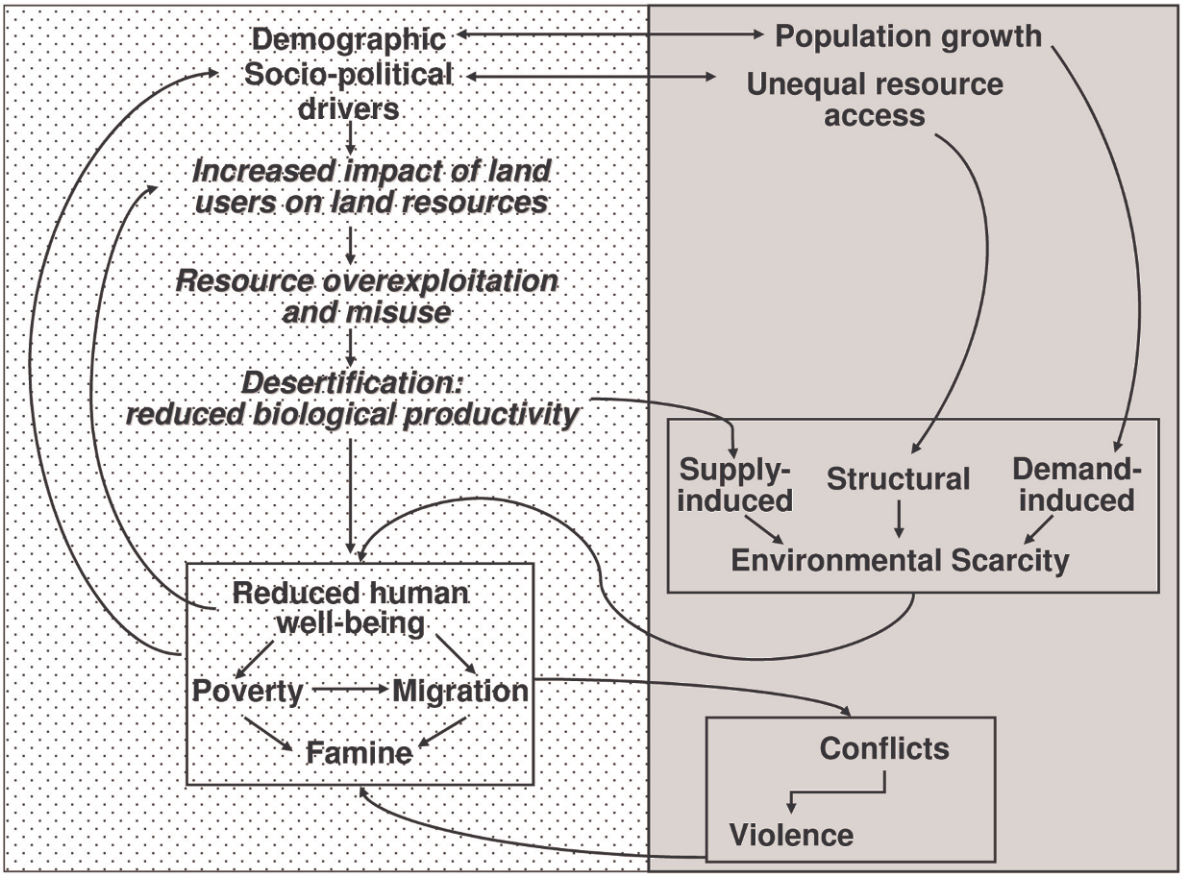
Figure 48.1: The rural drylands' 'desertification paradigm': social and policy processes (in conventional font), biophysical processes (*in italics*). **Sources**: The left column is adapted from Safriel/Adeel (2005). The right column introducing the 'environmental security' issue is adapted from Homer-Dixon (1999) and Homer-Dixon/Deligiannis (2009)



For attaining dryland sustainability alternative and traditional dryland livelihoods need to coexist as a mutual back-up, for buffering against uncertainties that affect both the ecological and the human dryland systems. This chapter explores the linkages between poverty and its resulting insecurity, and between these and the currently prevailing land use in drylands, based on land productivity. It then elaborates on the potential of alternative livelihoods in addressing dryland sustainability.

48.2 The Desertification – Security Nexus

48.2.1 The Desertification Paradigm

Desertification, defined by the *United Nations Convention to Combat Desertification* (UNCCD) as land degradation in the drylands is addressed by the *Millennium Ecosystem Assessment* (MA 2005) as a paradigm[6]. According to this 'desertification paradigm' (Safriel/Adeel 2005) demographic and sociopolitical factors drive dryland farmers and herders to overexploit or misuse land resources, which results in desertification, expressed by a persistent reduction of bio-

5 Desert drylands are the hyper-arid and most of the arid drylands, whereas non-desert drylands are the semi-arid and the dry sub-humid drylands (Safriel/Adeel 2005; Ezcurra 2006).

6 A cluster of conceptual and methodological presuppositions embodied in an exemplary body of scientific work, or the predominant worldview in the realm of human thought, e.g. Kuhn 1962).

logical productivity. This leads to interlinked poverty, famine, and migration of the land users (Brauch 2006, 2006d; Boulharouf/Pattie 2008; Rechkemmer 2008). These in turn further amplify the demographic and sociopolitical drivers that had initiated this desertification positive feedback loop (figure 48.1, left column).

This paradigm is often extended to suggest that the desertification-driven reduced human well-being, especially when expressed in poverty that motivates emigration, is prone to become a 'security issue' (Kepner/Rubio/Mouat/Pedrazzini 2006). Since the UNCCD is formally an 'environmental' convention, being designated as a 'Rio Convention' (Bauer 2006), the relevant 'security' is not necessarily associated with armed conflicts, but is alluded to as a 'soft' security issue, often termed 'environmental security'.

The notion that environmental degradation has sociopolitical implications (e.g. Homer-Dixon 1994) and may constitute an emerging security risk, and the term 'environmental security', was coined in the late 1980's (Levy 1995, Brauch 2003, 2005, 2005a). Since then the issue aroused interest but also generated controversy as the term 'environmental security' has not been formally defined, neither scientifically nor legally (Glenn/Gordon/Perelet 1997–1998), yet it has been instrumental in promoting an environmental discourse (e.g. Helm/Sprinz 2000).

'Environmental Security' has been used in the desertification context probably first by Olsson (1993), and was later extensively elaborated on in a 2003 conference on *Desertification in the Mediterranean Region: A Security Issue* (Kepner/Rubio/Mouat/ Pedrazzini 2006; Brauch 2006; Liotta 2006).

The linkage between 'environmental degradation' (including 'desertification' as a special case) and 'environmental security' is one between biophysical and societal-political processes, thus drawing natural scientists and sociopolitical scientists to the same arena. The latter introduced the term 'environmental scarcity' as a mediator between 'environmental degradation' and its expression in reduced human well-being, culminating in conflicts and violence. This scheme, that can be incorporated into the 'desertification paradigm' (figure 48.1, right column), was proposed in the early 1990's (Homer-Dixon 1994, 1999; Bächler 1999; Bächler/Böge/Klötzli/Libiszewski/Spillmann 1996; Bächler/Spillmann 1996a, 1996b) and has become prevalent in the sociopolitical discourse (e.g. Dalby 2004; Brauch 2003, 2005, 2005a, 2006; Liotta 2006). 'Scarcity' in this scheme is generated by each of three mechanisms or their combination: the low supply of the resource due to its degradation ('supply-induced' scarcity), which can be further exacerbated by population growth ('demand-induced' scarcity), and an often emerging inequitable societal distribution of land resources resulting from one segment of the population reducing resource accessibility to the socially and economically weak segments of society ('structural' scarcity). Sociologists often differ from ecologists in the way they perceive these 'scarcity' mechanisms, and an attempt to bridge this gap is presented in the following section.

48.2.2 Scarcity and Degradation – Sociological vs. Ecological Perspectives

Natural scientists practising the discipline of ecology would argue that 'scarcity' is induced by resource limitation, and not necessarily by resource 'degradation'. Using ecology jargon, individual-weighted, density-dependent, intra-population exploitative or interference competition on the finite resource on which the dryland livelihood depends, determines the fraction of the resource available for an individual user (e.g. Puigdefabregas 1995).

Thus, ecologists would claim that the sociologist's 'supply' and 'demand' are interlinked – use of the 'supply' increases the 'demand' through promoting population growth (or wealth), and the increased 'demand' reduces the 'supply' through consumption. Ecologists would also ascribe the sociologists' 'structural scarcity' to the mechanism of asymmetric competition, by which some individuals are affected more than others by intra-specific competition (for terminology see e.g. Begon/Harper/Townsend 1996). Thus, the distinction between supply-induced and demand-induced scarcity is rather artificial, and since at least theoretically any use of finite resource generates competition, i.e. conflict, 'scarcity' is not necessarily a useful term for addressing the 'environmental security' issue, including when the environment is that of a dryland ecosystem.

Furthermore, not only 'scarcity' but also 'degradation' is not required for linking resource use with 'environmental security' and its poverty-conflict nexus. For example, a farmer's income can decrease when his plot loses half of its previous productivity due to desertification. Yet his income can be equally reduced with no desertification, but as a result of losing half of his plot due to social, cultural or policy-driven causes. Moreover, in the dryland context, where productivity is inherently low relative to that of many non-dryland ecosystems, rural poverty can emerge with no land

degradation, i.e. it need not be driven by desertification. In the following section alternatives to the desertification paradigm are brought forward.

48.2.3 The 'Dryland Livelihood Paradigm'

Ecologists have elaborated on several mechanisms that generate nonlinear relations between consumption rates and resource abundance at low resource levels, whereby the cost surpasses the benefit of resource acquisition. These relate to time spent on travelling between low-density resource items or low-density resource patches and the risk and costs involved in this travel (e.g. Optimal Foraging Theory, suggesting that the forager would abandon a resource when the cost of its acquisition surpassed its benefit, see Begon/Harper/Townsend 1996), or to the minimal number of resource items that promote search efficiency (e.g. type 3 functional response, or the Allee effect, see Begon/Harper/Townsend 1996). These mechanisms are relevant to the pastoral livelihood in drylands, whose practitioners' well-being can be reduced by a combination of climate variation and low productivity of non-degraded land. Thus, a herder may become poor not because the range has become degraded, but because plant productivity is too low there, which requires moving with the flocks over an area larger than what is manageable or profitable to cover. Similar considerations apply to a dryland farmer who is poor even though his plot size is large enough to provide for his needs, yet too large for his capacity to make the investments required for its productive cultivation.

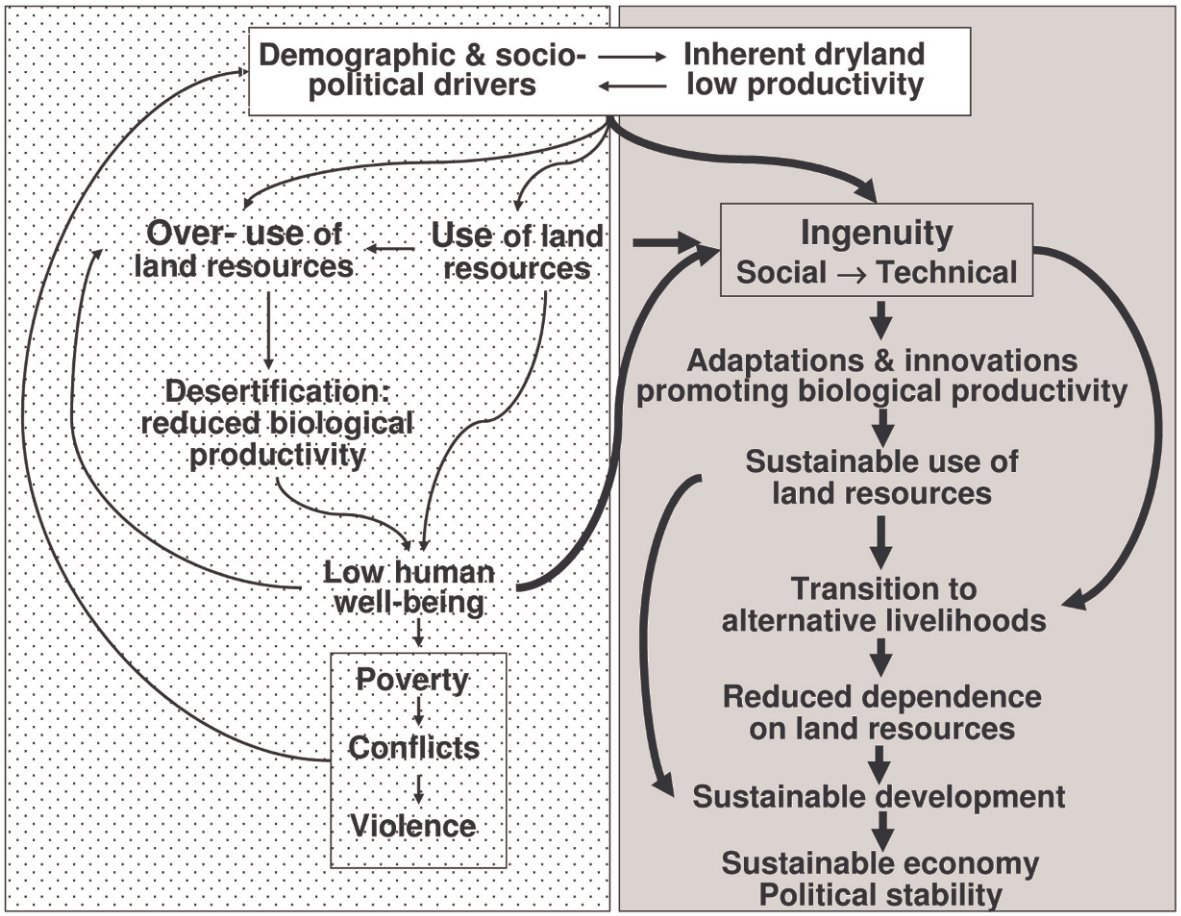
These examples suggest that the dryland practitioner of either pastoral or farming livelihoods can become poor and generate or experience conflict situations without degrading his land. By the same token, the inherently low productivity may motivate the dryland farmer or pastoralist, whether already or not yet poor, to intensify his land use practices (overstocking of rangelands, expansion and intensification of farmlands), thus leading to desertification and poverty. These two scenarios, driven by the drylands' inherently low productivity, call for a '*dryland livelihood paradigm*' which addresses poverty derived from non-degrading dryland use. The '*desertification paradigm*' then becomes a special case in which the inherent low land productivity, and/or the low human well-being of dryland users, motivates them to overuse the dryland, thus leading to its degradation. In both the degrading and the non-degrading track, the low or reduced human well-being generates the downward spiral and feedback loops of poverty, conflict, and their security concerns (figure 48.2, left).

However, increasing evidence suggests that this is not always the case, and that dryland use can also take another, alternative trajectory. Thus, the Millennium Ecosystems Assessment's '*desertification paradigm*' is complemented by an alternative 'counter-paradigm' (Safriel/Adeel 2005). This too can be incorporated in the '*dryland livelihood paradigm*' (figure 48.2, right).

The inherently low dryland productivity and/or the poverty generated by use or overuse of the dryland are a challenge to the land users. Their inherent ingenuity then yields adaptations and innovations that keep them ahead of desertification, poverty, and conflict. This ingenuity is expressed in taking measures such as improving marketing infrastructures, developing financial and extension services ('social' ingenuity, Homer-Dixon 1994) or organization of labour ('induced innovation', Boserup 1965; Tiffen/Mortimore/Gichuki 1994). This implicitly-inherent social and technical ingenuity can be expressed in adaptation of technologies and innovations in cultivation practices, which promote rather than degrade biological productivity (Adeel/Safriel/Niemeijer/White 2005). Hence, in this counter-paradigm, dryland people use the soil and its biological productivity at rates that are within the capacity for renewal, thus practising sustainable use (IUCN/UNEP/WWF 1991) of land resources.

Yet, because land resources remain finite, as long as human pressure increases, ingenuity and adaptive capacity that target biological productivity are bound to be exhausted at some point in time. However, ingenuity and adaptive capacity can also take a different trajectory before land use loses sustainability by turning into livelihoods that 'decouple' from dependence on land resources (Homer-Dixon 1994), or at least reduce the dependence on them (Matthew/Gaulin/McDonald 2003). These are the 'alternative livelihoods' (Safriel 2004, 2006a) that mostly capitalize on non-agricultural dryland assets. Either independently or combined with the attained sustainable use of biological productivity, these alternative livelihoods are likely to lead to a genuine sustainable development – improvement of human well-being which is supported by a sustained flow of dryland ecosystem services (Millennium Ecosystem Assessment 2003). This dryland sustainable development leads to sustainable economy, one which maintains the natural resource base, yet it allows for growth through improvements of knowledge, organization, governance and technical efficiency (IUCN/UNEP/WWF 1991), both enjoying and supporting political stability (figure 48.2, right).

Figure 48.2: The 'Dryland Livelihood Paradigm'. The interaction between people and the inherent low dryland productivity (top) can generate two contrasting development trajectories leading to low human well-being (directly or through desertification), poverty and conflict (left, column, dotted), or through ingenuity and adaptation leading to sustainability and security (right, column, grey). **Source**: The author.



48.2.4 Uncertainties, Loose Terminology, and Controversies

The causal relationships between each of the elements of both the 'desertification paradigm' (figure 48.1) and the 'dryland livelihood paradigm' (figure 48.2), as represented by the arrows in these schemes, are not well understood, and are controversial. It is therefore unknown where, when, and why land use in the drylands leads to conflict and violence, or to sustainable economy and political stability. There are disagreements regarding both the biophysical and the sociopolitical mechanisms involved, and since these are interconnected, the paradigms remain elusive.

Regarding the biophysical processes, the term 'desertification', though defined in a legally-binding international agreement (UNCCD), is loosely and indiscriminately used by stakeholders, implementing parties of this agreement and others (e.g. 'desertification' is used in describing the clearing of sub tidal Mediterranean rocks from algae, caused by fishing of edible, rock-boring marine bivalves; see Guidetti/Fraschetti/Terlizzi/Boero 2004).

This might have led to loss of credibility by sizeable segments of the scientific community, pointing at over-simplification and confusion in describing and addressing dryland processes, and even at deliberate inflation in use of the term as a strategy to attract attention and funding (Warren/Olsson 2003). There is also a disagreement within the scientific community whereby 'desertification' is invoked or refuted depending on whether the context is biophysical or sociopolitical (Herrmann/Hutchinson 2005): a site can be described by social scientists as suffering from severe desertification, whereas biophysical scientists dismiss this claim (Mortimore/Turner 2005).

The definition of the socio-economic terms 'poverty' and 'human well-being' too are not robust. Survey data of consumption and income are used to determine 'poverty lines' set by social norms and expectations that differ between individual countries. For the sake of global aggregation and comparison, the World Bank employs reference lines using two Purchasing Power Parity terms set at $ 1.08 and $ 2.15 in 1993 (Chen/ Ravallion 2001), and the United Nations employs a 'Human Poverty Index' as a composite measure of social, economic, and health parameters (Fukuda-Parr 2003). 'Human well-being', on the other hand is defined as a composite qualitative state, including the above measures as well as others, such as security (e.g. MA 2005). Furthermore, the only available figure to date on dryland poverty ("Of the population living in dry areas approximately 1 billion are poor, which accounts for close to half of the world's poor." UNDP 2008) cannot be substantiated by quantitative data relating to the World Bank's Purchasing Power Parity poverty levels or to values of the Human Poverty Index applied to dryland populations. To conclude, these shortcomings of both the biophysical and the socio-economy disciplines contribute to the difficulties in assessing when and where land use becomes overuse, overused land becomes desertified, and desertification leads to poverty.

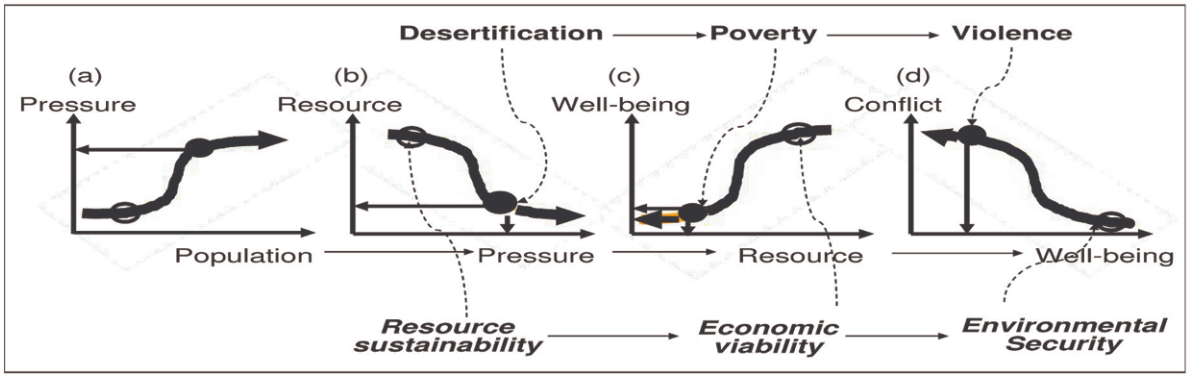
Beside difficulties caused by loose definition of states (e.g. desertification, poverty), social scientists disagree on the relative role of environmental degradation in generating conflicts and violence. The thesis of Homer-Dixon (1994, 1999), that depletion and degradation of renewable 'environmental resources' leading to 'environmental scarcity' contributes to civil violence, was criticized by Hauge and Ellington (1998) as fraught with a shaky theoretical basis and flawed data treatment. Subjecting a wider data set to robust statistical analysis suggested that though degradation of renewable resources, alone or combined with elevated population density, increase the risk of low-level domestic conflict, this degradation is only a marginal driver of violent conflicts (Hauge/Ellington 1998). Analysing the evidence for supporting and refuting Homer-Dixon's thesis, Gleditsch and Urdal (2002) concluded that the existing empirical evidence was still insufficient to demonstrate a tangible effect of population growth and environmental scarcity on conflicts and violence.

Social scientists also disagree on whether population growth, environmental degradation, scarcity and poverty, individually or combined, induce ingenuity and innovation (e.g. Boserup 1965; Tiffen/Mortimore/Gichuki 1994: de Soysa 2002; Dalby 2004), thus leading the drylands onto the sustainability and stability trajectory; or, scarcity and poverty suppress ingenuity by hampering effective social and technological investments (e.g. Homer-Dixon 1994, 1999), hence pushing the drylands into the spiral of desertification and conflict. To conclude, both paths of the *'dryland livelihood paradigm'* are controversial, what calls for a different approach.

48.2.5 The 'Dryland's Alternative Stable States' Hypothesis

The recognition that the processes in the '*dryland livelihood paradigm*' may be nonlinear could contribute to resolving some of the contentions discussed above. It has been hypothesized (Safriel/Adeel 2008) that nonlinear processes characterize the various components of the dryland livelihood paradigm. Accordingly, the paradigm can be collapsed into a chain of variables – population size, population pressure, land resources level, human well-being level, and conflict level. Each of these links in the chain is of a potential to drive the forefront link and to be driven by the preceding link (figure 48.3). It has been further suggested that the functional relations within this chain are nonlinear, such that each of the linked variables can be maintained in two alternative equilibrium states which are locally stable, but each of them can be destabilized once a threshold value is crossed, driving the variable to the alternative locally-stable state. Thus, the effect of a linear population growth on its pressure on land resources may not be linear – when population size is low a low level of pressure is exerted, but when a threshold level of population size is crossed, a strong pressure becomes evident (figure 48.3a). Since the pressure on resources may be buffered under a regime of low population growth rates, resource levels then maintain high, sustainable levels (i.e. its renewal and consumption rates remain similar, figure 48.3b, empty circle), human well-being benefits from economic viability (i.e. the practiced livelihoods generate stable and satisfying income) and only mildly fluctuates around high levels (figure 48.3c, empty circle), thus leading to high 'environmental security' expressed in a low incidence of conflict (figure 48.3d, empty circle). However, when population size reaches a level at which the pressure on land resources steeply climbs to a high state, whereby land resources and their biological productivity sharply drop to a persistent low value, an alternative, relatively stable state of desertification is attained (figure 48.3b, solid circle). Similarly,

Figure 48.3: The 'Dryland's Alternative Stable States' Hypothesis. Nonlinearities in the Dryland Livelihood Paradigm – the desertification – poverty – violence chain (top, bolded) and states (solid circles), and the resource sustainability – economic viability – environmental security (bottom, italics) and states (empty circles). **Source**: The author.



this new, undesirable locally stable state of desertification reduces human well-being in a nonlinear way, to an alternative low state – poverty (figure 48.3c, solid circle). By the same token, the declining human well-being and conflict level may drive conflict level in a nonlinear mode, crossing the violence threshold (figure 48.3d, solid circle).

Note that nonlinearities in the '*dryland livelihood paradigm*' model (figure 48.2, left) can also be then transformed into a feedback loop when the open-ended chain is 'closed'. The prevalence of the security stable state can maintain resource sustainability, or the alternative state of violence can drive the resource level to an acceleration and long-term prevalence of the desertification state.

The conflicting results generated by the different studies of components of the '*dryland livelihood paradigm*' depend on where the studied systems were positioned along the nonlinear curves when observations and data were made and collected, respectively. For example, whereas in a certain area the pressure level is not sufficient to generate desertification the same pressure level under different circumstances does cross the threshold. This also applies to the poverty and security states.

Finally, just as desertification, poverty, and violence result from crossing thresholds by relatively strong perturbations of relatively stable desired states, restoration of security, human well-being, and biological productivity also require a relatively strong perturbation in the opposite direction. This leads to the assertion that desertification, just as poverty and violence, represent a state that is not necessarily irreversible. Rather, it is a locally stable state that moving it to the alternative state, i.e. restoring sustainability would require sizeable investment.

48.2.6 Multiple Stable States in Ecological Systems and in Drylands

The notion that ecological systems can theoretically be maintained at multiple stable states has been deliberated by ecologists for more than three decades; this notion can also be applied to social systems that depend on ecological systems. Evidence for alternative stable states and nonlinearities in ecological and natural resource systems is gradually emerging (Gunderson/Pritchard/Holling/Folke/Peterson 2002). An example that reflects on desertification is, rather paradoxically, that of the Jamaican coral reef, where human-induced increased nutrient input combined with overfishing of herbivorous coral-reef fish drive the coral-dominated reef to algae dominated reef. The latter is a stable, hard to reverse state, with a lower provision of biological productivity, tourism and coast protection ecosystem services as compared to the former state (Janetos/Kasperson 2005; MA 2005).

Two other examples, though controversial, come from the drylands. The first relates to vegetation cover of the semi-arid African Sahel. Much of the rainfall there may be recycled by the vegetation through its effects on *albedo*.[7] It has been claimed that overgrazing and exploitation disrupted this vegetation-related rainfall generation over a long period, leading to reduced productivity (Janetos/Kasperson 2005). This, however, may not be a locally stable state, since the

7 Albedo is the fraction of solar radiation striking earth that is reflected by its surface back to space.

Sahel's productivity recovered following drought years (Safriel/Adeel 2005).

The salient example of a nonlinear, desertification-attributed transition between dryland stable states is that of bush encroachment onto arid and semi-arid grasslands This increase in density of woody plants often unpalatable to livestock reduces the value of the range, though the overall primary productivity is not reduced. Livestock overgrazing is implicated – removal of shallow-rooted grasses enhances water storage in deeper soil layers, thus favouring deeper-rooted shrubs (e.g. in Botswana, Walker/Ludwig/Holling/Peterman 1981). The shrubs are further promoted by the leakage of nutrients from the grass-denuded surfaces into the vicinity of the shrubs, thus a mosaic of 'islands of fertility' in a soil-degraded matrix (e.g. in south-western USA, Schlesinger/Reynolds/Cunninghan/Huenneke/Jarrell/Virginia/Whitford 1990: Schlesinger/Raikes/Hartley/Cros 1996) is established as an alternative stable state, desertification. Bush encroachment in Namibia, however, is not induced by livestock grazing. Rather, the transition between bush-covered and open savannah states is driven by inter-tree competition and patchy rainfall patterns (Wiegand/Ward/Saltz 2005).

Though claims for nonlinear nature of desertification are not yet sufficiently founded, options for nonlinear behaviour of socio-economic states driven by resource nonlinear behaviour can be considered too. It is claimed (Janetos/Kasperson 2005) that at least with regard to fisheries, societies moving from subsistence harvesting to harvesting with improved technology can cause sudden and large changes in the rate of resource exploitation, which often irreversibly pass the threshold of sustainability.

To conclude, though evidence is not conclusive, desertification may be defined as an alternative stable state of the multiple-stable-state dryland ecosystem, as suggested by the '*dryland's alternative stable states*' hypothesis described by the graphical model of figure 48.3. As land use intensifies, soil resources are depleted and biological productivity declines. This leads to a reduced human well-being and even an increase in social conflicts, yet this system remains relatively stable and sustainable. Only when land use intensity reaches a threshold value the system moves to a low-productivity stable state. Once it is in this state, subsequent release of the pressure would not regenerate, let alone restore, biological productivity. Even if the rate of forage use equals the theoretical rate of renewal, the rate of soil degradation or loss is far faster than that of soil renewal, and hence productivity can not be restored. Only input-laden, aggressive management may push the system back to its former, productive stable state.

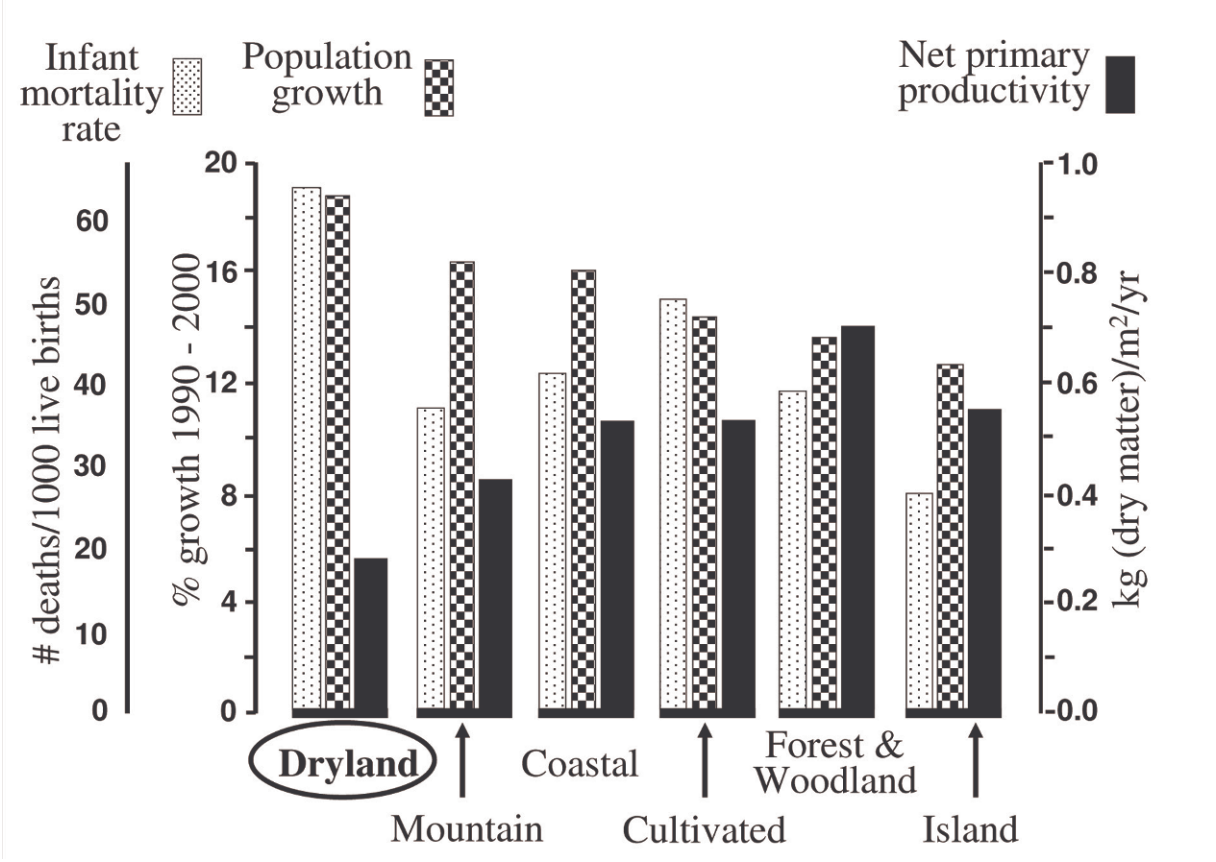
It is likely, however, that the financial resources required for such management are beyond the reach of communities whose land is already desertified. However, a way out can be envisaged whereby another threshold can be crossed, leading to sustainability of the rural drylands. This is based on livelihoods that reduce the dependence on the inherently low dryland productivity through an exploitation of other dryland attributes whose economic potential has not yet been fully recognized. The option of adopting such livelihoods, termed 'alternative livelihoods', is presented and discussed in the following section.

48.3 The 'Alternative Livelihoods' Track

48.3.1 The Imperative of Dryland's Alternative Livelihoods

The '*dryland's alternative stable states*' hypothesis developed in the previous section may support the 'desertification paradigm' section of the 'dryland livelihood paradigm' (figure 48.2). And, there is some evidence to suggest that the alternative track of the latter paradigm, in which crossing the thresholds of population size and population pressures (figure 48.3a, 3b) does not move the system to the desertification alternative state, but instead induces ingenuity, which leads to avoiding desertification and maintaining sustainability (figure 48.2, right). Yet, it is conceivable that this track only pushes the threshold in figure 48.3 further to the right; since resources remain finite, further population increase or increase in demand will eventually lead to crossing the desertification threshold. When approaching the neighbourhood of this new threshold, only another nonlinear change can detract the system from the desertification track – crossing a threshold of moving from land-dependent to land-independent livelihoods. Rather than striving through ingenuity and adaptation for sustainable use of biological productivity, people would divert their ingenuity and adaptive capacity and use them for developing, adapting, or adopting 'alternative livelihoods'. To conclude, as long as population is beyond the threshold (state a in figure 48.3) it is likely that at some point in time the desertification threshold will be crossed too, whether the system as a whole represents the desertification paradigm or its counter-para-

Figure 48.4: Global net primary productivity (black), global population growth rate (coarse dots), and infant mortality rate in Asia (fine dots), in the major global land-human systems. **Sources**: Adapted from the Millennium Ecosystem Assessment (MA 2005) and Adeel/Safriel/Niemejer/White (2005).



digm; the only way out is a gradual, and at least partial shift to livelihoods not based on the land productivity resource.

This shift is likely to be driven by a nonlinear cultural, social, economic or political process, which diverts human endeavour from land productivity-based livelihood, to another, not only non-degrading, but one actually independent of land resources. This option is worth elaboration in face of some sober emerging realities of current dryland uses. Biological productivity and infant mortality, a strong signal of critically reduced human well-being, are lower and higher, respectively, and population growth is higher in the drylands than in any other major human-ecological system on earth (figure 48.4). A decade of implementation of the UNCCD does not seem to have dramatically improved human well-being in the drylands, let alone slowed down population growth rate or increased dryland biological productivity. It is therefore high time to look at livelihoods for the drylands' growing populations which do not further increase the pressure on land resources. These can only be ones with reduced dependency on land productivity.

The notion of alternative dryland livelihoods is not new. More than a decade ago a simple ecological model based on prey-predator dynamics was used to demonstrate that threshold in human pressures on land resources exist, whereby small changes in consumption rates at the neighbourhood of this threshold may lead to destabilization of systems prone to desertification (Puigdefabregas 1995). This analysis suggested that at this point further intensification of land use would increase rather than decrease the per capita consumption rates and lead to desertification. It has been then suggested that this can be avoided by developing the ability to generate income while releasing the pressure on land resources, through increasing economic diversification (Puigdefabregas, 1995). This diversification is expressed in developing and adopting 'alternative livelihoods'.

48.3.2 What is a Dryland Alternative Livelihood?

A dryland livelihood can qualify as an 'alternative livelihood' by complying with one or several of the four following criteria, ordered at an additive, increasing contribution to sustainability: (a) it is of minimal dependence on land primary productivity for producing subsistence products; (b) inasmuch as it does depend on land productivity, it does not impair the provision of other services of dryland ecosystems, which are essential for human well-being (e.g. the provision of water resources and the maintenance of biodiversity, see also MA 2005); (c) it generates more income per investment of local dryland resources, as compared to the traditional, biological productivity-dependent livelihood that it replaced, and (d) it provides its practitioners with a competitive edge over others who practise the same livelihood outside the drylands. These features of alternative livelihoods, and especially when the last one is in place, enable dryland people to be better off than non-dryland people, rather than perpetually lagging behind them in income and well-being.

A common feature of all alternative livelihoods, whether they comply with all four qualifications or only fewer, is that their viability requires capital and trade infrastructures, which in turn depend on compatible policies and governance, attributes that are often deficient in many dryland countries. On the other hand, engagement in these alternative livelihoods does not require particular technological sophistication on the part of the practitioners; science and technology are of course mobilized to generate and support these livelihoods, but their implementation is user-friendly, tailored for the needs of the local people.

Some of several major alternative livelihoods already elaborated on in previous publications (e.g. Safriel 2004; Adeel/Safriel 2005; Safriel/Adeel 2006; Safriel 2006a, Adeel/Safriel 2008) are here reconsidered in order of decreasing dependence on land productivity, and hence of decreasing desertification risks and increasing likelihoods of sustainability. Furthermore, their reduced dependence on land resources determines the dryland type in which their practice will be most sustainable and economically viable.

The four alternative livelihoods to be considered in the following sections are dryland afforestation (generating income from firewood production and from trading the sequestered carbon in the carbon market), controlled-environment dryland agriculture producing cash crops, dryland aquaculture (producing aquatic organisms, mainly fish), and urban-supported dryland alternative livelihoods (such as tourism and industrial energy production based on solar radiation).

48.4 Dryland Afforestation – Land-dependent Alternative Livelihood

Woodlands naturally occur in drylands, and their incidence declines as aridity increases (Safriel/Adeel 2005). Afforestation, i.e. forestry activities in areas that have been naturally devoid of woodlands, also takes place in some drylands (Ginsberg 2002). Dryland afforestation of the least dry drylands (e.g. the dry sub-humid and the semi-arid drylands), though fully dependent on the dryland biological productivity, can have the potential to become an alternative livelihood, by producing fuel wood, biofuel, and sequestered carbon.

48.4.1 Firewood Production

The global fuel wood consumption from sources other than major forest areas increased by 42 per cent between 1961 and 1980, but was down to 38 per cent from 1980 to 2000, apparently due to an increasing shift to fossil fuels. The number of people depending on firewood for heating and cooking is expected to decline by 2030 in China, but to increase in Africa (Arnold/Köhlin/Persson 2003). Though on the local scale, many rural communities experience firewood shortages, both in Africa and in Asia (Sampson 2005), at the global scale firewood supply from reforestation of areas that had been deforested is projected to grow 3- to 5-fold by 2020 (Shvidenko/Barber/Persson 2005). Regarding drylands, an increasing demand is expected, driven by the high population growth rate, coincidental with an increasing decline of firewood provision by dryland ecosystems, caused by livestock grazing and firewood collection at rates faster than those of regeneration (Sauerhaft/Berliner/Thurow 1998).

48.4.2 Biofuel from Forests and Plantations

The elevated awareness of global warming linked to recognizing the need to diversify and increase renewable energy sources on the global energy market (Sampson 2005), draw attention to the option of using the drylands' biological productivity for biomass

Figure 48.5: Landscape manipulation for water harvesting supporting afforestation in an arid dryland (Negev Desert, Israel). **Source**: Photo by Keren Kayemet Le'Israel (JNF). Reprinted with permission.

production. This includes for example 'plantation forestry' in Australia producing wood biomass (Foran 2001; Eco Resource Development 2002) and dryland cultivation of woody perennials for their biodiesel producing seeds in India (Anonymous 2004). Provided that such plantations do not appropriate land used for food production, their sustainability is expected to be higher than that of biodiesel production from agricultural food crops (Hill/Nelson/Tilman/Polasky/Tiffany 2006), a rather unfortunate emerging trend of the first decade of the 21st century. Sustainable dryland biofuel production can be achieved through reforestation in dry sub-humid and semi-arid rangelands and croplands created through woodland clearing. In the dryer arid and hyper arid drylands the required practice is that of afforestation, which is there feasible only through landscape manipulation for runoff harvesting (figure 48.5). Such afforestation may qualify as an alternative livelihood if it can profitably and sustainably replace, or significantly augment, the current traditional livestock production in these drylands.

Furthermore, woodlands and forests in drylands are more effective than rangeland and croplands in preventing soil erosion, and they significantly enhance the soil organic matter contents. Their effect on soil moisture and on dryland water resources, on the other hand, is debatable. Under some circumstances dryland afforestation utilizes local water resources in a non-sustainable manner, and their relatively high evapotranspiration compared to that of the natural ecosystem they replaced, reduces groundwater recharge (Carrere/Lohmann 1996). Yet in other cases dryland afforestation reduces water losses and increases rainfall penetration (Shachanovitch/Berliner/Bar 2008). Furthermore, effective surface cover and optimal viability, growth, and productivity greater than those of rain fed annual crops are achieved by rain fed afforestation (with no supplemental irrigation) even in an arid site, provided appropriate runoff harvesting measures are taken (ICARDA 2007).

48.4.3 Carbon Sequestration

The emerging global carbon trading under the *Clean Development Mechanism* (CDM) of the Kyoto Protocol (TERI 2000) can add much to the qualification of dryland afforestation, as a successful alternative livelihood (UNCCD 1999), on top of its economic value in providing firewood and renewable biomass (Chichilnisky/Heal 1998). At the global scale, about four million hectares of plantations were established with funding for carbon sequestration by the year 2000 (Shvidenko/Barber/Persson 2005). Data on such developments in drylands are not yet available, though conversion of 'marginal agricultural land' to 'woodland' was recommended as a measure for carbon sequestration (Cassman/Wood 2005).

An afforestation project using mostly the Mediterranean, drought-resistant pine *Pinus halepensis* that was initiated in 1964 and extends over 3,000 hectares at the border between the semi-arid and arid region of Israel (270 mm of mean annual rainfall) demonstrates the carbon sequestration potential of arid afforestation. This forest sequesters 165 $gC/m^2/yr$ (as compared to an average of the global monitoring network's dataset [FluxNet] of 270 $gC/m^2/yr$), and its mean annual addition to the carbon reserve since planting is 150 $gC/m^2/yr$, thus storing by now twice as much carbon as the adjacent non-forested rangeland (Gruenzweig/Lin/Rotenberg/Schwartz/Yakir 2003). Though this forest is already more than 40 years old, its carbon sequestration worth is \$18/ha/yr (using the 2005 values of the global carbon market), which augments the \$63/ha/yr generated by the value of the firewood collected by the local Bedouins. At the same time this forest still produces forage valued at \$43/ha/yr (Rueff/Kressel/Schwartz 2004).

Combined, these non-timber products of this afforestation project do not generate ample livelihood and the livelihood of the local population there is totally detached from this forest. Yet, given the projected values of renewable energy and of carbon, similar projects designed for biomass production and for driving CDM contracts or for selling carbon offsets (Aune 2003), are likely to qualify as sustainable dry sub-humid and semi-arid alternative livelihoods.

48.5 Controlled-Environment Protected Agriculture

Under the *desertification paradigm* dryland agriculture is one of the main drivers of land degradation, since the attempt to intensify productivity where it is inherently low brings about reduced rather than increased productivity. Somewhat paradoxically, a high level of agricultural intensification in the drylands is not only non-degrading but also of high economic returns provided it is practised within a confined space that enables manipulation of most environmental variables – that of a greenhouse.

48.5.1 Attributes of Greenhouse Agriculture in Drylands

Figure 48.6: Commercially provided colonies of bumblebees for pollination within a greenhouse in Israel's semi-arid region. **Source:** BioBee (2006); at: <http://www.bchothouse.com/greenhouse-3.html>.

Following the invention of polyethylene in the late 1940's, plastic sheets revolutionized agro-technologies and crop production through an accelerated development of plastic-based protected agriculture. The most advanced component of 'protected agriculture' is the greenhouse and its controlled environment technologies, which transformed farming into industry (see chap. 56 by Garcia Lorca). The plastic cover allows

light penetration and the operation of technologies that manipulate most crop-environment interactions, including the drylands-relevant water use efficiency. The investments required for maintaining an internal favourable environment increase with increasing aridity of the outer environment. Ultimately, in hyper arid areas, the internal environment can be fully detached from the outer environment (Arbel/Segal/Yekutieli/Zamir 1990). While reducing water loss within the enclosed chamber, the internal 'greenhouse effect' also helps in maintaining warm atmosphere, especially during the cold nights or seasons in deserts. In the hot seasons this 'greenhouse effect' is a liability, and cooling is required. Yet, specifically in deserts, evaporative cooling is very effective, though this cooling requires additional water, on top of the irrigation water (Jensen/Malter 1995).

Greenhouses also reduce the use of pesticides and the risk of crop diseases, but once a pest penetrates, it rapidly spreads. Yet, its eradication can be effectively controlled within the confines of the greenhouse. Within a fully-equipped greenhouse temperature, humidity, atmospheric carbon dioxide, light, nutrients and even pollination (figure 48.6) are controlled, and excess water and fertilizer are collected and recycled. This tight management allows for reliable quantity and high and uniform quality of the crop. Production is also independent on seasonality and can be manipulated to take advantage of market needs. Increased number of crops per year, faster growth, longest harvest period, reduced losses due to weather vagaries and pests, and tailoring the internal environment for the specific traits for which each cultivar had been bred, all result in yields four times higher than the nearby open agriculture (Jensen/Malter 1995).

48.5.2 Shortcomings and Advantages of Dryland Greenhouses

The greenhouse intensification of production, which reduces the pressure on local land resources and is independent of the drylands' productivity, requires high investment in infrastructure, inputs, and maintenance as well as research and extension. Yet the operation of the system does not require an outstanding expertise and training. But due to the high input, dryland greenhouse agriculture is sustainable only when the produced crops are of very high value, and are marketed when and where their high value can materialize.

Dryland greenhouse agriculture fully qualifies as an alternative livelihood due to its competitiveness, by virtue of two physical/climatic attributes of many, though not all drylands – high irradiation due to relatively low overcast, and higher ambient winter temperatures relative to those prevailing in the nearest non-dryland areas. Indeed, the gross value added and the cash output per unit area of greenhouse agriculture widely practised in the hyper arid dryland of Israel, are higher than those of all other types of Israeli agriculture, including in the least dry areas of the country (Portnov/Safriel 2004). Yet, though water use efficiency in greenhouses is high, a reliable supply of high quality water resources is imperative, and when this requirement is compromised, this alternative livelihood becomes non-sustainable (Puigdefabregas 1995; chap. 56 by Garcia Lorca).

48.6 Dryland Aquaculture

Drylands are defined as ecosystems whose productivity is water-limited (Safriel/Adeel 2005), hence drylands and aquaculture seem to be at odds. But strange as it may sound, aquaculture in dryland is not only a viable alternative livelihood, but in desert drylands it is even advantageous over dryland agriculture; using a metaphor, whereas fish live in water but don't drink water, dryland plants don't live in water but constantly transpire water. The merits of dryland aquaculture as an alternative livelihood are elaborated on in the following sections.

48.6.1 Higher Water Use Efficiency in Aquaculture than in Agriculture

Aquaculture generated 43 per cent of global fish consumption in 2006 as compared to only 9 per cent in 1980. Between 1994 and 2003 aquaculture increased its share from 1.4 per cent to 1.9 per cent of global agricultural value. Increasing cost of fish indicate increased demand in the developed world, yet the bulk of aquaculture's products comes from developing countries, with projection of further increase and contribution to food security and poverty alleviation in these countries (FAO 2006a).

Since drylands are by definition short of water they are not expected to support a livelihood such as aquaculture, which is apparently one of the most water-dependent livelihoods on earth. However, since unlike terrestrial organisms, aquatic ones do not transpire water, the potential of aquaculture for high water use efficiency in areas of high evaporative losses is higher than that of agriculture. Thus, while most of

Figure 48.7: A fish farm in the arid region of Israel (Kibbutz Mashabe-Sadeh, Negev Desert). **Source:** © Photo by Uriel N. Safriel.

the rainfall and/or irrigation water is lost in drylands through crop transpiration and soil evaporation, aquatic organisms like fish and crustaceans not only do not transpire water, but the evaporative losses of the water in which they live is minimized; since these aquatic organisms do not require light for their production, their containers can be made evaporation-proofed even in ways that compromise light penetration (figure 48.7).

Due to these differences in water conservation, water use efficiency of aquaculture compared with that of agriculture is high in drylands, and even augments with increased aridity. For example, between 0.05 m^3 (Koren/Alon 2004) to 0.03 m^3 (Rothbard/Peretz 2002) are used to produce one kg of fish in fish farms of the Israeli desert, whereas 0.45 m^3 to 1.79 m^3 of water input produces one kg of wheat grains in drylands of Australia (Sadras/Angus 2005) or China (Fan/Stewart/Payne/Wang/Song/Luo/Robinson 2005), with or without supplemental irrigation (values based on water use efficiencies calculated as kg grain/ha/mm rainfall or rainfall equivalent of irrigation).

48.6.2 Avoidance of Potential Drawback of Dryland Aquaculture

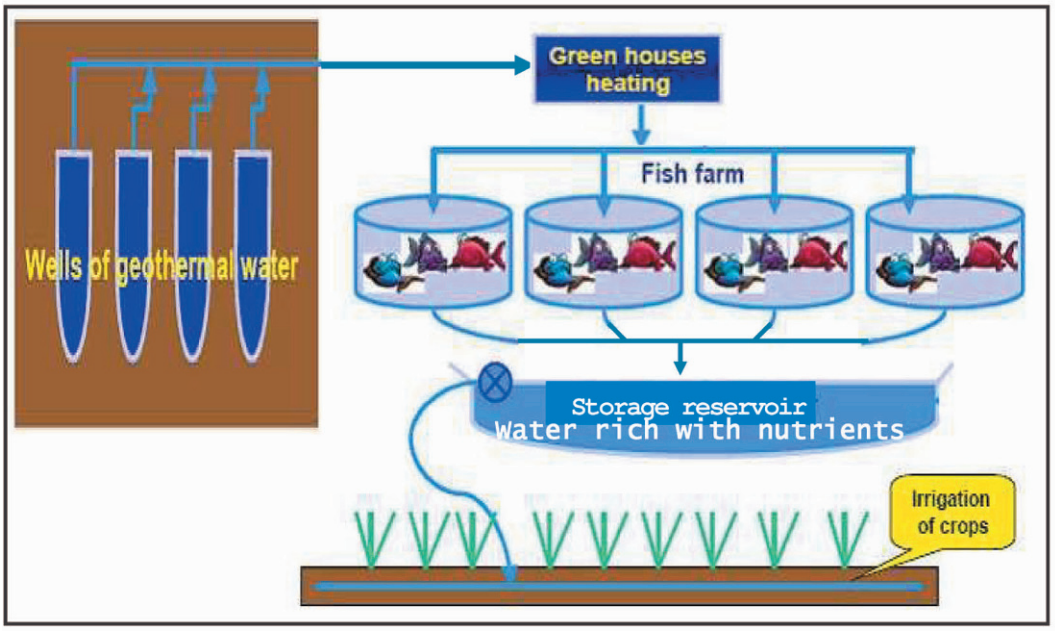
Dryland aquaculture is based on a stable supply of water, and thus may compete with other dryland water uses. However, many aquatic organisms are tolerant or even thrive in water of saline concentrations to which most cultivated crops are sensitive (Koren / Alon 2004). In many dryland regions, aquifers of fossil or partly renewable, brackish water abound, e.g. in Israel (Kolkovsky/Hulata/Simon/Segev/Koren 2003) or Australia (Allan/Banen/Fielder 2001). This water resource is often geothermal, enabling cultivation of tropic and subtropical edible or ornamental fish with no investments in warming during the cold seasons (Rothbard/Peretz 2002). Thus, dryland aquaculture and dryland agriculture differ in the type of water they require and need not compete on water resources. Furthermore, whereas irrigation water can not be reused, aquaculture effluents, enriched by feed residues and fish excrement, can be used for both irrigating and fertilizing crops (e.g. olives, King/McIntosh/Ryder/Fitzsimmons/Collins 2002). Thus, desert aquaculture can be integrated with crop cultivation in controlled-environment greenhouses in drylands (figure 48.8; Kolkovsky/Hulata/Simon/Segev/Koren 2003; FAO 2006a).

Aquaculture may compete with agriculture in the least dry drylands, where population densities are high, land is valuable, and agriculture does relatively well. But in more arid regions with lower population pressures, open agriculture is less successful and land is cheap, providing aquaculture with a competitive edge over agriculture. However, aquaculture may conflict with the livestock sector, since both utilize fishmeal (mostly ocean-derived) for feeds. Furthermore, the dependence of aquaculture on fishmeal may add to the demise of marine fisheries and impinge on the health of marine ecosystems. Greater efficiency in fishmeal use is therefore required in aquaculture (FAO 2006a), and dryland aquaculture need to diversify, in both the spectrum of cultivated fish species (by increasing the use of herbivorous species) and of fish feed sources.

48.6.3 Products of Dryland Aquaculture

Dryland aquaculture can sustainably provide protein-rich edible crops for self-sustenance, local consump-

Figure 48.8: Scheme of aquaculture-agriculture hybrid. **Source:** Adapted from Rothbard/Peretz (2002); permission was granted by the copyright holder.



tion and marketing, but its practitioner can generate a greater return on his investment growing high value crops – ornamental fish and freshwater shrimps. Algae – a crop traditionally associated with oceans, rivers, and lakes – can thrive in dryland conditions, and produced for nutritional, pharmaceutical, or industrial use. Unicellular, or 'micro' algae fare even better than fish and crustaceans under dryland conditions; like cultivated crops, they produce their own carbohydrate food by photosynthesis (and often may require an addition of nutrients), and like fish – live in water but do not transpire it. If cultivated in transparent tubes, they enjoy the abundance of light in the drylands without losing water. Being unicellular they rapidly produce their valuable chemicals, e.g. Astaxanthin produced by *Haematococcus* and used in the food and health industry (Warren 2006). In addition, microalgal aquaculture can be integrated with fish aquaculture since larval stages of many fish species depend on microscopic algae, and highly nutritious microalgae may substitute for fishmeal.

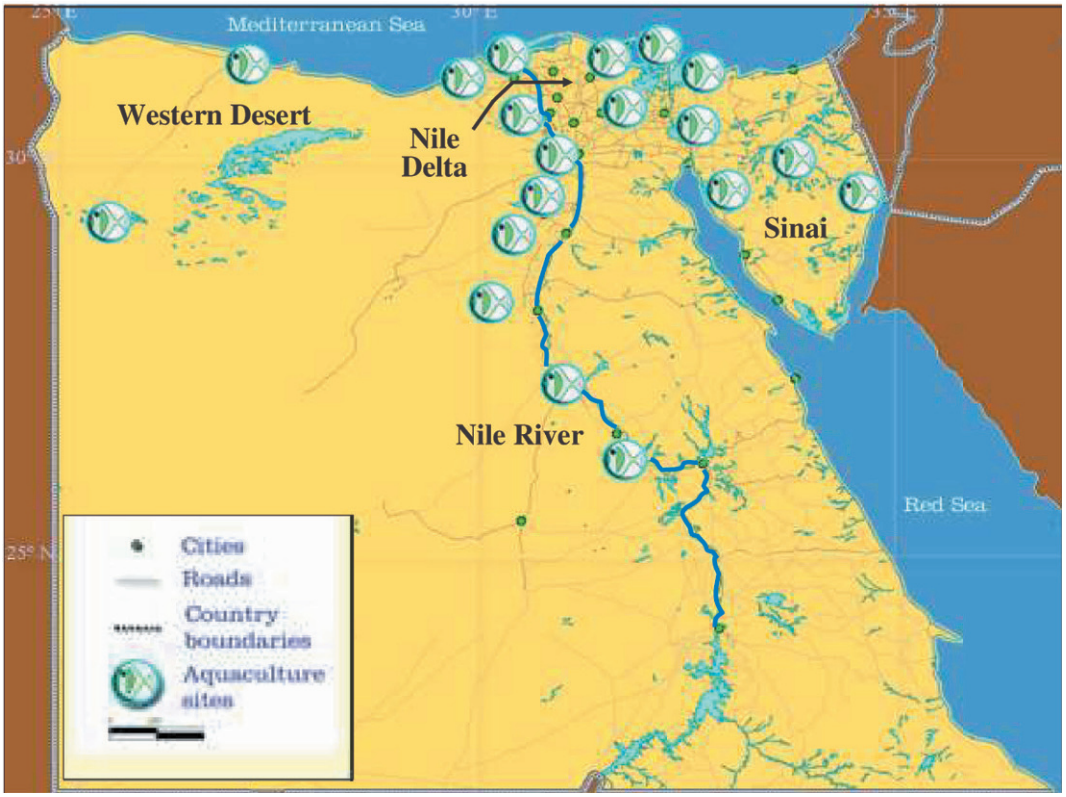
48.6.4 Where Dryland Aquaculture is already practised?

The knowledge, expertise, and investments required to start a modest dryland aquaculture venture are not beyond the means of many farmers in developing dryland countries. In fact, industrial countries such as Israel (Kolkovsky/Hulata/Simon/Segev/Koren 2003), Australia (e.g. Wallace/Barker 2003), and the United States (McIntosh/Baldwin/Fitzsimmons 2003) started dryland aquaculture after it had long been practised in a number of developing countries (FAO 2006a). Dryland aquaculture has been practised in Egypt for thousands of years, along the Nile and its delta, and in recent decades it expanded to the arid and hyper-arid Western and Sinai Deserts (figure 48.9). Currently, a large number of dryland developing countries practise aquaculture, where fish farming rural people are better nourished and have an increased income than others (FAO 2006a, Adeel/Safriel 2008).

48.6.5 Environmental Effects of Dryland Aquaculture

Compared to land cultivation, aquaculture does not have the potential to cause massive land degradation; it is an intensive cultivation that requires relatively little land surface (as compared to traditional agriculture). Land degradation due to soil salinization is often caused by coastal aquaculture of marine organisms (Naylor/Goldburg/Mooney/Beveridge/Clay/Folke/Kautsky/Lubchenco/Primavera/Williams 1998), whereby to avoid accumulation of pollutants (antibiotics, heavy metals, etc.) in the enclosed containers frequent flushing of the containers with seawater (facilitated by the proximity of abundant sea water) is prac-

Figure 48.9: Aquaculture sites in Egypt. **Source:** Adapted from Salem (2006); at: <http://www.fao.org/figis/servlet/static?dom=countrysector&xml=naso_egypt.xml>.



tised. This practice should be avoided, and dryland aquaculture based on brackish water must practise care in maintaining high water quality in the containers and in the disposal of used water. In sum, non-seawater dryland aquaculture does not cause desertification, and its use in the rural drylands as a livelihood alternative to agriculture is a strategy for both avoiding desertification and improving economic viability.

48.7 Urban and Urban-supported Alternative Livelihoods

Whereas the previous sections addressed alternative livelihoods for dryland rural communities, the following section explores the option of dryland urban development that impinges on the overall sustainability of living in drylands, including in the rural areas.

48.7.1 Dryland Urbanization – Trends and Advantages

The accelerated global urbanization trend (UN 2005) has not missed out the drylands, deserts included. Beside their historical functions as commercial and administrative centres, the currently growing dryland cities attract land-consuming military, industrial, and technological installations relocated from overpopulated non-drylands. Within the last thirty years of the 20th century desert cities of both developed (e.g. Phoenix, Arizona) and developing (e.g. Riyadh, Saudi Arabia) countries grew three-fold and seven-fold, respectively. Furthermore, growth of the urban population in drylands is projected to increase to around 52 per cent by 2010 and to 60 per cent by 2030 (Adeel/Safriel 2005).

Interestingly, an inverse relation between the dimension of the agricultural and the urban sectors is evident in dryland countries: the share of arable land, averaged for Pakistan, Uzbekistan, Somalia, and Niger is 12 per cent (CIA 2006), and the share of the urban population averaged for each is only 33 per cent (Herrmann/Hutchinson 2006), whereas these values for Libya, Saudi Arabia, Israel, and Qatar are only 5 per cent for arable land, but 90 per cent for the urban population. Yet, it is not known how much of the current and the projected increase in drylands' urban population is attributable to migration of dryland ru-

ral people, or of non-dryland people attracted by dryland cities. Nevertheless, dryland cities could provide livelihoods to migrants from rural areas, thus releasing pressure on land resource, since urban livelihoods require smaller area per person, as compared to rural livelihoods. Thus, desertification can be avoided by creating economic opportunities in dryland urban centres that would constitute alternative livelihood.

For dryland urban areas to become attractive, services and jobs are imperative (Adeel/Safriel 2005), and dryland-sensitive urban planning (Pearlmutter/Berliner 1999) and architectural design (Etzion/Pearlmutter/Erell/Meir 1999) are required. The low air humidity in the dryer drylands makes summer evaporative cooling efficient and cost-effective adaptation to desert urban life, and the low dryland overcast and the intense solar radiation is projected to provide cheap energy (Faiman 2004, 2008) for cooling and heating buildings or for water desalination for urban domestic use.

Any urban livelihood that is economically viable and can attract rural dryland people qualifies as an alternative livelihood. Yet, there are alternative livelihoods that can be adopted by rural populations and be practised within the rural areas, while being supported by adjacent urban centres. These are the emerging dryland tourist industry that capitalizes on the aesthetic, cultural, and recreational values of many drylands, and the solar energy-generating industry that will capitalize on the forecasted increasing demands for reducing emissions of greenhouse gases coupled with the high potential of drylands to generate economically-viable solar-based alternatives to fossil energy.

48.7.2 Dryland Tourism

Dryland tourism is driven by the increasing affluence, free time and motorization coupled with the growing craving for non-congested, non-polluted, pastoral and pristine landscapes. The scenic, wildlife, biodiversity, historical, cultural, spiritual and therapeutic values unique to many drylands, enrich the quality and appeal of recreation in the drylands (Safriel 2006a). A large segment of the tourist population, however, does not compromise on comforts and other leisure-time amenities, what makes drylands' urban centres a prerequisite for exploiting the recreational values of the dryland rural areas. Dryland tourism is thus an urban-supported alternative livelihood that can be adopted by both rural and urban dryland people.

However, the tourism industry is sensitive to political unrest, corruption, crime, terrorism, recession, and instability in transportation costs (Warren 2006). Therefore this dryland alternative livelihood needs to be backed up by traditional livelihoods. Tourism is also a voracious water user, thus competing with other dryland demands – an issue that may be resolved by desalination and treatment of marginal water resources, including urban wastewater. Tourism often risks the resource on which it depends by littering, eroding soils, and interfering with wildlife, biodiversity, and indigenous cultures. To address this threat, cautiously adopting practices and attitudes of ecotourism, a fast-growing sector of the tourist industry may be appropriate (Warren 2006).

48.7.3 Generation of Solar Energy as an Alternative Livelihood

Drylands are of high potential to become exporters of solar energy to non-dryland areas. The economic value of this clean and renewable energy will gradually increase as the detrimental effects of global warming, coupled with the forecasted depletion of fossil fuel reserves, will become apparent. It is estimated that already by 2025 solar energy may out-compete fossil fuel, and renewables will supply up to one half of global energy by 2050 (Warren 2006). Drylands, and especially deserts, are likely to be competitive in solar energy generation, due to high solar radiation, low cloudiness, and expansive cheap spaces uncontested by other users or objectors, but required for capturing sunlight by photovoltaic cells, mirrors, or their combination (Faiman/Biryukov/Pearlmutter 2002).

The world's drylands are sufficiently large that, in theory, covering a fraction of their landmass with photovoltaic systems could generate many times the current global energy supply. Four per cent of the global desert area can produce an annual energy production by 'very large scale photovoltaic power' (VLPVP) generation plants which would equal world energy consumption (Kurokawa 2003). On the other hand, transportation costs may be forbidding; it was calculated that the cost of installing a power line between a site of a projected small-scale solar power station and the customers in Namibia is three times higher than the cost of installing the solar station itself (Warren 2006). However, developments in the electricity cable industry are likely to reduce these costs. Nevertheless, desert edges would surely be appropriate regions for exported solar power generation, while stations for local uses could be placed at other dryland

sites, which can also include wind energy production as a back-up to solar energy. In both cases, the solar 'farms' of photovoltaic panels, mirrors, and large-scale solar thermal energy devices require much space, and hence will be placed in rural areas.

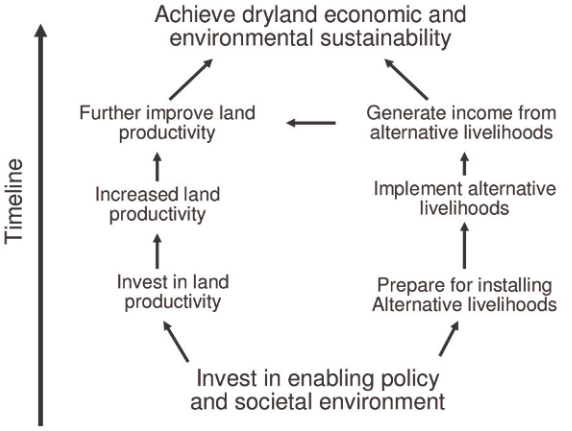
The maintenance of these facilities and the revenue from this land use would augment the income of rural populations, yet the administrative, marketing, and technical backstopping would likely reside in urban centres. Thus, solar energy generation, though not yet practised extensively, has good prospects of becoming an urban-supported dryland alternative livelihood in decades to come (Brauch 2006, 2008).

48.8 Conclusions and Recommendations

Dryland people apply measures for maintaining productivity in face of increasing demands, ranging from adapting local, traditional knowledge to adopting imported technologies. In some cases these combined approaches are successful while in others they fail, resulting in desertification that leads to reduced human well-being of rural people that may generate conflicts and reduced security at both the local and the regional scales. Often the reasons for such failure are not due to flaws in the adopted technologies or to their misuse, but to policy, social, and economic factors that are not conducive for the prescribed implementation (Safriel/Adeel 2005; Adeel/Safriel 2006). But even if and when the social and policy constraints are removed yet pressure on the resources continues to mount, the combination of good practices and supporting policies can be effective only as long as the local resource base is not exploited beyond its capacity for renewal. Therefore, in places where the limit to sustainable land productivity has been already reached, and in others where productivity failure is expected due to projected demographic and social trends, productivity will decline and the risk of desertification and/or consequent local poverty and regional insecurity will increase. When the drylands' inherent limited productivity becomes fully exploited and can not be further increased at a reasonable economic and social cost, maintenance of well-being can be achieved only if the required additional income is generated by livelihoods independent of land productivity, i.e. the "alternative livelihoods".

A promising approach for avoiding degradation and poverty and for achieving resource-use sustainability in the drylands is to adopt both tracks simultaneously – strive for attaining the enabling societal and policy environment, and at the same time (a) apply measures for promoting human well-being through adaptive traditional livelihoods based on land productivity, and (b) invest in preparation for future reduced dependence on land productivity by developing 'alternative livelihoods' often based on introduction of new practices and technologies. Once the enabling societal and policy environment is in place, the alternative livelihood can take off, bringing about both a reduction in the pressure on land and an increase in income. Part of this added income can be reinvested in further promoting the traditional livelihoods based on land productivity (figure 48.10). Coexistence of both tracks can provide a mutual back up, thus buffering against climatic and economic-policy vicissitudes, and conferring stability and sustainability to the rural dryland livelihood (UNCCD 2005). Furthermore, investments in dryland alternative livelihoods such as fish production that can relieve the crisis of global oceanic fisheries, or solar energy development that can reduce dependence on fossil energy sources, can contribute not only to the sustainability of the dryland rural livelihood, but also to regional and even global security in both the environmental and the political sense.

Figure 48.10: Proposed strategy for attaining sustainability in the drylands, through introducing alternative livelihoods. **Source:** Adapted from UNCCD (2005).



49 Societal Vulnerability to Desertification and Policy Response Options

Zafar Adeel

49.1 Introduction

Desertification – land degradation and loss of productivity in drylands resulting from human and climatic factors – is one of the greatest global challenges of our times, and correlates directly to poverty, food insecurity and degradation of human well-being. Desertification directly results in biodiversity changes and a decline in soil fertility, water availability and plant cover, which indirectly affect the livelihoods of dryland populations. Conservative figures estimate the extent of the desertified area ranging from 10 to 20 per cent of all drylands, while a much larger area remains at risk.[1] Measurement of a persistent reduction in the capacity of ecosystems to supply services provides a robust and operational way to quantify land degradation, and thus desertification. Such a quantification approach is robust because these services can be monitored, and some of them are monitored routinely.

This chapter explores the linkages between the desertification process and the vulnerability of dryland populations to environmental and economic shocks of the societies located in water-scarce countries. It argues that the desertification process occurs at a global scale and most of the developing-country societies are ill prepared for its consequences. The chapter addresses the global scope of the desertification and summarizes some of the key impacts already observed (49.2), presents the generic notions of vulnerability (49.3), and how they relate to the impacts of desertification (49.4). It briefly presents the gaps in national and international policies (49.5) which, if unchanged, would lead to exacerbation of the societal impacts. In conclusion (49.6), it proposes that meeting the desertification challenge head on – through significant changes in development and economic policies and in allocation of national and international resources – is critical to meeting the developmental challenges in water-scarce countries. As long as these challenges persist, the societies remain vulnerable to deterioration, conflict and outright collapse.

49.2 The Desertification Challenge

Desertification is now recognized as one of the most pressing global environmental challenges of our time.[2] This recognition has evolved slowly, as the underlying research at a global scale has emerged in the recent years as a by-product of research on global climate change. This recognition has also evolved with a better understanding of the threats desertification poses to the existing achievements in sustainable development as well as their future viability. Nonetheless, conceptual understanding of desertification still remains poor in policy-formulation environments, e.g., national governments, and consequently leads to inadequate or improper responses. Desertification is often equated to encroaching sand dunes (figure 49.1), and is incorrectly considered absent when significant decline in natural productivity exists but there are no moving sand dunes covering roads and buildings.

The policy regime is a very significant reflection of how we perceive and respond to desertification, particularly at the national level. These policies often reflect political perceptions; for example, water scarce areas are seen as derelict and non-productive, and thus not worthy of economic development or investment. Such political marginalization of the dryland communities exacerbates the plight of dryland com-

1 See: Adeel, Safriel, Niemeijer, White, deKalbermatten, Glantz, Salem, Scholes, Niamir-Fuller, Ehui, Yapi-Gnaore (2005).

2 See: Adeel, Bogardi, Braeuel, Chasek, Niamir-Fuller, Gabriels, King, Knabe, Kowsar, Salem, Schaaf, Shepherd, Thomas (2007).

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Figure 49.1: Sand dune encroachment, like this example in an Algerian village, is misconceived to be the only type of desertification, ignoring the broader examples of persistent declining natural resource provisioning. **Source**: Photo by Houcine Khatteli.

munities, which are typically poor. Analysis of economic data in accordance with the level of aridity shows that within developing countries, dryland regions are the worst off in terms of income levels (Safriel/Adeel 2005). The political marginalization also manifests itself through slow growth of health and education infrastructure and the lack of viable livelihood alternatives to the often resource-depleting agricultural practices and natural resource harvesting. It is argued that desertification can destabilize societies in the extreme case, by deepening poverty and creating so-called 'environmental refugees' (Requier-Desjardins 2008) or 'environmentally-induced migrants' (IOM 2007). Some examples exist, particularly in Africa, where population movement patterns as a result of desertification have led to political instability – either armed conflict between rival factions or destabilization of governmental institutions (chap. 92 by Meier; Brauch/Oswald 2009).

The international community has also recognized that desertification is a global process, although a few detractors still remain. Recent dialogue among experts and unpublished work by the author highlights that the political definition of desertification should be expanded to include areas that are not considered drylands but suffer from significant land degradation. Such re-tooling of the definition will lead to an even larger worldwide scope of desertification. On the whole, the global nature of desertification can be understood through three distinct perspectives:

First, the physical process of degradation of natural resources is driven by global climate change (chap. 78 by Church/Asrar/Busalacchi/Arndt) and biodiversity losses (chap. 76 by Walther/Larigauderie/Loreau). In fact, these three processes – desertification, climate change and biodiversity loss – take place at the planetary scale, and inter-connect and amplify the impact of each other.[3] While some may argue that land management and agricultural practices at the local scale are the sole drivers of desertification, such arguments ignore the role of global climate change in re-distributing water resources and significant world-

3 See: Adeel, Safriel, Niemeijer, White, de Kalbermatten, Glantz, Salem, Scholes, Niamir-Fuller, Ehui, Yapi-Gnaore (2005); Bigas, Gudbrandsson, Montanarella, Arnalds (2009).

wide reduction in water availability for drylands (chap. by Leemans/Rice/Henderson-Sellers/Noone).

Second, the biophysical processes triggered by desertification go beyond their local to continental and global scales (Sivakumar/Stefanski 2007). The most common and visible example of such a process are dust storms; the dust from storms in Sahara and Gobi deserts affects the entire Northern hemisphere. Significant increase in dust concentrations from the Sahara and Sahel region has been observed since the 1970s and is projected to get worse with climate change (Prospero/Lamb 2003). Recent data from China show that the frequency and strength of sandstorms affecting eastern China, Beijing in particular, has significantly increased, as limited surface vegetation has been eroded due to land degradation and intensifying human pressure (Gaoming 2008). Downstream flooding is yet another example in which land cover removal due to land degradation can trigger severe flooding events. Destruction of vegetation as a result of desertification also leads to impairment of carbon sequestration capacity and increase in albedo (Sivakumar/Stefanski 2007).

Third, the societal impacts of desertification go beyond the boundaries of drylands. These include migration patterns of people from desertified areas; some experts estimate that the number of people at risk of displacement due to severe desertification will exceed 50 million over the next ten years. Such mass movement of population is not independent of economic influences, social security and ongoing conflicts (Knerr 2004). Nonetheless, it has become a top-level political issue in many countries like Algeria, Morocco, Cote d'Ivoire, the United States, France, Spain and Italy.[4] An indirect indication of the significance of this issue can be derived from the estimated migrant population in these countries (table 49.1).

This three-pronged understanding of desertification is quite critical in devising responses. Such responses must, therefore, lead to policies at national and international levels that include incentives for improved management, provision of resources to improve livelihoods, and political empowerment of dryland communities.

Table 49.1: The number of migrants in selected countries, shown also as a fraction of the global number of migrants and national population. **Source:** Adapted from Renaud, Bogardi, Dun and Warner (2007).

Country	Number of migrants (millions)	Fraction of the total migrants in the world (%)	Fraction of the national population[a] (%)
USA	38.4	20.2	12.9
France	6.5	3.4	10.7
Spain	4.8	2.5	11.2
Italy	2.5	1.3	4.3
Cote d'Ivoire	2.4	1.2	13.2

a) Estimates based on 2004 population figures provided by the UN Population Division. **Sources**: UN (2005a); UN (2006).

It is alarming that the global community has so far failed to adequately understand or respond to the desertification challenge. This failure, in part, relates to our inability to formulate effective, comprehensive, and successful policies. A notable example is the *United Nations Convention to Combat Desertification* (UNCCD), where developed countries have shied away from investing adequate resources and developing countries have been unable to demonstrate any remarkable successes in dealing with desertification. Additionally, some forces of globalization, while ostensibly striving to reduce economic inequality and eliminate poverty, are contributing to the worsening desertification. Studies have demonstrated that trade liberalization, macroeconomic reforms and intensifying agricultural production for exports can contribute to desertification. Perverse agricultural subsidies are one such example, which are estimated at US$300 billion annually for industrial countries, and undermine the ability of food producers in many poorer countries to enter international food markets (box 49.1 for an example of these barriers).[5] This can be compared with an estimated loss of $65 billion annually as a result of land degradation (GEF/GM 2006).

4 Leighton Schwartz, Notini (1994); Puigdefábregas, Mendizabal (1995); Brauch (1997b, 2006d); Oswald Spring 2006; Adeel, Bogardi, Braeuel, Chasek, Niamir-Fuller, Gabriels, King, Knabe, Kowsar, Salem, Schaaf, Shepherd, Thomas (2007).

5 Adeel, Safriel, Niemeijer, White, de Kalbermatten, Glantz, Salem, Scholes, Niamir-Fuller, Ehui, Yapi-Gnaore (2005).

Box 49.1: WTO's Agreement on Agriculture. **Source**: Adapted from the Millennium Ecosystem Assessment (Hassan/Scholes/Ash 2005).

The Word Trade Organization's Agreement on Agriculture has introduced 'green box' provisions as an ostensible mechanism to provide support to producers for improving the landscape and environmental dimensions of farming; these include a number of conservation and countryside stewardship programmes. The espoused intent of these provisions is to introduce less polluting and more environmentally-sensitive practices. However, such provisions have emerged as contentious because most developing countries perceive them as a means to legitimize financial support and subsidies for farmers in rich countries (Wood/Ehui 2005).

49.3 Elements of Societal Vulnerability

The notion of vulnerability[6] can be defined in the context of desertification: It is a way to determine the risks and hazards to communities and societies as a result of losing the provisioning capacity of natural systems in drylands. Societal vulnerability[7] can be measured at a given time, considering the state of the economy and the environment, the level of social and societal support available, and the magnitude of exposure to risk (Cannon/Twigg/Rowell 2005; Birkmann 2006). The examples of how this approach can be used to develop a comprehensive assessment of a community, or a society, has been undertaken through a worldwide project: *Sustainable Management of Marginal Drylands* (SUMAMAD). A number of papers have captured the application of this approach in eight countries (Adeel 2006; King 2007; see below for selected examples).

Societal vulnerability could also be used as a predictive tool in which drivers that impact these state factors are considered in making future projections: population growth, down-turn in economic and agricultural productivity, change to climate patterns, and water availability. For example, water availability when measured on a per capita basis is directly influenced by population growth and change in precipitation patters as a result of global climate change. As the 2007/2008 Human Development Report notes:

> An additional 1.8 billion people could be living in water scarce environments by 2080. Central Asia, Northern China and the northern part of South Asia face immense vulnerabilities associated with the retreat of glaciers – at a rate of 10–15 metres a year in the Himalayas. Seven of Asia's great river systems will experience an increase in flows over the short term, followed by a decline as glaciers melt. The Andean region also faces imminent water security threats with the collapse of tropical glaciers. Several countries in already highly water-stressed regions such as the Middle East could experience deep losses in water availability (UNDP 2007).

Desertification adds to societal vulnerability at several levels, and it exacerbates the situation for highly vulnerable populations already living in drylands countries.

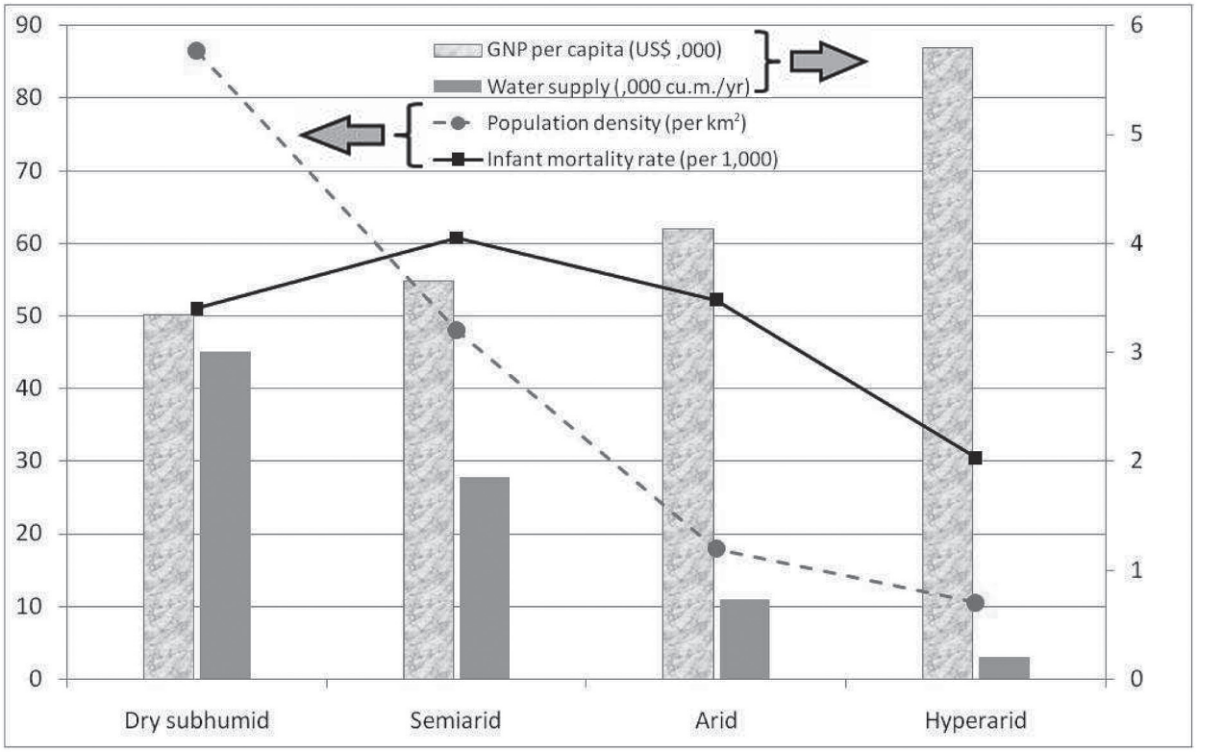
First, it reduces the societal 'resilience' to events that fall outside of the realm of 'norms'. When the social and natural systems are already under stress from desertification, the communities are bound to have great difficulty in bouncing back from adverse events like floods or droughts (Hutchinson/Hermann 2008). Stresses on social systems can include poverty and economic deprivation, poor nutritional status of population, and an inability to continue normal livelihoods. Stresses on the natural system can include shortage or excess of available water, reduction or destruction of natural biological diversity, reduction in crop resilience due to monocropping and soil quality degradation due to poor management and inappropriate introduction of chemicals and nutrients.

The *Millennium Ecosystem Assessment* (MA) charted some of these impacts for the drylands systems in developing countries (figure 49.2). The level of aridity is closely tied to the availability of natural resources, economic development, population stress and their combined impact on human well-being. As dryness increases, water availability also decreases by

6 For an overview of the many different concepts of vulnerability see: Brauch 2005 (with an extensive bibliography); and in this volume: chap. 2 by Brauch; chap. 3 by Cardona; on the notion of social vulnerability: chap. 29 by Pelling; chap. 30 by Nathan; chap. 37 by Tekeli Yeşil; chap. 70 by Villagran; chap. 71 by Warner; chap. 72 by Oswald Spring.

7 This author refers to 'societal vulnerability' as a comprehensive term that encompasses the vulnerability of society as a whole – it includes the resilience of formal and informal social institutions; governance structures and norms; condition of infrastructure related to public welfare, health, transport, and water delivery; financial resources; and environmental conditions and risks. This is a wider definition and includes within itself the more common used terminology of 'social vulnerability'.

Figure 49.2: Key statistics for dryland countries (excluding OECD or developed countries). Drylands are classified according to the climatic conditions as *dry sub-humid, semi-arid, arid* or *hyper-arid*; this classification is based on the values of the Aridity Index, which is the long-term mean of the ratio of an area's mean annual precipitation to its mean annual potential evapotranspiration. **Source:** Safriel and Adeel (2005).



default, whereas all other well-being indicators are driven primarily by population density. Highest population density, in dry sub-humid regions, also leads to lowest GNP per capita and highest infant mortality rates. Safriel and Adeel (2005) thus concluded that the greatest level of vulnerability lies in dry sub-humid and semi-arid regions where population densities are the highest. It should also be stressed that, on average, dryland populations suffer from very low human well-being conditions; this is obvious because the infant mortality rates are greater by a factor of 10 or more when compared with those of OECD countries and by a factor of 2 when compared to that of developing country areas with greater water availability.

Second, desertification nurtures the perception amongst many national policy-makers that drylands are essentially wastelands that can be conveniently forgotten, often with drastic consequences for these dryland dwellers. Political marginalization leads to inadequate allocation of resources and stunted development of fundamental infrastructure, like roads, power and water provisioning, public health facilities, and primary education; the latter two manifest themselves through poor human well-being indicators, like infant mortality rates. The situation of inadequate investments in sustainable land management is similar at the international level where GEF and GM (2006) recommends a 5–15 per cent increase in the annual investments made by the international community to foster sustainable development.

Third, desertification, when coupled with political marginalization and economic deprivation, also leads to gaps in human, technological and institutional capacity. 'Brain drain' often leads to situations where societies can no longer have indigenous human resources to cope with urgent disasters. Lack of appropriate institutions also means that the communities cannot organize themselves to cope with adverse conditions and inherently become dependent on development and emergency aid from elsewhere. Recent studies have also suggested that mass migration of people away from such locations is in part driven by adverse environmental and economic conditions (Renaud/Bogardi/Dun/Warner 2007). Conversely, societies that are well-organized but poor tend to recover from adverse condition much better (Hutchinson/Hermann 2008). An example of this resilience is the Hunshandake Sandland in Inner

Mongolia, China, which is a SUMAMAD project site where significant depletion of the natural grasslands was observed in the recent decade or so (Gaoming 2008). By developing a cohesive community group, provision of appropriate scientific expertise and introduction of livelihood innovations like ecotourism and chicken farming instead of goat herding, led to significant increase in income levels (Adeel/Safriel 2008). Most significantly, this case also demonstrated a rebound of the natural grassland ecosystems, which by default increases the resilience of the communities depending on them.

Fourth, desertification is also intricately linked to the lack of access to safe water for communities. A lack of such a fundamental need leads to disastrous and ongoing consequences for communities, as discussed below. Recent analyses show that communities that are suffering from joint impacts of desertification and lack of safe water are most vulnerable to both chronic (poverty, nutritional status, etc.) and acute (infant and maternal mortality, low resilience to AIDS, etc.) human wellbeing problems (Adeel 2009). Such linkages are discussed next in detail.

49.4 Societal Impacts of Desertification

The societal impacts of desertification are wide-ranging and relate to economics, public health, social welfare, politics and development. Some of these impacts can be quantified, while others manifest over long periods of time and are hard to measure in quantitative terms. Economic and public health impacts are somewhat easier to be treated through commonly used and measured quantitative indicators; typical reporting cycles at national and international level range from quarterly to annual. On the other hand, changes in the political environment and improvements in governance appear to evolve slowly, typically over decades. Increasing land productivity – the opposite to desertification – can also be viewed as the correlation between desertification and societal impacts; for example, GEF and GM (2006) noted:

> Investment in land productivity is a vital engine in development. The rural development strategy documented for the World Bank (2005), for example, shows that for the 35 developing countries in the analysis, a 1 per cent increase in agricultural GDP led to a 1.6 per cent gain in the per capita income of the poorest fifth of the population. A 10 per cent increase in crop yields led to a reduction of 6–10 percent of people living on less than US$1 per day. Thus, if land degradation is allowed to continue, major opportunities for the creation of new wealth and the reduction of poverty will be passed by.

The economic impacts of desertification manifest themselves as loss of income, which is estimated at US$ 65 billion annually (GEF/GM 2006). Table 49.2 shows income levels for six drylands countries (Bolivia, Chad, Mali, Mongolia, Niger, and Sudan), presented as the *gross domestic product* (GDP) per capita in purchasing power parity terms. These countries are considered as drylands in their entirety, and are globally recognized as least developed countries. At the same time, they are also facing significant levels of desertification, as observed through a number of methodologies (Safriel 2007). When comparing the economic status with developed or OECD countries, it is quite obvious that the economies differ by one or two orders of magnitude in per capita terms. This gross disparity can be linked to aridity levels, reduced land productivity and eventual desertification. Yet another manifestation is that almost two-thirds of the population in these countries live below poverty levels, with the exception of Mongolia.

In the public health domain, several key indicators highlight the situation, but perhaps the starkest and most comprehensive indicator is infant mortality. It encapsulates the status of public health support, level of nutrition, access to water and sanitation, exposure to toxins and environmental pollutants, and the level of literacy and education. Shortcomings in any of these services can contribute to increased infant mortality rates. On average, infant mortality in drylands in developing countries averages about 54 children per 1,000 live births, 10 times higher than that in developed countries.[8] Table 49.2 presents the infant mortality rates for the six selected countries and compares them with those for developed countries. Again, there is an order of magnitude difference in infant mortality rates.

The economy and social well-being are not independent of each other. A lack of available financial resources, and often a misguided sense of national priorities, leads to inadequate national investments in the most fundamental infrastructure needed for human well-being; e.g., that for provision of safe water and adequate sanitation. This is further compounded by the inadequate investment in the public health sector which, in turn, is burdened by a disproportion-

8 Adeel, Safriel, Niemeijer, White, de Kalbermatten, Glantz, Salem, Scholes, Niamir-Fuller, Ehui, Yapi-Gnaore (2005).

Table 49.2: Comparison of economic and social indicators in developing dryland countries. **Source:** Column 2: Adeel/Safriel/Niemeijer/White/de Kalbermatten/Glantz/Salem/Scholes/Niamir-Fuller/Ehui/Yapi-Gnaore (2005); column 3-5: UNDP (2007).

Country	Aridity Level	Income	Population below poverty	Infant mortality rates
		GDP (US$ PPP)/capita	Percent	Per 1,000 live births
Bolivia	Hyper arid - Dry Sub-humid	2,619	62.7	52
Mongolia	Hyper arid - Semi-arid	2,107	36.1	39
Sudan	Hyper arid - Dry Sub-humid	2,083	-	62
Chad	Hyper arid - Dry Sub-humid	1,427	64.0	124
Mali	Hyper arid - Dry Sub-humid	1,033	63.8	120
Niger	Hyper arid - Semi-arid	781	63.0	150
High Income OECD		33,831	0	5
Year of data	2000	2005	latest in 1990-2004 period	2005

ately high number of health cases, when compared to OECD countries.

49.5 Policy Gaps

There are some rather fundamental questions related to policy formulation that we need to respond to; these questions can help us in identifying policy gaps:

- What are the most effective policies for combating desertification and how best can we integrate our responses to desertification?
- When we see isolated success stories in dealing with desertification, why are these not propagated at a larger scale and what policies may be serving as stumbling blocks?
- How can we better engage the private sector, which may provide additional financial resources that are neither available within national economies nor through international donors?
- How can globalization be made to benefit developing countries and minimize the adverse impacts of massive public subsidies to agricultural production in developed countries?

In order to respond to the questions, we must realize that major policy gaps exist at the national level; sectoral divisions in policy formulation represent the greatest hurdle to the integration and harmonization of national policies. These can be characterized in terms of gaps within economic policies, agricultural policies, public health and infrastructure development approaches, and policies for management of natural resources. Policy formulation processes in all these realms are also not integrated with each other, often amplifying discrepancies. Underlying problems – lack of scientific knowledge and adequate human resources, shortage of financial capital, and corruption, to name a few – are also persistent and difficult to adjust in countries where stable governance mechanisms are lacking. The economic disparity and shortcomings – as shown in table 49.2 for countries like Mali and Chad – translate to a lack of financial wherewithal to meet the national challenges.

Further, the use of science to inform policy formulation and decision-making remains nearly non-existent. This is in part driven by a lack of relevant scientific information available at the appropriate local or national scale; what little research is done indigenously often fails to focus on emerging issues. Nonetheless, even when scientific information exists or can be brought in from outside, its incorporation into policies, laws, regulations and action programmes to overcome desertification is deficient. This is partly caused by ineffectiveness of the scientific community, which does not ensure that its findings are made available and understandable to decision makers.[9]

The national-scale policy failures are also worsened by a comparable lack of international awareness of the interconnectivity of these developmental and environmental issues, particularly amongst those responsible for designing and implementing develop-

9 Adeel, Bogardi, Braeuel, Chasek, Niamir-Fuller, Gabriels, King, Knabe, Kowsar, Salem, Schaaf, Shepherd, Thomas (2007).

ment aid policies. Very few development and aid policies recognize desertification as the top-most investment priority; most often, governance, gender equity and 'economic development' (often defined as industrial and/or agricultural growth) are considered the top development priorities. Additionally, one may argue that the international trade volumes, particularly those for agriculture, are based on the short-term exploitation of local resources for exports. Such approaches are detrimental to the long-term interests of the people living in developing countries.

The international policy failure is most prominent in how member states relate to environmental conventions and how international development agencies coordinate their own efforts. Most aid agencies rely on a superficial partition between 'environmental' and 'developmental' funding, as if the two are mutually exclusive; the same approach is applied to the UNCCD. It becomes a stumbling block in providing support to developing countries in which developmental needs identified through the UNCCD processes are deemed to be a mismatch with the so-called 'environmental' convention. On the other side, the developing countries have also demonstrated very limited success in developing *National Action Plans* (NAPs) and deploying them effectively within the context of their economic development regimes, such as the *Poverty Reduction Strategy Papers* (PRSPs). Of the 193 countries that have ratified the UNCCD, less than half have developed formal NAPs (GEF/GM 2006); measuring the effectiveness of these plans is difficult in the absence of good benchmarks and baseline data.

Challenges also persist at the international level in how various United Nations conventions are related to each other. In particular, the Secretariats are constrained by their own constitution and procedures, which makes it difficult to focus on areas – like financial, scientific, policy – where substantial synergies exist amongst conventions. More proactive, country-centric efforts may provide a user-perspective that brings together action, reporting and monitoring between key conventions dealing with desertification, climate change and biological diversity.

49.6 Conclusions: What Response Options Exist

On the whole, combating desertification yields multiple benefits at the local and global levels. Addressing desertification is a critical and essential part of adaptation to climate change and mitigation of global biodiversity losses. The *United Nations University* (UNU) has led the argument over the last decade that such interlinkages in policy formulations must be beneficially exploited (Velasquez 2000). Policy- and decision-makers need to understand the critical nature of the desertification challenges and also overcome the incorrect conventional thinking that drylands are a lost cause. There is a need to recognize the opportunities that are offered by drylands, and use them to catalyze investment. Economic arguments about the 'return on investment' are now emerging and can be useful in political contexts. Thorough and detailed research on such cost benefit analysis is still lacking and mostly comprises location-specific and anecdotal evidence (GEF/GM 2006); the SUMAMAD study in Hunshandake Sandland in China is one such example. Achieving effective responses to the desertification challenge requires actions on part of three broad categories of actors: a) the international community, b) governments operating at national and other levels, and c) the research and scientific community.

While there is increasing recognition at the international level of potential synergies between agendas for environmental management and poverty reduction, this must be converted into integration of actions at all levels, and a concurrent decrease in the multiplicity of developmental and environmental frameworks. It is important to enable the capacity of national governments to address their own challenges. Achieving this *inter alia* requires bridging of ministerial and sectoral differences. Development aid should also be directly linked to these integrated responses and efforts to build national capacity. As an example, the *Global Environment Facility* (GEF) is developing Country Partnership Programmes, which promote a 'landscape approach' and focus on system-wide change at both local and national levels.[10] Such approaches give due recognition that desertification affects landscapes and not just single ecosystems.

There has to be a considerable focus on pro-active, cross-linked environmental management at various scales, from national to local. This means that development of agricultural practices, rangeland management approaches, water conversation techniques, soil management practices, alternative livelihoods, economic growth in rural drylands, and removal of perverse subsidies must be considered as part of a comprehensive solution. Enabling policies must provide

10 See Adeel, Bogardi, Braeuel, Chasek, Niamir-Fuller, Gabriels, King, Knabe, Kowsar, Salem, Schaaf, Shepherd, Thomas (2007).

incentives to strengthen land tenure, enhance management of common pool resources, increased access to credit institutions, decentralized government services, and enhancement of research and extension systems. The scope for success of these initiatives can be measured by how well the national investment policies are influenced (Mortimore 2005).

Significant consideration must be given to an effective engagement of the private sector, primarily through economic incentives to invest in efforts to combat desertification. There is a need for measures at governmental level to secure capital investments by the private sector. Such policies, and consequent engagement of the private sector, are essential for the mobilization of technical and financial resources to overcome the shortfall in the public sector.

Several examples of such synergistic approaches are being considered. Some have argued that carbon sequestration in drylands can play a major role in mitigating climate change and providing sustainable livelihoods for drylands people (Niamir-Fuller 2009). Such ideas are of substantial interest when we consider the large surface area of drylands, which is nearly 40 per cent of the global land mass. Recent carbon trading approaches are vehicles through which such approaches can be deployed in dryland countries (Sivakumar/Stefanski 2007).

And finally, one has to recognize that the success of dryland communities can provide tangible benefits to national economies and consequently magnify their significance in national politics. In the same vein, dissemination and advocacy of success stories (or 'bright spots') by stakeholders in affected countries and the international community will further extend the influence of local benefits. These benefits can take the shape of an increase in ecotourism, incremental values of trade and real-estate, and improvements to ecosystem conservation and productivity.

50 Desertification Process in Egypt

Ismail Abd El Galil Hussein

50.1 Introduction

Egypt is one of the most arid lands in the world as 86 per cent of its total area is hyper arid while the remaining area is arid and semi-arid (Meigs 1953). Four agro-ecological zones are distinguished, namely, the Nile Valley, the North Coastal Zone, the Inland Sinai, the Eastern Desert and the Western Desert. As significant variations in ecosystem services are recognized among the four agro-ecological zones, desertification affects each one differently.

However, desertification is strongly affected by population growth (size and density) in Egypt due to the fact that whenever the demand of the population for livelihood exceeds the resource supply, an imbalance is expected to happen for the ecosystem which consequently causes degradation of its services and eventually result in desertification after a long-term failure of such imbalance between demand (human activities) and supply (ecosystem services).

In 2009, the Egyptian population was estimated at 83,082,869 persons with an annual growth rate of about 1.64 per cent. By 2025, Egypt's population is projected to increase to 103,573,056 people. This will further reduce the per capita share of agricultural land and water, as well as increase the pressure and competition for ecosystem services due to the overexploitation of the natural resources. About 20 per cent of Egypt's population lives in Cairo, 6 per cent in the coastal governorates, 40 per cent in the Delta governorates, 33 per cent in the Upper Egypt governorates, and 1 per cent in the remaining areas of the country that amounts to about 95 per cent of Egypt's territory.

Egypt is considered one of the most vulnerable countries to the adverse effects of climate change (loss of agricultural land and production in the Delta, water shortage, and soil salinity) which are expected to exacerbate the desertification process which will eventually result in a substantial increase in food insecurity, poverty, inland migration, and immigration.

This chapter offers background information on Egypt (50.2), it analyses the desertification processes and its multiple drivers (50.3) and discusses the role of traditional knowledge (50.4) and ends with some policy conclusions (50.5) for coping with the challenge of desertification.

50.2 Background Information on Egypt

Egypt is highly diverse due to its location as an African, Asian, and Mediterranean country. It occupies an area of about one million km^2, between latitude 22^o and 32°N and longitude 25° and 35° E. However, 86 per cent of the total area of Egypt is affected by hyper-arid climatic conditions (figure 50.1; table 50.1). The country is endowed with four main agro-ecological zones with specific attributes of resource base, climatic features, terrain and geomorphic characteristics, land-use patterns, and socio-economic implications.

The four agro-ecological zones (figure 50.2) are distinguished as follows:

- The *Nile Valley* (35,000 km^2) encompasses the fertile alluvial land of Middle and Upper Egypt, the Nile Delta region, and the reclaimed desert areas in the fringes of the Nile Valley.
- The *North Coastal Zone* (NCZ) is composed of two major subzones, the north-western coast and north-eastern coast of Sinai. This zone represents the arid province under the maritime influence of the Mediterranean with a shorter dry period.
- The *Inland Sinai* (61,000 km^2) and the *Eastern Desert* (223,000 km^2) with their elevated southern areas.
- The *Western Desert* (681,000 km^2) includes oases and the southern remote areas, including East Uweinat, Tushka and Darb El-Arbian areas.

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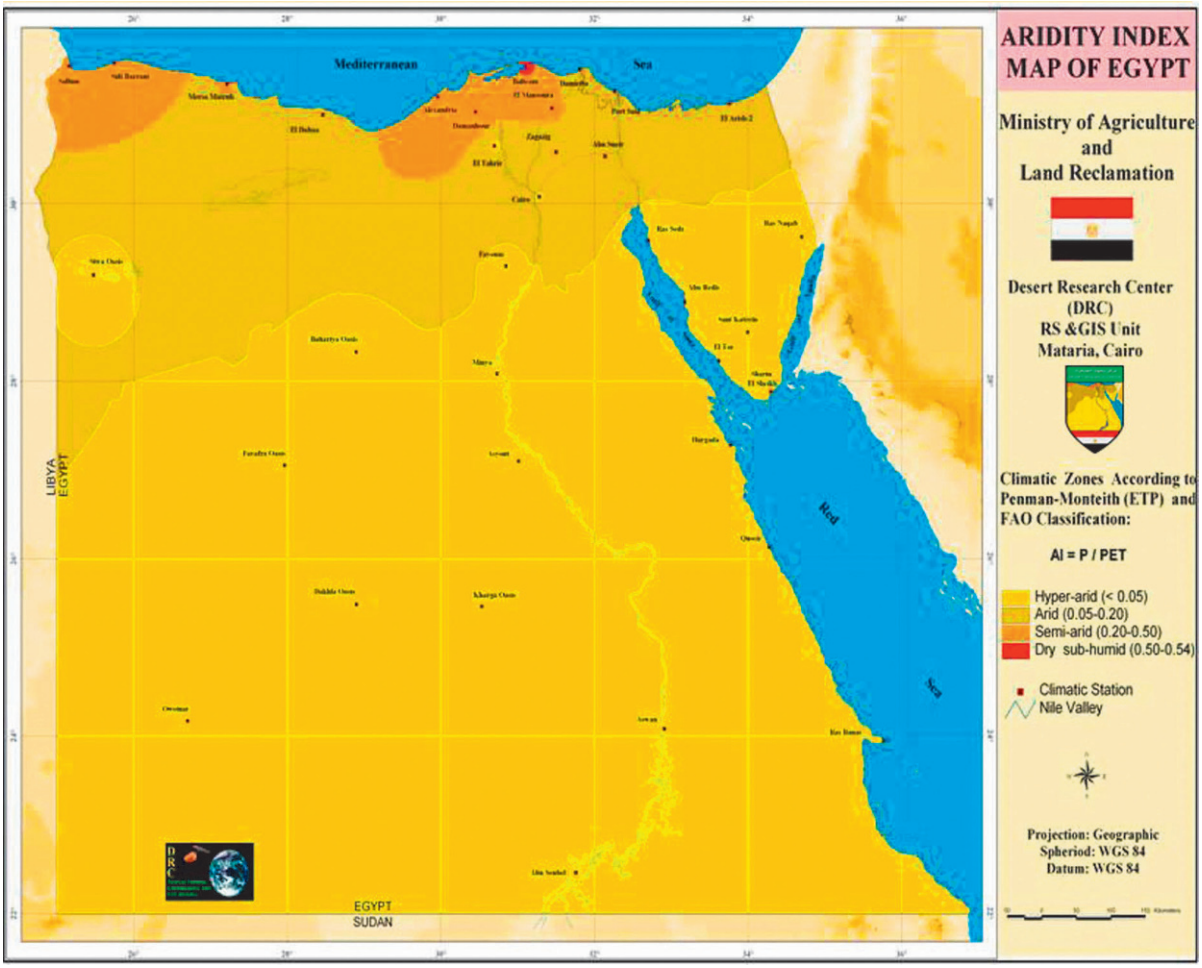
Figure 50.1: Map with the aridity index of Egypt. **Source:** Ministry of Agriculture and Land Reclamation. Desert Research Center (DRC), RS & GIS Unit, Mataria, Cairo.



50.2.1 Population Pressure

Egypt's population still grows each year by approximately 1.5 million people. In 2009, the Egyptian population was estimated at 83,082,869 with about 1.64 per cent of annual growth rates while the projected population in 2025 was 103,573,056. However, a demographic imbalance is recognized as about 20 per cent of the current population is squeezed into the capital city of Cairo, 6 per cent live in the coastal governorates, 40 per cent in the Delta governorates, 33 per cent in the Upper Egypt governorates, and 1 per cent is distributed among the remaining areas of the country (in about 95 per cent of the total area of Egypt).

Desertification in Egypt is obviously linked to the demographic pressure due to a high annual population growth accompanied by a continuous increase in population density in the inhabited areas which represent 5 per cent only of the total area of Egypt (table 50.2).

Due to the population increase without any additional water supply to justify the elevated gap between demand and supply, water share per person has significantly declined and is projected to drop further due to future population trends. These projections show that with the current population growth rate, the annual amount of water available per person would decline by 2026 to nearly half of today's levels, by falling from 980 m^2 per person per year in 2010 to 570 m^2 by 2026. However, the available amount would drop only to 670 m^2 if reduced population fertility should be achieved, which would allow each person to consume an additional 100 m^2, or 18 per cent more water per year. The standard yearly requirement for water consumption per person is 1,000 m^2. Given that more than 90 per cent of Egypt's water supply originates outside its borders, reducing water consumption

Figure 50.2: Agro-ecological zones of Egypt. **Source**: Government of Egypt.

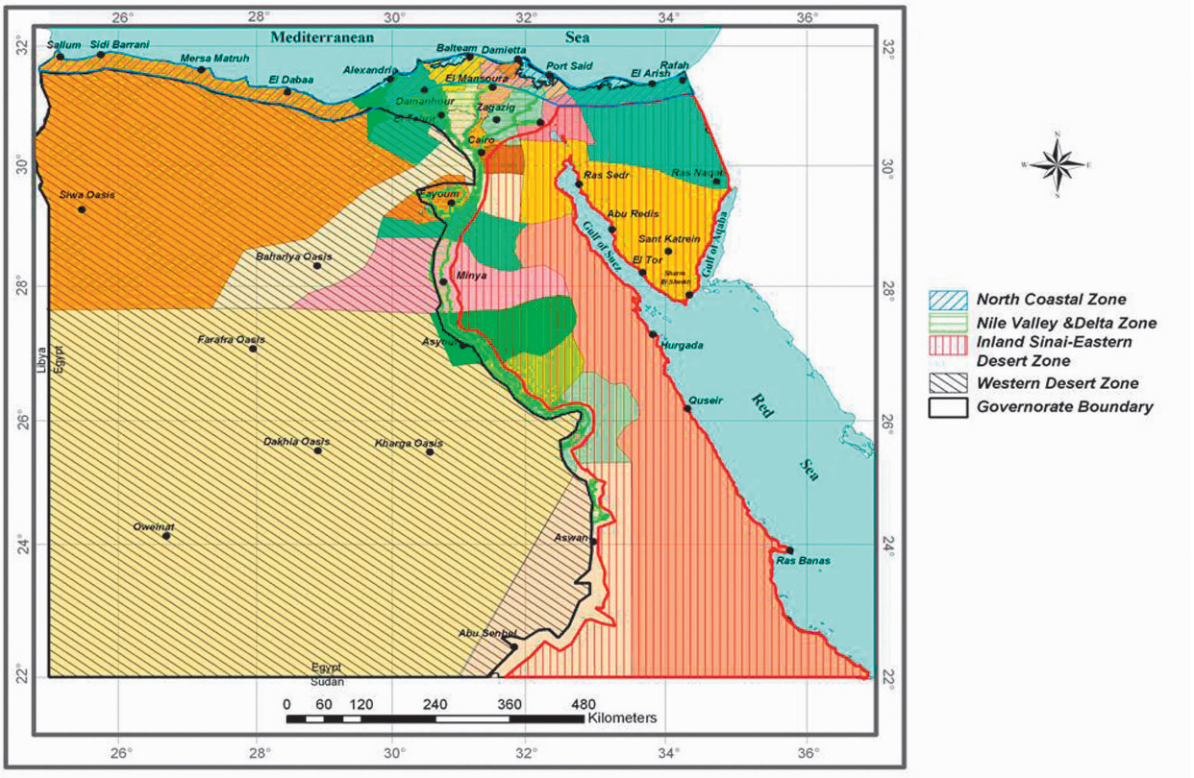


Table 50.1: Percentage of hyper-arid, arid, semi-arid, and dry sub-humid drylands in the Arab world. **Source:** Meigs (1953: 203-209).

	Drylands				
	Hyper-arid	**Arid**	**Semi-arid**	**Total**	**Dry Sub-Humid**
Egypt	86	14	–	100	–
Libya	75	23	2	100	–
Algeria	50	38	9	97	3
Sudan	24	34	34	92	8
Palestine	19	42	15	76	24
Jordan	5	92	3	100	–
Morocco	–	27	52	80	20
Tunisia	–	75	14	89	11
Lebanon	–	–	–	–	100
Syria	–	16	73	89	11
Iraq	–	80	16	96	4
Kuwait	–	100	–	100	–
Yemen		44	42	86	14
Rest of peninsula	21	69	10	100	–
Arab world	27	43	16	96	4
World	4	15	14	33	67

Table 50.2: Population density in several governorates of Egypt in 2009. **Source:** Annual Report 2009 (Cairo: Central Agency for Public Mobilization and Statistics).

Governorates	Total Area (km^2)	Inhabited Area(km^2)	Total Population	Population Density / Total Area (km^2)	Population Density / inhabited Area (km^2)
Cairo	366	290	7,036,811	19,226	24,265
Alexandria	2,300	1676	4,283,393	1,862	2,556
Port Said	1,351	1,321	593,016	439	449
Suez	9,002	9,002	536,389	60	60
Helwan	7,082	334	1,789,880	253	5,353
6th of October	8,741	677	2,682,850	307	3,963
Damietta	910	669	1,155,598	1,270	1,728
Dakahlia	3,716	3,471	5,192,169	1,397	1,496
Sharqia	4,911	4,764	5,597,348	1,140	1,175
Qalyubia	1,124	1,073	4,448,629	3,958	4,147
Kafr el-Sheikh	3,748	3,748	2,739,477	731	731
Gharbia	1,948	1,942	4,184,219	2,149	2,154
Monufia	2,499	2,436	3,421,508	1,369	1,405
Beheira	9,826	6,944	4,950,854	504	713
Ismailia	5,067	5,067	1,003,187	198	198
Giza	80	80	3,276,607	40,958	40,958
Beni Suef	10,954	1,369	2,407,301	220	1,758
Fayoum	6,068	1,856	2,646,461	436	1,426
EL-Minya	32,279	2,412	4,369,104	135	1,812
Asyout	25,926	1,574	3,610,536	139	2,294
Sohag	11,022	1,594	3,927,886	356	2,464
Qena	10,798	1,741	3,139,596	291	1,804
Aswan	62,726	1,005	1,234,134	20	1,228
Luxor	2,410	227	474,849	197	2,095
Red Sea	119,099	71	300,746	3	4,230
New Valley	440,098	1,082	195,689	0.45	181
Matruh	166,563	1,716	338,743	2	197
North Sinai	27,564	4,059	363,492	13	90
South Sinai	31,272	16,791	153,640	5	9

could also reduce the harmful effects of disruptions in supply.

The results of efforts in the past two decades to increase the amount of cultivated land lagged behind population growth. The average individual's share of cultivated land fell from 3.1 carats[1] in 1981 to 2.7 carats in 1994 and 2.5 carats in 2009. Egypt's strategy for land reclamation aims to increase the area of cultivated land by about 25 per cent during the next 20

1 carat =175 m^2

Table 50.3: Changes of the population size (in thousands) and of the urban population in Egypt (1950-2050) for the medium variant. **Source:** UN (2009, 2008); at: <http://esa.un.org/unpp/p2k0data.asp>.

Year	Population Size	Urban population	Percentage urban	Year	Total annual growth rate
1950	21 514	6 971	31.9	1950-1955	2.46
1955	24 378	8 602	34.8	1955-1960	2.40
1960	27 798	10 541	37.9	1960-1965	2.51
1965	31 573	12 840	40.7	1965-1970	2.18
1970	35 575	14 853	42.2	1970-1975	2.14
1975	39 599	17 022	43.5	1975-1980	2.17
1980	44 433	19 154	43.9	1980-1985	2.38
1985	50 655	21 611	43.9	1985-1990	2.28
1990	57 785	23 972	43.5	1990-1995	1.91
1995	63 858	25 966	42.8	1995-2000	1.85
2000	70 174	28 364	42.6	2000-2005	1.82
2005	77 154	31 062	42.6	2005-2010	1.76
2010	84 474	34 041	42.8	2010-2015	1.61
2015	91 778	37 577	43.6	2015-2020	1.42
2020	98 638	41 684	45.0	2020-2025	1.24
2025	104 970	46 435	47.1	2025-2030	1.10
2030	110 907	51 950	49.9	2030-2035	0.97
2035	116 503	58 002	53.1	2035-2040	0.83
2040	121 619	64 066	56.3	2040-2045	0.69
2045	126 004	69 991	59.4	2045-2050	0.55
2050	129 533	75 623	62.4		

years but it depends on the future water availability. If fertility remains at its current level, however, the per capita share of cultivated land will also remain at today's level. The projects designed to increase the area of land on which the Egyptian population lives from 5.5 per cent of the total area to 25 per cent in the next 25 years are expected to relieve the high population density in the Nile Valley. However, this relief will not be available in the short term.

The most serious concern of Egypt's population growth is linked to the increase in population density due to the imbalance in the geographic distribution (table 50.2). The Egyptians are squeezed into the Nile Valley which represents less than 5.5 per cent of the total area of Egypt. Most governorates (29) have a population density of more than 1,000 per km^2, while the three largest governorates (Matruh, New Valley, Red Sea) have a population density of less than 2 persons per km^2. Official government statistics estimate the population density of Cairo to be 31,000 persons per km^2.

The high levels of population density (table 50.2) resulted in a fierce competition over the use of land for agriculture and for housing, and have thus overloaded the use of ecosystem services. These facts highlight the danger posed by population density to Egypt's ongoing development efforts. Moreover, high population density along the Nile Valley, especially in Lower Egypt and its urban governorates, will constitute a huge threat to the per capita share of water. For example, in the case of potable water, assuming an annual population growth rate of 1.6 per cent by 2016 (figure 50.3, table 50.3), the water share per capita is expected to sharply decrease during the coming 15 years. This is particularly worrying as Egypt's share of the waters of the River Nile is fixed at 55 billion m^3. Based on that, the per capita share of water sources will decrease as the population grows (figure 50.4).

Figure 50.3: Egyptian population (1897-2017). **Source**: Ministry of Water Resources and Irrigation.

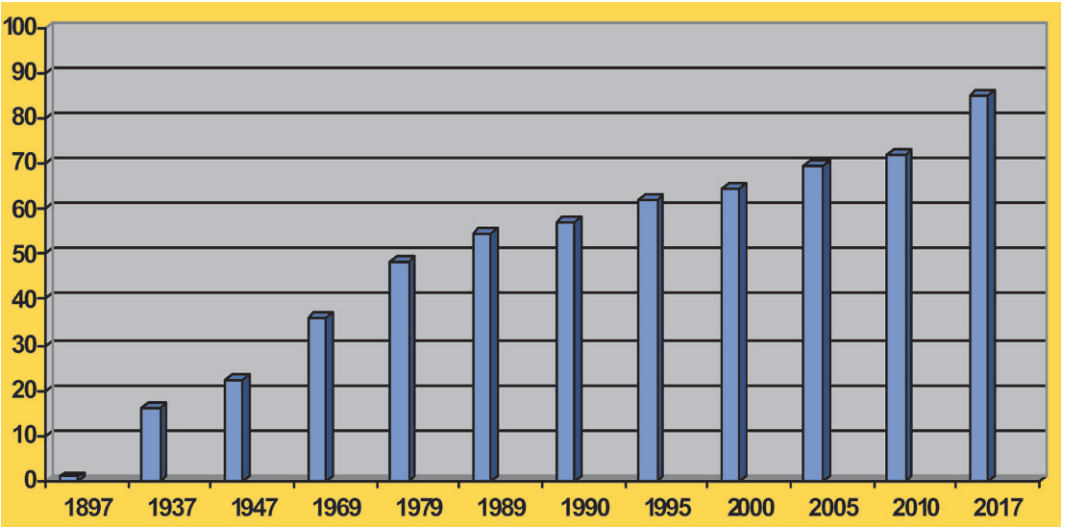
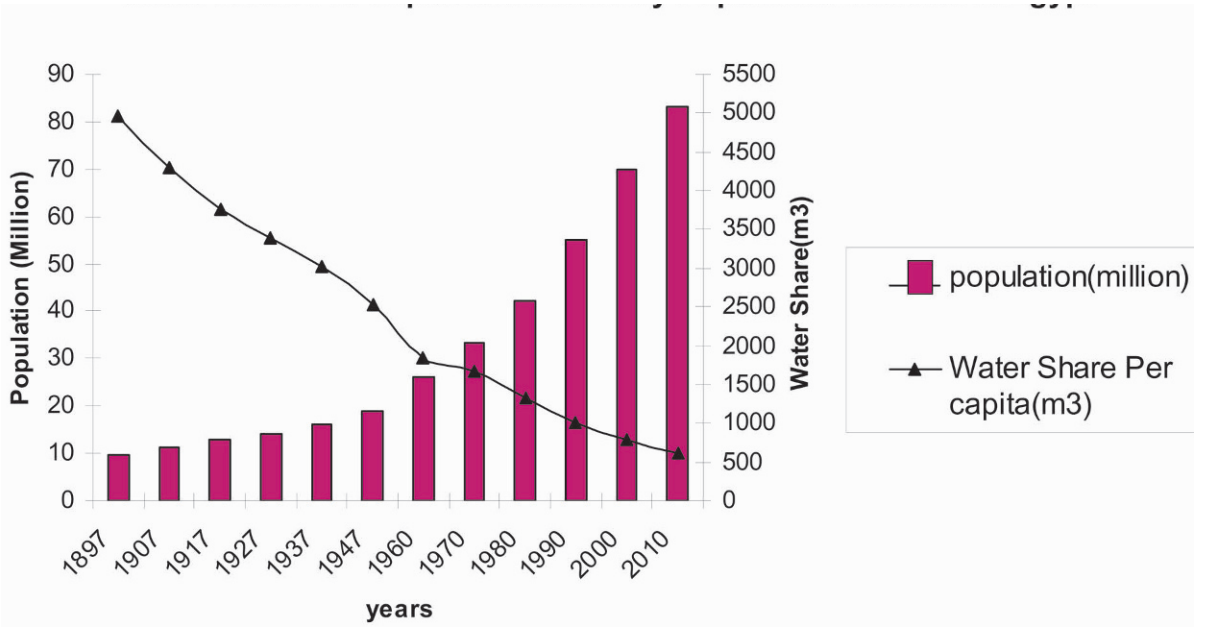


Figure 50.4: Water share in Egypt per capita/m^3 (1897-2010). **Source:** Ministry of Water Resources and Irrigation.



50.3 Desertification Processes and its Drivers

The main processes involved in land degradation are driven by urbanization (50.3.1), salinization (50.3. 2), pollution (50.3.3), soil fertility depletion (50.3.4), wind (50.3.5) and water erosion (50.3.6), sand encroachment (50.3.7), overgrazing (50.3.8), over pumping (50.3.9), and by the loss of genetic plant resources (50.3.10).

50.3.1 Urbanization

In Egypt, where only 3 per cent of its total territory is fertile land, the encroachment of cities, towns, and random urbanization has been significantly increasing, what has caused serious stress in the Nile Valley and in the Delta. Other types of land degradation evolved, starting with the illegal use of agricultural land to divert it for dwelling purposes and other forms of encroachment.

Also, the skimming layers of the fertile soil surface of agricultural land for the production of bricks, up to an average of one metre deep, has been another reason for the degradation and the shrinking area of productive agricultural land. In 2003 the Ministry of Agriculture and Land Reclamation estimated a total loss of 1,200,000 acres, or of about 16 per cent of Egypt's total irrigated agricultural area.

50.3.2 Salinization

Salinity problems are widespread in Egypt. Almost 30 per cent of the irrigated farmland is salt-affected. It is estimated that 60 per cent and 20 per cent of the northern cultivated land and both the middle and southern Delta regions, in sequence, have salt-affected soils. Meanwhile in the Nile Valley, especially in Upper Egypt, salt affected soils represent about 25 per cent of the cultivated areas. Likewise, many areas of the reclaimed desert land adjacent to the Nile Valley and the Delta, as well as in the Sinai and in oases suffer from waterlogging and high salinity. These soils are characterized by excess soluble salts with sodium chloride in substantial quantity. Consequently, soils accumulate sodium on the exchange of complex causing poor physical and chemical properties, which adversely affect water infiltration, soil tilth, plant growth, and yield. The process of salinization is due to:

- excessive application of irrigation water;
- irrigation with poor quality water, e.g. using low quality mixed drainage water, and increased use of low quality ground water;
- inadequate salt leaching practices;
- inefficient or impaired drainage conditions;
- evaporation from water table especially when it is within 2 metres, significantly contribute to root-zone salinity;
- poor land levelling with consequent localized redistribution of salts can often cause salinity problems of significant magnitude.

50.3.3 Pollution

Chemical degradation of water and land resources, defined as the combined negative effects of the chemicals and chemical processes on the aquatic system and the properties that regulate soil function, has considerably emerged as an important agent of desertification. In most cases the root causes of these problems have been the mismanagement of water and agricultural land as well as the poor implementation of pollution control regulations. The major sources of land and water pollution in Egypt can be summarized as follows:

- The discharge of industrial effluents and agricultural drainage water and navigation activities in the Nile, main canals and drains contaminate the surface water resource. The most important industrial areas that directly affect the water quality of the River Nile system include factories of the Egyptian Chemical Industries (Kima) at Aswan; sugar factories at Kom-Ombo, Edfu and Naga-Hammadi; cement and fertilizer plants at Asyut; iron and steel, coke and chemicals at Helwan; Kafr El-Zayat and Alexandria industrial areas, etc.
- In the rural areas, where 75 per cent of the population (or 45 per cent of Egypt's population) has no access to any sanitary facilities, wastewater and latrine fills are directly absorbed underground or discharged by truckloads in drains, therefore the shallow groundwater, i.e. the Nile aquifer (of less than 50 m) shows signs of pollution. Thus, the use of such contaminated water sources for irrigation progressively undermines not only the quality and quantity of agricultural production but also soil biodiversity.
- The excessive use of fertilizers due to the frequent and intensive cropping pattern, whose rate reaches, on average, 319 kg/ha of basic nutrients N (nitrogen), P (phosphorus) and K (potassium). These rates are very high compared to applied rates worldwide. This overuse has resulted in nitrate pollution of the water table and drainage water. Despite recent significant reductions in the application of pesticides and herbicides that has been observed, excessive amounts of their residues in the soil and in both surface and shallow water tables are reported to create serious impacts on public health and environmental risks for the communities in the rural areas.

50.3.4 Soil Fertility Depletion

Extensive and frequent cropping under the conditions of an unsustainable irrigation water management and of improper agricultural practices in the Nile Valley and in the Delta have resulted in a depletion and a deficiency in many nutrient elements. This situation has been exacerbated after the construction of the High Dam, which sharply decreased the annual additions of the fertile sediments to the soils. Consequently, all Egyptian soils are poor in their content of

organic matter, total nitrogen, and other nutritive elements.

50.3.5 Wind Erosion

The fragile ecosystem in the *North Costal Zone* (NCZ) is subject to soil erosion by wind and water. The most fertile topsoil of rain-fed cultivated areas has been eroded, leaving less productive subsoil to produce crops. Thus, crop yields will continue to decline, providing less protection to the soil surface and putting more pressure on the already fragile ecosystem.

To achieve sustainable rain-fed agriculture, it is essential to control wind and water erosion to minimize its impact. Therefore, it is vital to assess the soil loss due to water and wind erosion, and to develop conservation methods for affected sites to maximize the income of rain-fed agriculture through achieving its sustainable development.

Because of the arid climate, wind erosion is one of the major processes of land degradation in Egypt, as it prevails in the Western desert and in the Eastern Desert and in the agro-ecological zones in the Sinai which are mostly sand textured. Wind erosion also occurs in the coastal zone where coastal sand dunes dominate. Therefore, wind erosion affects about 90 per cent of the total country area, causing its fragility due to deterioration and a distinction of plant cover due to overgrazing, ploughing, and intensive cultivation in the rain-fed areas of the northern coastal zone where the soil is shallow.

The average rate of soil loss via wind erosion in the oases of the Western desert has been estimated as 5.5 ton/ha/year, indicating that the rate of wind erosion is moderate, while the rate of deposition varied from 4.5 to 66.9 ton/ha/year. Data on the percentages of total hours of the active wind speed per year showed that their values varied between 9.4 and 29.0, indicating that wind erosion hazards in this area range between moderate and severe. However, the calculated annual rate of wind erosion in the Omayed area (NWC) based on the *Wind Erosion Equation* (WEQ) reached 100 tons/ha. Meanwhile, the calculated rates in Fuka in the same sub zone have shown to be dependent on the land use, and ranged between 5.2 to 71.3 tons/ha compared with the measured values of 2.43 and 10.63 tons/ha for the same site. In El-Sheikh Zowaied, along the north-eastern coast of Sinai, the amount of airborne materials reached 3.16 tons/100 m spread over 193 days.

50.3.6 Water Erosion

Water erosion is among the major processes of land degradation in the northern coastal zone of the country where abrupt and intense rainstorms cause excessive runoff and considerable soil loss. This process also prevails in the coastal plains, in the hilly and mountain slopes of the Red Sea, in the Gulf of Al Aqaba, as well as in the southern parts of the Sinai and in many wadis in the Eastern Desert. The annual soil loss via water erosion in rain-fed areas along the north-western coastal subzone was related to the number of the effective storms, the amount of rainfall in each storm, the land use, the soil erodibility and slope. The annual water erosion rate has been estimated between 0.8 and 5.3 tons/ha/year. It is also found that the losses of plant nutrients, of nitrogen, phosphorus, and potassium are linearly proportional to the soil loss. In addition, the *Universal Soil Loss Equation* (USLE) was the best for predicting the rate of soil erosion.

50.3.7 Sand Encroachment

Active dunes and sand encroachment cover more than 166,000 km^2, or about 16.6 per cent of the total area due to an ecosystem imbalance caused by erratic rainfall, active winds, soil instability, scarcity of plant cover, overgrazing, and practising of intensive agriculture in marginal land, especially in the coastal area.

- Sand accumulations are located in the north-western coast (5,000 km^2), in the north-eastern coast (4,000 km^2), in the Kattara and Siwa depression (1,000 km^2), in middle and southern oases (4,500 km^2), in the Wadi El-Natron and in the West Delta (500 km^2), in the Great Sand Sea (135,000 km^2), in the East Delta (500 km^2) and in the Fayoum and Wadi El Rayian (3,000 km^2).
- The dominant types of dunes are the longitudinal and barachan in the Western Desert. The traverse, crescentic, star and, longitudinal in the North Sinai and the oolitic sand ridges in the north-western coastal area.
- Shifting dunes are particularly detrimental to agriculture on the two sides of the Nile Delta and along the western windward margin of the Nile Valley between Beni-Suef and Asyut. They also threaten the Western Desert oases and the coastal communities. Shifting dunes threaten many agricultural settlements and socio-economic activities. They also have negative impacts on health and on the environment, in addition to high annual costs

for repairing and maintenance of roads and other elements of the infrastructure.

- The High Dam Lake is exposed at several sectors to sand encroachment, which is blown from the west and north-west. The active winds which have velocities of more than 15 km/hr frequently blow from the north and the north-west. The hazardous impact of such winds and the ensuing sand movement on the lake are accelerated by many environmental factors, among them the favourable morphological setting conditions of the lake for the shifting sands derived from plains.
- The extremely arid conditions (rainfall is almost zero) and the prevalence of high sand dunes and other sand forms in the coastal and inland deserts are the most vulnerable to wind erosion and deposition, consequently they constitute a serious threat to the agricultural development, to rural and urban settlements, to road traffic, and public health.

The characteristics of sand dunes either active or inactive and their potential threatening of the agricultural land in the Nile Delta and in the Valley were studied using a multitude of land satellite images across the area surrounding the cultivated land. The study concluded that there are five discernable areas characterized by serious sand dune encroachment:

a.) The west of the Nile Delta where dunes cover about 255 km^2 with on orientation towards the western and south-western sides of the cultivated land in the Nile Delta.

b.) The Fayoum and Wadi El-Rayan depression, which have three types of active dunes, namely; the longitudinal dunes covering about 480 km^2, sand sheets covering about 240 km^2 and barachan dunes having an area of about 160 km^2. Because of hyper-arid conditions, the activity of the wind and the virtually non-existing desert vegetation, such sand sediments are actively attacking the cultivated land of the western and southern sides of the Fayoum and Rayan depression.

c.) The Nile Valley, where the linear dunes located south-west of the El-Minya governorate cover approximately 350 km^2 and are characterized by steep slip, are actively encroaching on the fertile cultivated land along the western side of the Nile Valley.

d.) The Al Kharga Oasis, which is dominated by longitudinal and linear dunes covering about 400 km^2. The source of the longitudinal mobile dunes is the Great Sand Sea in the Western Desert. As this area is almost rainless, flat in its topography, and has an increasing gradient in wind velocity, such dunes are active and migrate from the north and north-east to the south and south-east. These dunes seriously affect infrastructure and even engulf the villages and palm groves in the area.

e.) The north-western High Dam lake; where longitudinal and barachan dunes located at a distance of about 5 km to the north-west of the lake and extend from the north-west to the south-west cover an area of about 800 km^2. These dunes migrate to the south and south-east, and hence attack the north-west edges of the lake.

There are two major areas characterized by inactive sand accumulations, which can be delineated briefly in the following areas:

a.) East of the Nile Delta, where some longitudinal and barachan dunes are located between east of the Nile Delta and north of the Gulf of Suez. These dunes have low elevation (2–5 metres) with about 2–5 km length and 1–2 km width, and are surrounded with sand sheets. They trend from north to south and do not currently pose any threat to the cultivated land in the Nile Delta.

b.) The Sinai Peninsula, where a zone of inactive sand extends between the east of the Bitter Lakes and north of the Wadi El Arish. These dunes are far from the fertile land in the Nile Valley and the Delta. Nevertheless, at present a new land reclamation project is currently being implemented and a greater canal (El Salam) crossed a part of these dunes, which may disturb the dunes ecosystem, thereby special attention should be focused on the influence of such dunes on the agricultural development in this area.

50.3.8 Overgrazing

The general trend is shrinkage of rangelands coupled with a decline in the quantity and quality of forage production. Adverse changes in range plant composition, i.e. more annuals, less palatable and more unpalatable and noxious species are reported for most range areas. The combined effects of overgrazing, uprooting of woody plants, and extension of rain-fed cultivation have accentuated the decline in native forage production and the deterioration of good native forage species gene pool, thus threatening biodiversity. A recent report indicated that in most areas of the western coastal zone, and of the north Sinai, forage production had declined by 50–60 per cent in less

Figure 50.5: Deterioration of groundwater quality due to an intensive cultivation along the sea shore of Al-Arish/ North Sinai which is causing depletion for the thin lens of sweet water floating over the sea water. **Source**: Photo by Ismail Abd El Galil Hussein.

than 30 years and about 40–50 per cent of the plant cover has been lost. These changes are mainly attributed to ploughing of the most productive range areas to cultivate barley (and sometimes wheat), uprooting of shrubs for fuel, and to increasing grazing pressure.

No real data are available from the actual stocking rate trials to estimate the carrying capacity of the range types. The available data are only some estimates carried by some experts based on their field observation and their long experience in the region. However, the estimated carrying capacity differs from 4 acres/sheep unit/year for the Fuka grazing district to 22 acres/sheep unit/year for the El-Salloum district.

Rangelands deterioration had been accelerated during the last decades of the 20th century by the overuse and improper management practices such as:

- The expansion of rain-fed cultivation (particularly barley and wheat and horticultural crops) in the favourable rangeland areas (especially in the coastal areas, wadis and depressions).
- Increasing uprooting of trees and woody shrubs for fuel.
- Continuous overgrazing due to the rapid increase in the population of small ruminants which was encouraged by the availability of subsidized feed.
- Increased development of stock watering points for grazing herds allow for the extended use of rangelands where grazing was only possible during the rainy season. This increased the proportion of sacrificed areas around water points.
- Increasing use of trucks and water tankers for transporting grazing herds and water to far range areas.
- Neglecting the traditional grazing system as a result of a continuous shrinkage of the common grazing areas due grazing system as a result of the reduction of the common grazing areas due to the appropriation of rangelands by the desert governorates, indivi-duals and families for touristic activities, housing, roads, manufactures, etc.
- The management programme designed by most experts to address the balance in the relationship between animals and carrying capacity in the arid and semi-arid ecosystem is primarily concerned with the long-term production of the resources. On the other hand, the pastoralists are primarily concerned with the survival, first in the short term and then in the long term. Survival for the pasto-

ralist means not only his own personal survival but also the survival of his socio-cultural unit which relies on the productivity of the herds. It is obvious that the two concerns overlap but they are centred on different priorities which are, in turn, based on different values. This conflict between technical experts and pastoralists will not be solved as both of them are not able to provide alternatives to overcome it, but it could be solved in the larger political process.

50.3.9 Overpumping

Serious degradation of water quality has been observed in the north-eastern costal area of Sinai, specifically in Rafah and Shikh Zuwaid due to overpumping of water skimming wells, where lenses of thin fresh water exist. Although these kinds of wells require a high degree of precision in operation and management of the system, the local farmers are overexploiting this water for practising very intensive cultivation. However, the groundwater potential in the Sinai contains shallow groundwater in the Quaternary aquifer and deep groundwater in the fissured carbonate and Nubian sandstone aquifer. The total present usage is about 90 million m^3/yr. A large portion of the water is pumped from the Quaternary aquifer in the northern part of the Sinai (El Arish, Rafah, Bir el Abd). Most of the groundwater is slightly brackish and poses limitations on its use for potable supplies without further treatment. Fresh groundwater is mainly confined to the sand dunes, which are recharged from direct rainfall. Groundwater salinity shows wide values often exceeding 1,000 ppm *Total Dissolved Solids* (TDS). In El Arish and Rafah, the use has already exceeded the potential resulting in a continuous increase in salinity. In Bir el Abd and Sahl el Qaa, on the other hand, small reserves are still available, provided the wells are properly sited. Both the carbonate and sandstone aquifers can be developed, based on the amount of water in the storage and recharge from rainfall. The major portion of available groundwater is found in the middle of the Sinai.

The misuse of groundwater is another serious problem, which minimizes the aquifer capacity or the fresh water potentials. The current trends of population growth, urbanization, and industrialization will substantially increase the pressure on the quantity and quality of water. However, the country's limited water resources will come under further pressure as demand increases with the rapidly growing population. According to the UN survey of Sub-Saharan African countries, eight of 29 countries experienced water stress (less than 1,667 m^3 per capita per yr) in 1990 and will suffer water scarcity (1000 m^3/ capita/yr) in 2025. Egypt has been suffering from water scarcity since 1990.

50.3.10 Loss of Genetic Plant Resources

The Egyptian flora comprises about 2,121 species and 153 infraspecific epithets belonging to 121 families, unevenly distributed over its different agro-ecological zones. The highest species density is in the Mediterranean coastal zone, in the Nile Valley, in the Gebel Elba, and in the mountains of Sinai.

The number of species in proportion to the total surface area of the country (one million km^2) is considered very small. This is evidently due to the arid climatic conditions, where the annual rainfall nowhere exceeds 200 mm but is below 50 mm in most parts of the country. Egypt and Libya (except El-Gebel Al-Aghder) are the only two countries in North Africa where the Saharan climate extends up to the Mediterranean coast, thus preventing the development of any Mediterranean arboreal vegetation.

Due to the very scanty rainfall, most vegetation of Egypt is concentrated primarily in the wadis and depressions (contracted distribution pattern). Although most of the greater part of Egypt is Saharan in vegetation, the proportion of the Saharan plants is relatively small as compared to other phytogeographic regions.

A striking feature in Egypt's flora is the large number of genera in proportion to that of the species, amounting to about 3 species per genus. This is a very low figure compared to the average global proportion which amounts to about 14. The generic index, i.e. the number of genera per 100 species is relatively high, which points to the marginal conditions of Egypt with respect to many genera, and also indicates the lack of accumulation and differentiation centres in Egypt.

50.4 The Role of Traditional Knowledge

Traditional knowledge is a dynamic system which enables local communities to adapt to environmental changes and to create innovative solutions (chap. 52 by Laureano). The *UN Convention to Combat Desertification* (UNCCD) includes the natural and the cultural dimension of development. Therefore, participation of local communities in environmental decision-

making and management has become a valuable means to achieve the environmental objective of several conventions since the *United Nations Conference on Environment and Development* (UNCED) in Rio de Janeiro (1992). The role of traditional knowledge is described in the articles 18 and 20 of the UNCCD convention, in which the parties are asked to protect, promote, and use in particular relevant traditional and local technology, knowledge, know-how and integrating traditional practices with modern technologies (Art 18.d and 19.d). UNCCD endorses a human-centred approach to sustainable development and places the knowledge holders and capacities of the local communities to prevent desertification at the centre.

The role of traditional knowledge has been overlooked in the Egyptian deserts which were historically sustained over centuries by an efficient indigenous system for natural resources management. For instance, *Orf* is an unwritten law adopted by the Bedouin population, which covers several issues, among the items of this law, there are rules regulating the collection and cutting of herbs and wood. It is forbidden to cut the green parts of the tree, and who does so is subject to a penalty of 50 LE. The *Hema* system (Arabic) had been used to conserve the range of plants from extinction through centuries of misuse and communal grazing. No doubt, this system preserved the valuable genetic resources which are unfortunately being overexploited these days. However, *Helf* was also one of the most interesting regulations that the Bedouins in St. Katherine were practising. It is a sort of communal regulation that was arranged by the Bedouins without any interference from governmental authorities for the protection of the plants in certain places against grazing in certain periods of the year to allow proper biomass production and fruit setting in that area. Every year, the sheikhs of the tribes agreed about certain areas to be kept away from grazing in a period starting from the onset of the rainfall in October until the end of the growing season (Batanouny 2000).

The apricot fruit setting was the sign to cease the *Helf* for that season, and then the zoned area was opened first for camels only for one month, thereafter, it was allowed for the other animals; sheep and goats. The selected area was changed every year. The *Helf* was arranged and guaranteed by the sheikhs, who are the wise leaders of the tribes. There were serious penalties for anyone who did not follow these rules.

50.5 Policy Suggestions for Coping with Desertification

Despite informal data indicating that 30 per cent of the drylands in Egypt is actively subject to desertification process, insufficient measures have been taken by policy-makers. The author has experienced as the focal point of UNCCD the lack of awareness by the majority of politicians, as well as the public. The reason behind this might be the nature of the phenomena as its processes occur over a long time period and that makes it invisible. Therefore, the challenge is how to make such invisible phenomena visible to policy-makers and to the public as well, and how to make the desertification definition understandable. For instance, building houses on fertile agricultural land has never been considered by policy-makers in Egypt as a cause of desertification, despite the fact that Egypt is suffering from a growing food gap and very limited agricultural land. Most laws to stop such activities are not properly being implemented due to a lacking political will.

- Accordingly, enhancing all means of mass media, of audio-visual material, and printed sources is of utmost importance by setting up national programmes that focus on social and cultural aspects to raise awareness, helping to mitigate the negative impacts and consequences of desertification.
- Mainstreaming efforts at the cabinet level for combating desertification are required to be proactive in order to minimize risks and costs, to avoid double efforts, and to fulfil obligations adopted by UNCCD. Accordingly, it is needed that the cabinet approves the needed tasks and allocates sufficient funds.
- The role of NGOs to voice their demands and needs is still lacking political support and recognition by the government. Furthermore, the development of a scientific research strategy in cooperation with the private sector that is specifically concerned with desertification will be very helpful.

51 Impacts of Drought on Agriculture in Northern Mexico

Tulio Arredondo Moreno and Elisabeth Huber-Sannwald

51.1 Introduction

Mexico is situated between 14º and 32º latitude North within the tropical and subtropical regions. This wide geographic expansion contributes to the preponderance of arid and semi-arid climates in Northern Mexico covering almost 50 per cent of the country's territory. The Northern region of Mexico is home to close 30 per cent of the total national population (table 51.2), of which more than 6 per cent live in rural areas.

The limiting conditions of drylands both in a biophysical and socio-economic context have favoured the development of rain-fed agriculture, a production system that is increasingly vulnerable to long periods of drought, low crop output, and soil degradation. The declining viability of subsistence production systems forces farmers to opt for alternatives including the exploitation of natural resources; however, future prospects are similarly low. Overexploitation such as overgrazing by livestock often culminates in severe land degradation followed by land abandonment and migration. Since subsistence farming and direct harvesting of natural resources can no longer fulfil the living demands of rural communities, government assistance through self-help programmes or the introduction of technologies may improve the socio-economic situation of some communities or community members in some areas, however, these programmes are rarely sustainable eventually causing the system to convert in unproductive land.

Also, social equity issues related to land tenure and property rights may restrict some community members' access to these assets in turn feeding back on social disparity, exacerbating the exploitation of land, and causing the complex and irreversible process of land degradation. Hence, it is the interaction between biophysical and socio-economic phenomena and their feedbacks that need to be addressed when trying to elucidate the underlying mechanisms of how drought may impact on agriculture and the livelihoods of many rural communities in Northern Mexico.

Over the last decades, Northern Mexico has been greatly affected by climate change with extended periods of drought interrupted by heavy often torrential rainstorms. Recent regional and global scenarios of climate change (IPCC 2007a; Fernández/Martínez/Osnaya 2003) predict decreases in annual precipitation and increases in the frequency of extreme events for arid and semi-arid regions of the world and for Northern Mexico. Unfortunately, it is the rural communities that are at highest risk with respect to these scenarios and directly and indirectly associated environmental problems. Global environmental change and increasing socio-economic constraints for a large proportion of the human population will result in increasing poverty and land degradation. The need to improve our capabilities to forecast future biophysical and socio-economic changes in the aridlands of Northern Mexico simultaneously is more pertinent than ever before. Particularly in the face of non-linear dynamics of global environmental change, new predictive tools will allow us to detect highly vulnerable regions and social groups, and to design flexible adaptation strategies for these regions to cope with drought and desertification.

This chapter is devoted to identifying those factors that may contribute to an exacerbation of land degradation in rural agricultural communities in Northern Mexico. The chapter examines the importance of arid zones in Northern Mexico as well as the agricultural systems in relation to social groups associated to them. We present the possible Global Environmental Change scenarios that may affect the northern aridlands and discuss aspects of vulnerability to natural, agricultural, and social systems. Further, we suggest some adaptation strategies to global change and some mitigation options to reduce desertification. Finally, we present a new framework, the *Dryland Development Paradigm*[1] that allows on the one side identifying the critical socio-economic and biophysical drivers

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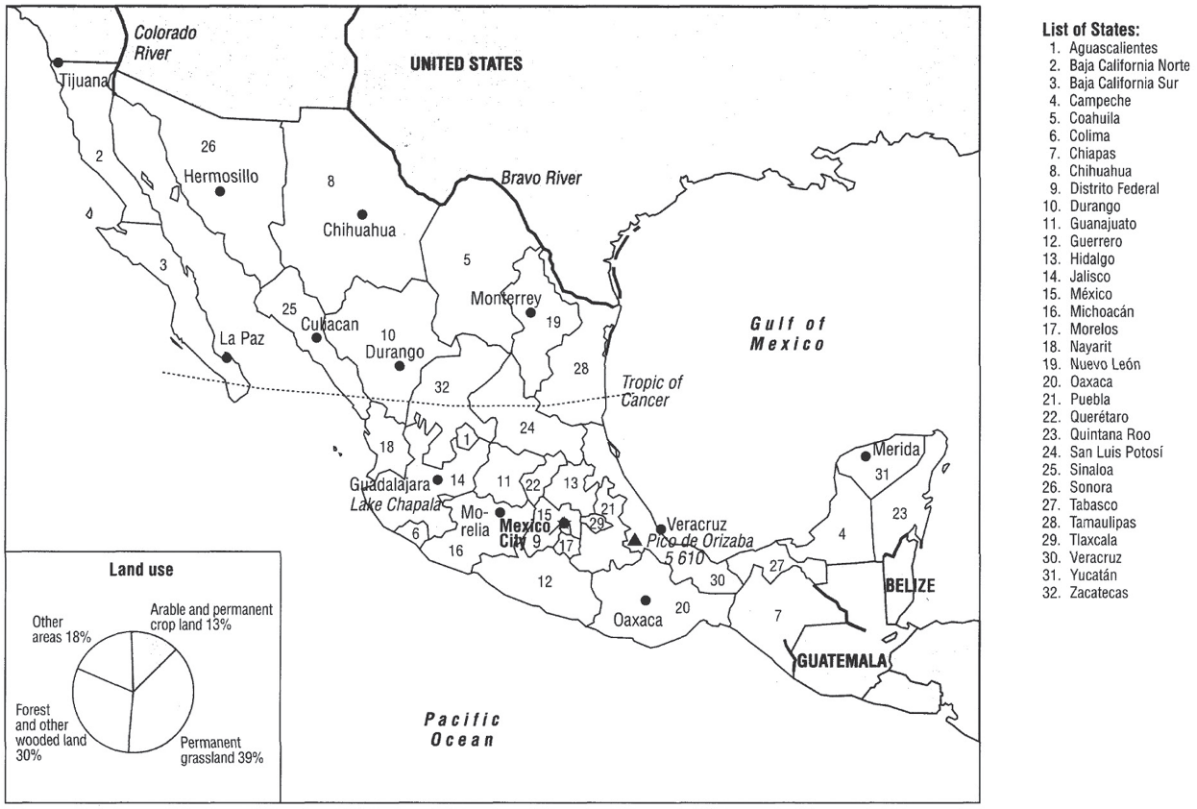
Figure 51.1: Administrative Districts in Mexico, 1990. **Source:** OECD (1998: 38).



that lead to desertification and on the other hand offering a holistic approach to mitigate land degradation and/or restore degraded areas; hence a comprehensive tool to tackle this global problem.

51.2 Agriculture in the Arid Zones of Northern Mexico

51.2.1 Characteristics, Extent, and Importance of the Arid Zones of Northern Mexico

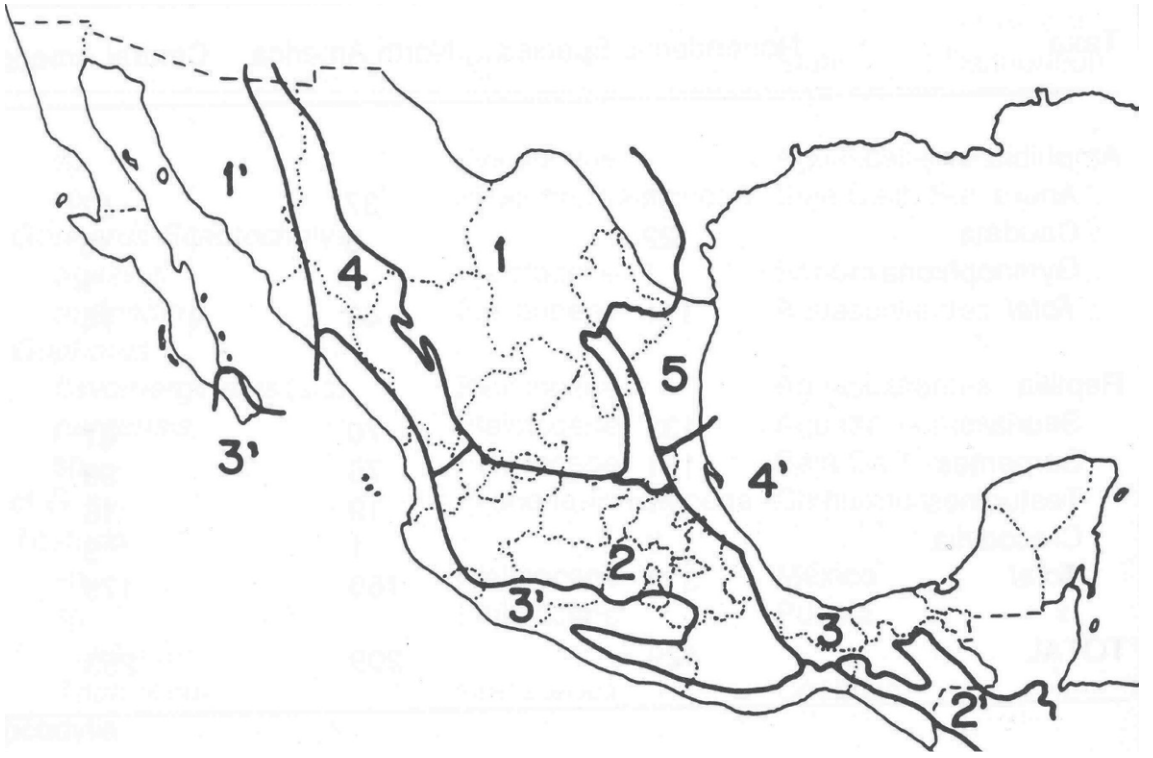
Mexico is characterized by a large diversity of ecosystems including alpine, coastal, desert, rain, and temperate forest. The most extended ecosystem types are arid and semi-arid ecosystems, which cover almost 50 per cent of Mexico's territory (Rzedowski 1978). Mexico's arid lands consist of two large regions: i) the *Sonora Desert* in the NW of the country with the states of Sonora, Northern and Southern Baja California, and ii) the *Chihuahua Desert* in the center-north of the country with the states of Chihuahua, Coahuila, Durango, Zacatecas and San Luis Potosí (figure 51.1; 51.2).

The vegetation in Mexico's aridlands is characterized by the desert scrub (*matorral*) and grassland biomes (table 51.1; figure 51.3). The arid and semi-arid regions have one of Mexico's highest species richness (around 6,000) with an extraordinary high number of endemic species (3,600) (CONABIO 2006). The desert scrub is the dominant ecosystem (table 51.1); its complex biota of diverse plant species and life forms including shrubs, subtrees, cacti, succulents (cacti, *Agave* spp., *Opuntia* spp.), and herbaceous perennials covers almost 50 per cent of the region (table 51.1). The grassland formations are less abundant; these are naturally relatively poor species communities; however, they provide the most important provisioning, supporting and regulating ecosystem services for the region.

The importance of these arid regions is related to several often conflicting biophysical and socio-economic factors that include the geographic extent, the enormous biological diversity, and endemism (Rama-

1 See: Stafford-Smith/Lambin/Turner II/Mortimore/Batterbury/Downing/Dowlatabadi/Fernández/Herrick/Huber-Sannwald/Jiang/Leemans/Lynam/Maestre/Ayarza/Walker (2007).

Figure 51.2: Map of Mexico's Arid Zones and Deserts of Northern Mexico. Arid and semi-arid regions are enclosed within zone 1. **Source:** Flores-Villela (1993: 264).



moorthy/Bye/Lot/Fa 1993), exploitation of natural resources, economic and social tensions as a consequence of being the border region to the United States of America, a large expanding human population (up to 20 per cent of Mexico's total population, table 51.2), urbanization, city growth, rural migration, and the high vulnerability of the region to natural and anthropogenic catastrophic events such as decades of droughts, flooding, land use change and abandonment of marginally productive land, expansion of intensive agricultural frontier, environmental degradation, etc.

51.2.2 Agricultural Systems in the Arid Zones of Northern Mexico

As a mega-diverse region, ranked fourth important in the world (CONABIO 2006), Mexico has also developed one of the richest agricultural cultures in the world. In spite of the limiting conditions that arid and semi-arid environments impose on plant growth and subsequently on agriculture development, strong agriculture-based cultures emerged in these environments in the past (e.g. The Pueblo Indian groups from Northern Mexico and Southern U.S.). Ethno-agriculture and traditional extraction of wild plants for food, medicine, fibre, beverages, religious practices, etc. are low-input sustainable production systems based on old traditional knowledge that date back to pre-Co-

Table 51.1: Area (total and per cent) of dominant land cover types in Northern Mexico in 2000 for the states of Northern and Southern Baja California, Chihuahua, Coahuila, Durango, Nuevo León, San Luis Potosí, Zacatecas (Region 1 and 1' in figure 51.2). **Sources:** INEGI (2004); Palacio/Bocco/Velásquez/Mas/Takaki-Takaki/Victoria/Luna-González/Gómez-Rodríguez/López-García/Palma-Muñoz/Trejo-Vázquez/Peralta-Higuera/Prado-Molina/Rodríguez-Aguilar/Mayorga-Saucedo/González-Medrano (2001).

Land cover type	Area (km^2)	Percentage
Desert scrub	484,654	42.7
Grassland	76,209	6.7
Forest	177,825	15.7
Agriculture	103,085	9.1
Irrigated	40,223	3.6
Rain-fed	62,862	5.5
Other	179,430	15.8
Total	1,135,631	100.0

Table 51.2: Total human population (in 1,000) growth between 1910 and 2004 in the arid lands of Northern Mexico for the states of Northern and Southern Baja California, Chihuahua, Coahuila, Durango, Nuevo León, San Luis Potosí, Zacatecas and between 1910 and 2004 in the major growing cities of the region (Aguascalientes, Chihuahua, Ciudad Juárez, Hermosillo, Mexicali, Monterrey, Saltillo, San Luis Potosí, Torreón) and percentage of total national population. **Source**: INEGI (2004).

Year Population	1910	1930	1950	1970	1990	1995	2005/7
Total	3,039	3,201	5,257	9,692	15,944	18,041	22,040
In major growing cities in N. Mexico	352	442	1,327	3,735	7,915	9,474	9,865
Urbanization rate (in %)	11.6	13.8	25.2	38.5	49.6	43.0	44.8
Percent of total population living in N. Mexico	20.1	19.2	20.4	20.1	19.6	19.8	21.3

Figure 51.3: Four characteristic arid ecosystem types in the Chihuahua Desert. Desert scrub (top left: Matorral rosetófilo, top right: Matorral microfilo, bottom left: Matorral espinoso and bottom right: Matorral crasicaule). **Sources:** The authors.

lumbian times (Aguirre-Rivera/Charcas-Salazar/Flores-Flores 2001). Typical examples of extracting plants from natural systems include the use of *Agave* plants for the production of fibre (*Agave lechuguilla*; see Reyes-Agüero/Aguirre-Rivera/Peña-Valdivia 2000), fermented beverages such as pulque or traditionally distilled beverages such as mezcal (*Agave salmiana*; see Aguirre-Rivera/Charcas-Salazar/Flores-Flores 2001). In some places, lack of plant population management and overexploitation could potentially threaten the viability of these plant species. It has been estimated that in a single season 40 million plants of *Agave le-*

chuguilla are harvested to obtain lechuguilla fibre (Reyes-Agüero/Aguirre-Rivera/Peña-Valdivia 2000).

Most of the agricultural systems developed from converting grasslands and desert scrub into cropland. Today, two types of agriculture systems dominate traditional low-input agriculture and intensive, high input farming systems. In the arid zones of Mexico, rain-fed agriculture for corn, bean, and squash production dates back to 5000 BC (Cue 1963). It was primarily adopted for self-consumption. The development of water holding structures such as terraces and retaining furrows (Fortanelli-Martínez/Aguirre-Rivera 2000) was a key aspect contributing to its success. Rain-fed agriculture has either been practised as monocultures or as intercropping where e.g. beans are interspersed with corn. Until now, rain-fed agriculture continues to be a traditional farming technology with tools and management approaches from the beginning of colonization times, and by using a diversity of empirically domesticated plant species adapted to local environmental conditions (Hernández/Inzunza/Solano/Brauer 1977). Producers with access to government cash-based subsidy programmes (like PROCAMPO) have access to modern technology such as mechanization, fertilization, etc. which greatly alter crop residues and soil management, questioning the long-term ecological benefits of this development (Ribeiro-Palacios 2007).

Intensive farming is mostly practised in form of irrigated crops. Paradoxically, the arid and semi-arid regions of Mexico has prime importance for the national production of alfalfa, beans, chilli, cotton, corn, cucumber, garlic, grapes, melon, safflower, sesame, sorghum, soy bean, strawberry, tomato, and wheat. Traditional crop production has been displaced by these highly rentable crops for exportation. These irrigated production systems have contributed up to 48 per cent of the total crop production of the country (Chalita 1974). The largest irrigation districts of the country are located in these regions (Bassols 1970, CNA 2007a). Irrigation technology includes a) open-channel irrigation, b) water tunnels for alluvial water springs (qanat from North Africa), and c) deep pumping from rechargeable aquifers and fossil wells (Fortanelli-Martínez/Aguirre Rivera 2000). Annual water use from surface and subsurface water for irrigation agriculture ranges between 15–20 km^3. Of this, almost 50 per cent is gained from the 318 aquifers occurring in the region, of which 62 are on average overexploited (CNA 2007a, table 51.3).

Irrigation agriculture including high-input agrotechnology have triggered serious environmental disasters in Northern Mexico (Matson/Naylor/Ortiz-Monasterio 1998); among those are soil erosion, soil salinization, soil subsidence, overexploitation of aquifers in addition to the simultaneous biological and ecological devastation. The far reaching environmental consequences of this truly non sustainable agriculture in Northern Mexico trigger also regional socio-economic problems associated with land abandonment, migration, poverty, etc. (Cloudsley-Thompson 1977).

51.2.3 Socio-economic Aspects Associated with Agricultural Practices in Northern Mexico

Historic and current agricultural practices in Mexican drylands have been greatly shaped by a series of complex socio-political phenomena such as the transition from a nomadic to a settled lifestyle, the Hispanic conquest, land ownership, land leasing, conflicts between minifundia and latifundia, agrarian revolution, agrarian reform, communal land structure (ejido), property rights, etc. (Soto-Mora/Fuentes-Aguilar/Coll-Hurtado 1991). Prior to the Hispanic colonization, the arid and semi-arid lands of Northern Mexico were inhabited by semi-nomadic indigenous groups known as the chichimecas (Montejano 1978). These groups were hunter-gatherers that were not familiar with agricultural practices (Clavijero 1979). With the discovery and exploitation of several important silver mines in the central part of Northern Mexico by the Spaniards, the first settlements were established and associated with those, agriculture started. Large landholdings associated with the haciendas promoted crop and livestock production for self-sufficiency and for supplying mining centres in Guanajuato, San Luis Potosì, Zacatecas, Chihuahua and Sonora (Cardoso/Pérez 1979). The feudal type organization of the haciendas allowed the development of semi-intensive, mostly irrigated agriculture. After 300–400 years of social inequalities and land exploitation, the political, economic, and social pressures culminated in profound hacienda criticism and its feudal system, and thus were one of the main causes for the Mexican Revolution in 1910. The agrarian land reforms in 1917 led to shifts in land tenure, when large areas of the country were granted to rural and peasant communities or *ejidos* (Sanderson 1984). In Northern Mexico, there are currently, 7,200 ejidos (table 51.4, INEGI 2004).

These communes were not granted land ownership; however, they had both the rights to exploit the land without restrictions and hereditary privileges. The *ejido* structure consists of small individual farm-

Table 51.3: Hydrologic regions with corresponding total concessioned volume of water, average availability, pressure on the watershed (percentage of water used in relation to disponibility) and degree of pressure (above 40 per cent corresponds to strong pressure). **Source:** CNA (2007a).

	Hydrologic-administrative region (hm^3)	Total volume of concessioned water (hm^3)	Average natural availability (hm^3)	Pressure on hydrologic resources (%)	Classification for the degree of pressure
I	Península de Baja California	3492.6	4600	75.93	STRONG
II	Noroeste	6916.8	7944	87.07	STRONG
III	Pacífico Norte	10281.6	25681	40.04	STRONG
IV	Balsas	10569.3	21277	49.67	STRONG
V	Pacífico Sur	1279.4	32496	3.94	LIGHT
VI	Río Bravo	9112.4	11938	76.33	STRONG
VII	Cuencas Centrales del Norte	3807.4	8394	45.36	STRONG
VIII	Lerma Santiago-Pacífico	13665.7	34003	40.19	STRONG
IX	Golfo Norte	4587.5	25619	17.91	MODERATE
X	Golfo Centro	4929.5	102778	4.80	LIGHT
XI	Frontera Sur	2040.4	157753	1.29	LIGHT
XII	Península de Yucatán	1996.7	29645	6.74	LIGHT
XIII	Aguas del Valle de México	4642.9	3009	154.30	STRONG
	TOTAL	77.322	465137	16.62	MODERATE

Table 51.4: Area and percentage of land belonging to ejidos in each of the states from Northern Mexico for the year 2001. **Source**: INEGI VIII censo ejidal (2004); at: <http://www.inegi.org.mx/inegi/default.aspx?s=est&c=15688&pred=1>.

State	Total area (km^2)	Ejido area	Percentage of ejido land
Aguascalientes	5590	2755	49.2
Baja California N	71098	59485	83.6
Baja California S	71234	48955	68.7
Coahuila	151062	68166	45.1
Chihuahua	246686	103697	42.0
Durango	123020	86511	70.3
Nuevo León	64069	21152	33.0
San Luis Potosí	60995	41558	68.1
Sonora	178375	65271	36.5
Zacatecas	75300	38443	51.1

ing areas and a large communal land. The small areas are assigned to individual households of the ejido who use them for agriculture. The communal land is a dedicated rangeland area, where any member of the ejido can raise livestock usually without restrictions on stocking density. Because of the collapse of many irrigation systems with the shift of land ownership from Hacienda to ejido, many cropping areas turned into rain-fed agriculture. This, together with the inherently limiting growing conditions in the arid and semi-arid region caused a significant drop in crop productivity.

Ejidos have turned into small-scale subsistence agricultural systems (Assennato/León 2007) and livestock grazing in the communal rangelands has become one of the most important (economically) land use activities in the ejidos. Unfortunately, lack of management policies and regulations by the state has caused vast areas to become heavily overgrazed and degraded (Huber-Sannwald/Maestre/Herrick/Reynolds 2006, Manzano/Návar/Pando-Moreno/MartÌnez 2000). Finally, in 1992 the original law (Consti-

tution Article 27) that once created the 'ejido' was modified by a decree that allows ejido members to be granted land ownership. Consequences of this reform include a return to the concept of private property and likely a change in the agricultural systems of the region. However, we will witness the social, economic, and environmental outcome associated with this reform in the decades to come.

The historical development of ejidos and their agriculture systems are unfortunately tightly linked to a history of subsistence production systems and poverty. Given the close dependence of subsistence farming on summer precipitation, the livelihoods of ejido communities emerge to be one of the most vulnerable to climate anomalies that likely will intensify based on future scenarios of climate change (Conde/Ferrer/Liverman 2003; Fernández/Martínez/Osnaya 2003; Magaña/Conde/Sánchez/Gay 2003; Conde/Ferrer/Orozco 2006).

51.3 Global Environmental Change and Agriculture in the Arid Lands of Mexico

Global environmental change (GEC) is the result of several direct and indirect human drivers with land conversion of natural systems, urbanization, global loss of habitat and biodiversity, change in atmospheric chemistry and climate change being the primary ones. In Northern Mexico in particular, land conversion, inappropriate agricultural practices, overexploitation of rangelands and the associated loss of plant cover, soil organic matter and consequently long-term productivity of the drylands have led to the complex phenomenon of desertification. A phenomenon that tightly links the underlying biophysical and socio-economic dimension (UNFCC 1994; Reynolds/Stafford Smith 2002) of a severe global and regional environmental problem and that encompasses almost all of the above mentioned drivers. Especially, in the semi-arid and arid regions of the world and Mexico, the severe changes in the hydrological cycle are probably the most immediate and hardest to deal with impacts of GEC as they jeopardize the fundamental life-support system in regions, where social and ecosystems have to share freshwater as the survival and longevity of these human-environment systems depends above all on the continuous availability and quality of this key resource (Falkenmark 2003).

51.3.1 Drought and Scenarios of Climate Change in Northern Mexico

Drought is a permanent threat to agriculture in Northern Mexico. Almost 80 per cent of the arid and semi-arid region of Northern Mexico is located in a critical zone (mean annual precipitation less than 350 mm) for rain-fed agriculture, while in less than 5 per cent a favourable precipitation regime is recorded (450–500 mm; Conde/Ferrer/Araujo/Gay/ Magaña/Pérez/Morales/Saturnino 1999). Drought phenomena in this region reoccur every ten years (CNA 2006) and greatly negatively affect agriculture, livestock and forestry. In the past, extreme drought events impacted on food security in the region and in historic times even influenced important socio-political events such as the Independence War and the Mexican Revolution (García-Acosta/Pérez-Ceballos/Molina del Villar 2003; Florescano/Swan 1995; Conde/Ferrer/Orozco 2006). The most recent decade of drought ended in the late 1990's; it affected most of the Chihuahua Desert (Conde/Ferrer/Araujo/Gay/Magaña/Pérez/Morales/Saturnino 1999) causing ecologic, economic, and social collapse (box 51.1).

Box 51.1: Drought periods in Mexico associated with social phenomena**. Source**: The authors.

Although drought[a)] is a periodically recurring climatic phenomenon in large parts of Mexico not many historic records report on its existence. For instance, the *National Meteorological Service* (SMN) has climate records starting only in 1921. A few meteorological stations located next to monasteries and government buildings, as well as historic archives that describe the absence of rain have served as valuable sources to investigate the incidence and patterns of drought in the 19th century. In particular, a historian's perspective on drought such as by Enrique Florescano (1980), has allowed establishing links between historic climate and economic, social and demographic processes. In Mexico, historical drought occurrence suggests that impacts on food production and the subsequent increase in food costs triggered the social upheaval of the Independence War in 1810 and the Mexican Revolution of 1910 (table 51.5, 51.6, and 51.7).

a) Drought may be defined as an extended period, from weeks to years, when a region suffers a deficiency in its water supply. This occurs when a region receives below average precipitation and affect ecosystem functioning and agriculture. Even a short, intense drought can cause significant damage and harm the local economy.

Table 51.5: Years of observed and recorded droughts for the Northern States of Mexico. **Source**: Carrillo-Arronte cited by Contreras-Servín (2005: 123).

State	Years with drought
Nuevo León	1868,1886,1887,1889,1894,1905,1906,1907,1909,1910
Chihuahua	1877,1886,1893,1896,1908,1909
Coahuila	1868,1877,1883,1884,1887,1904,1910
Sonora	1886,1887,1893,1896,1897
Aguascalientes	1868,1895,1905
Durango	1850,1877,1894
San Luis Potosí	1875,1887,1889,1894,1896,1898,1899,1900,1904,1905,1906,1907,1908
Zacatecas	1875,1885,1889,1895,1907
General drought	1808,1809,1810-1811

Historic drought events in Mexico had likely greater social impact because of a higher proportion of the rural population and the characteristic self-sustaining food production system of these human communities. Thus, grain storage and grain importation was limited or not existing, so that even seasonal drought events could produce strong social pressure as the population was trying to satisfy food demands.

In modern times, there has been a switch in the proportion of the population with a drop of the rural population from 57 per cent to 23 per cent in the period between 1950 and 2006 (table 51.6). In 25 years from now there is expected to be a drop in 5 per cent in the rural population. Severe drought as expected under future climate change scenarios (table 51.7) will still hit rural communities, however, greater pressure will occur in urban centres where water availability would have a priority. Between 2006 and 2030 predictions estimate a drop in water availability of 575 m^3/inhab/year (CNA 2007a).

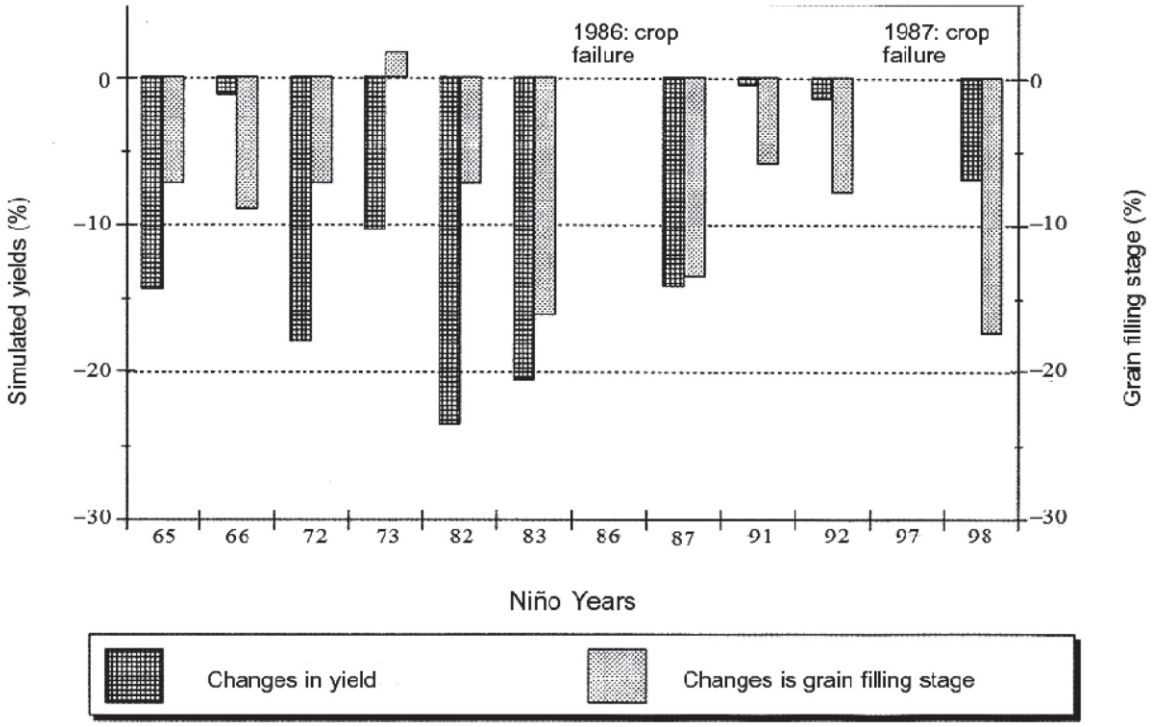
Table 51.6: Population growth in Mexico under rural and urban conditions for the past 50 years and projections to the year 2030. **Sources:** INEGI (2000) and CNA (2007a).

Population	1950	1960	1970	1980	1990	2000	2010	2020	2030
Rural	14.80	18.58	21.24	22.93	23.73	24.71	24.42	24.1	23.5
Urban	11.02	23.10	36.45	51.34	62.73	72.98	84.38	91.98	97.61
Total	25.82	41.68	57.69	74.27	86.46	97.69	108.8	116.08	121.11

Table 51.7: Proportional land surface of Northern Mexico affected by drought and projections under future scenarios of climate change (CCC and GFDL-R30 models). **Source**: Hernández-Cerda/Torres-Tapia/Váldez-Madero (2003).

Severity index of meteorological drought	Current proportion (%)	Projections CCC model (%)	Projections GFDL-R30 model
Severe	24.4	30.0	39.4
Very severe	8.1	7.8	7.4
Extremely severe	3.6	3.9	4.3

Figure 51.4: Estimated changes in yield and the stage of grain filling in corn during El Niño years. **Source:** Conde/Ferrer/Araujo/Gay/Magaña/Pérez/Morales/Saturnino (1999).



Large scale drivers of regional precipitation in Northern Mexico include the position of jet streams, the movement of polar-front boundaries, the intensity of summer monsoons, the surface temperature of neighbouring oceans, often regulated by oceanographic events such as *El Niño Southern Oscillation* (ENSO) and by even longer-term ocean cycles of the *Pacific Decadal Oscillation* (Caso/González-Abraham/Ezcurra 2007). From these, ENSO turns out to be a key driver of the climate in Northern Mexico. North of 22° latitude, ENSO brings primarily humidity (Caso/González-Abraham/Ezcurra 2007) while la Niña brings primarily drought (Holmgren/Stapp/Dickman/Gracia/Graham/Gutiérrez/Hice/Jaksic/Kelt/Letnic/Lima/López/Meserve/Milstead/Polis/Previtali/Richter/Sabaté/Squeo 2006). ENSOs are natural phenomena, however, in recent decades they occur with greater frequency, every 3 to 7 years (McPhaden 2004) than they used to (every 10–12 years) causing frequent yet still unpredictable drought events in Northern Mexico (table 51.5). El Niño events are also accompanied by an overall decline of crop yield and incompletion of grain filling in corn (figure 51.4).

In addition to the natural climate variability, the most recent climate change scenarios for the year 2050 simulated with *Global Circulation Models* (GCM) predict an increase in temperature by 2–4 °C. Northern Mexico will be the most affected region of Mexico (Magaña/Conde/Sánchez/Gay 2003). Also, precipitation will decline by up to 20 per cent in the arid and semi-arid regions of Mexico (SEMARNAT 2006), Bur there is still much uncertainty associated with these predictions (Magaña/Conde/Sánchez/Gay 2003; IPCC 2007a). The northern parts of the Chihuahua Desert and the Sonora Desert are the most vulnerable regions according to most recent climate change scenarios (SEMARNAT 2006).

51.3.2 Agriculture and its Vulnerability to Drought in Northern Mexico

Arid and semi-arid ecosystems are characterized by naturally low water availability and by relatively shallow unproductive soils with a general low water holding capacity. The Northern states of Mexico receive on average annual precipitation (for the years 1941–2005) of 260 mm (100–480 mm); 67 per cent of that fall during summer (June – September, CNA 2006). In addition, the onset of summer precipitation varies greatly (between May and August) which may considerably enhance drought effects. As a result, Chihuahua, Coahuila, Durango, Nuevo León, Baja Califor-

Figure 51.5: Distribution of areas suitable for corn production in Mexico. **Source:** Flores/ Araujo/Betancourt (2003).

nia, Sonora, Sinaloa, Zacatecas, San Luis Potosí, and Aguascalientes are the states most affected by pervasive drought (in decreasing order; CNA 2006) and consequently constitute the region with the highest vulnerability to future changes. O'Brien, Sygna and Haugen (2004) attribute vulnerability to the set of attributes generated by social and environmental processes, including climate change, which limit the ability of humans to cope with climatic and other stress types that fundamentally affect their livelihoods.

Rain-fed agriculture is particularly vulnerable to climate change and its predicted strong droughts in Northern Mexico (table 51.7), since it relies on a precise seeding schedule considering a more or less continuous rainfall distribution along the growing season. The vulnerability of rain-fed agriculture to the predicted climatic fluctuations in Northern Mexico is so extremely high that Flores, Araujo and Betancourt (2003) consider a large part of the Sonora Desert and Chihuahua Desert to be non-suitable for corn agriculture (figure 51.5). Modelling studies (Conde/Ferrer/Liverman 2003) on future climate effects on agriculture in more humid Central Mexico suggest that rain-fed agriculture practised in that region will suffer severe reductions in corn production, because of a reduction in the length of the growing season and an overall decrease in total annual precipitation. In Northern Mexico, it is also estimated that even irrigated crops may suffer increasing risks associated with predicted pervasive long-term droughts. These risks may be associated with the overexploitation of superficial and subterranean aquifers (CNA 2004).

51.3.3 Agriculture and its Vulnerability to Desertification in Northern Mexico

Rain-fed agriculture is practiced mostly in plains, at foothills and valley bottoms, where soils are deepest. However, aridisols the dominant soil types in the region are generally shallow and have a relatively low content of soil organic matter (<1.5 per cent). Additionally to rain-fed agriculture almost all subsistence farmers raise livestock on open unmanaged rangelands. Because of the enormous overuse of the rangelands (according to Manzano/Návar/Pando-Moreno/Martínez 2000, the rates of overgrazing in Northern

Mexico range between 182–1,500 per cent over the recommended capacity) many households are forced to feed their animals most of the annual crops as supplementary forage. Thus, upon harvest they remove all plant residuals leaving the soils void of any protecting cover, thereby provoking dramatic soil loss through water and wind erosion (Schoijet 2005; Lal 2004). Another phenomenon that increases the vulnerability of rain-fed agriculture to desertification is associated to a progressive loss in soil fertility as a consequence of inappropriate land management (conventional tillage, removal of plant residuals, crop monocultures, no crop rotation, etc.). Current agricultural practices and land abandonment both alter the biogeochemical cycles of the systems thereby greatly influencing the natural dynamics of hydrology, fertility, and energy balances. Current land use practices increasingly decouple the production systems from their environmental support systems (Naylor/Steinfeld/Falcon/Galloway/Smil/Bradford/Alder/Harold 2005), including the supporting and regulating ecosystem services (MA 2003).[2]

In total, 90 per cent of the area covered by rain-fed agriculture is affected by some sort of land degradation (López Ocaña 1996). According to a recent assessment of human induced soil degradation in Northern Mexico (SEMARNAT 2002), 40 per cent (413,827 km^2) of the soils are degraded, with wind erosion (15 per cent) being the most apparent type followed by chemical erosion (12 per cent; i.e. loss of soil fertility), water erosion (10 per cent), and physical erosion (3 per cent). Soil degradation is in fact the consequence of a more profound problem associated with a multitude of interacting biophysical and socio-economic factors leading to desertification (Reynolds/Stafford Smith 2002).

The UNCCD (1994a) defines desertification as "land degradation in arid, semi-arid, and dry sub-humid regions resulting from various factors, including climatic variations and human activities" and land degradation as the "reduction or loss of the biological and economic productivity and complexity of terrestrial ecosystems, including soils, vegetation, other biota, and the ecological, biogeochemical, and hydrological processes that operate therein" (United Nations 1994). When adopting these definitions, large areas of Northern Mexico must be influenced by desertification, however, to our knowledge there are no compiled statistics on the extent and/or degree of severeness of the land and human populations affected by desertification.

51.3.4 Socio-economic Vulnerability in Northern Mexico

Vulnerability of livelihoods of rural communities to drought and desertification in northern Mexico is directly linked to the susceptibility of subsistence farming and integrity of natural resources to persistent and frequent drought events. For instance, food security for a large proportion of the Mexican population depends on corn production while consumption rates of corn in Mexico approach 250 kg/inhabitant/year. Long-term sustainability of agriculture, particularly of basic grains such as corn and beans, should have high priority in state development plans, and call for innovative policies both to reduce poverty and migration (especially in Durango and Zacatecas; see INEGI 2004) to urban areas and the United States, and to improve the life support system of one fifth of the Mexican population.

However, recent policies associated with food security issues promoted importation rather than the enforcement of a self-sufficient agriculture. For example, in the last decade, Mexico imported food (mostly corn) for US$90,000 million (Perez 2005). Apart from socio-economic aspects this massive corn importation has also threatened the maintenance of the high genetic diversity of Mexican maize (Nadal 2000) which could essentially serve as a key source for adaptation strategies considering future scenarios of global warming. Equally, in 2007 an important increase in the tortilla price due to corn importation, subsidies cut-off and increased use of corn for biofuels, triggered the inflation rate of the Mexican peso. This illustrates how agricultural systems in Northern Mexico may become highly vulnerable and dependent not only on meteorological factors but also on national policies and global markets (Liverman 2000).

51.3.5 Social and Economical Pressures Affecting Dryland Agriculture

Paradoxically, global and national markets and international trade agreements (e.g. NAFTA) have resulted in a marked decline in the competitiveness of traditional crops such as corn produced by a large population in Northern Mexico (table 51.8).

2 This report was written by a team of 5 authors and 10 contributing authors. The MA was coordinated by UNEP and its Secretariat was based at several partner institutions.

Table 51.8: Collapse of corn prices in relation to costs of agriculture inputs between 1981 and 1994. Estimated to corn prices of 1994. **Source**: Becerra-Moreno (1998).

Year	NIP*) agricultural inputs	Real cost of corn N$ t^{-1}
1981	122	1,593
1985	1,097	1,441
1990	16,370	1,153
1994	29,667	749

*) NIP= National Index of Prices for agriculture inputs

With the introduction of NAFTA in 1994, Mexican producers were expected to strongly increase exportation of high rentability crops (Nadal 2000) and to move away from traditional crop production, with the goal that most subsidies for traditional agriculture could be cut back. A decade later, it was only the large-scale commercial farms in Northern Mexico that were able to increase production (forage, vegetables and fruits), however, at a high environmental cost related to high water use for irrigation, excessive fertilizer application and soil contamination through pesticides (Liverman/Vilas 2006). For smallholder farmers, it has become ever more difficult to access credit, water quotas, and technology to participate in the production of goods for exportation.

Among the key outcomes derived from implementing NAFTA in the agricultural sector of Mexico, Henriques/Patel (2004) and Nadal (2000) have mentioned a) international and national decreases in corn prices, b) stable levels of Mexican corn production despite price changes, c) increase in rural poverty, d) increase in out-migration, e) increase in the price of tortillas, f) tariff rate quotas not enforced and revenue foregone, and g) heterogeneity of impact on farmers (worse for small producers). Unfortunately, most of the mentioned outcomes have negatively affected subsistence farming and small agricultural producers (Henriques/Patel 2004).

The high-input production systems in Northern Mexico seem to have traded short-term increases in exportation for long-term sustainability of these highly vulnerable life-support systems (Robertson/Swinton 2005) by sacrificing supporting and regulating ecosystem services and putting economic interests first. Globalization and economic subsidies both in industrialized countries and within the country are also key drivers affecting corn farmers in Northern Mexico (Fitting 2006).

First, Mexican farmers have to compete with imported highly subsidized, low-cost US corn. US corn farmers received between 1993 and 2000 subsidies of up to 18 billion dollars (Henriques/Patel 2004). Secondly, subsidy programmes in Mexico such as PROCAMPO (a national programme for direct assistance to subsistence farmers) offer cash transfer to farmers in form of seed money of one of nine basic crops (corn, beans, wheat, rice, sorghum, barley, cotton, soybean and safflower, Saudolet/Janvry/Davis 2001). The programme was aimed at providing compensatory income for smallholders (targeted towards ejidos) to stimulate the production of low-price crops and to ultimately reduce poverty and out-migration. However, several unintended negative consequences emerged with this programme. Lack of technical support and access to mechanized agriculture resulted in inappropriate agricultural practices (tillaging, monoculture, use of tractors, etc) causing land deterioration and increasing conversion of natural ecosystems to rain-fed agriculture. Huber-Sannwald, Maestre, Herrick and Reynolds (2006) show that in the southernmost part of the Chihuahuan Desert (San Luis Potosí), intensification of farming promoted by PROCAMPO favoured a decline in soil fertility and increased soil compaction in corn, bean, and barley fields. Hence, unfortunately subsidy programmes may in some cases contribute to increased vulnerability of subsistence farmers.

Finally and ironically, environmental problems emerge also from the economical success (remittance) of emigrants and the economical support they provide to their rural regions. This, for instance, has generated a change in the production systems by turning from a low-return cropping system to an intensive livestock production system (Ribeiro-Palacios 2007). Concomitantly with this trend occurs a change in preference for forage crops at the expense of traditional crops. Not to mention an ever increasing grazing pressure in already overgrazed rangelands. These examples illustrate the complex interactions that may arise from coupled socio-economic and agro ecological systems. Additionally, the expectations that arid and semi-arid ecosystems will become unpredictable will contribute to enhanced vulnerability of dryland agriculture, particularly to drought and globalization.

51.4 Strategies for Adaptation and Mitigation to Climate Change in Dryland Agriculture of Northern Mexico

Future scenarios of climate change for arid and semi-arid regions of Northern Mexico include temperature increases between 1–2 °C, decreased rainfall of around 20–30 per cent, as well as changes in rain distribution (fewer but larger events). Potential changes in agricultural systems under the climate change scenarios for the drylands of Northern Mexico include loss of plant cover with increasing soil temperature and reduced precipitation, enhanced soil erosion, and a decline in soil water recharge. The resulting loss in soil fertility will impose more pressure on the land, exacerbating land degradation and poverty. Under these scenarios, regional policies for land management and social welfare should consider the development of strategies of adaptation and mitigation that consider also sustainable alternatives of agriculture to protect the soils against erosion and fertility loss that will contribute to a reduction of GHG emissions.

51.4.1 Adaptation Strategies for Rain-fed Agriculture

Historical accounts of drought events in Northern Mexico report that drought impacts are frequent and severe with on average 10–20 per cent loss of agriculture land and consequent declines in production, export of crops and livestock and increase in importation. Given the high incidence of unpredictable drought events, local communities in arid and semi-arid regions have developed traditional technologies to cope with these limiting conditions (box 51.1). For instance, the installation of sophisticated irrigation systems for water transport and storage in gallery tunnels allowed the collection of subsurface water at foothills and its transport to valley bottoms.

Another irrigation system still in use dates back to colonial times; it is the 'entarquinamiento' or 'water box' approach which was designed to collect and manage run-off water after torrential rainfall events for late fall or winter crops when water is scarce. The technology of entarquinamiento has been implemented extensively in Northern Mexico. For example, the prosperity of agriculture in the 'Comarca Lagunera' region in Coahuila and Durango states has been attributed to this irrigation technology (box 51.2).

Box 51.2: Water boxes in La Comarca Lagunera. **Source**: Eling/López-Pacheco/Palerm-Viqueira/Pimentel-Equihua/Sánchez-Rodríguez (2001); Palerm-Viqueira/Sánchez-Rodríguez (2002).

An 'entarquinamiento' is an irrigation system that consists of a series of crop fields of variable extension which are surrounded by soil furrows and function as 'water boxes' or water deposits for times when water is required weeks or months later. The Comarca Lagunera is a geographic and economic region in the states of Coahuila and Durango characterized by a network of water boxes that extends over 6000 km^2 in valleys with deep and fertile soils to promote winter crops. The volume of water avenues that feed these irrigation systems fluctuates between 177 and 3,157 million m^3. Water from torrential downpours is diverted to fill these boxes up to 0.3 to 1m for a period of 20 to 25 days. The water is then released and moves by gravity to the next box and so on (figure 51.6) and thus serves to flood crop fields prior to planting. The water is directed via natural channels and water avenues. This irrigation method promotes water infiltration and water storage in the soil profile between weeks and months, for the development of fall/winter agriculture (Palerm-Viqueira/Sánchez-Rodríguez 2002). While this system favours mostly winter crops including cotton, wheat, lentils and grapes, recently the system has also been implemented for summer crops including strawberry, some vegetables, sorghum, corn, and beans. Unfortunately, the establishment of ejidos and building of dams negatively affected the use of the entarquinamiento irrigation systems; but they still exist in some parts of this region.

Figure 51.6: Image showing the 'water boxes' of the 'entarquinamiento' system, during the process of being flooded and emptied. **Source**: Photo was taken by Jacinta Pelerm Viqueira/Martin sanchez Rodriguez/ Elvia Lopez Pacheco/Jose lUis Pimentel Equihua/Herb Eling.

Another fundamental strategy to adapt to adverse climatic and environmental conditions is to maintain a high diversity of crop varieties, particularly for maize (Hernandez-Xolocotzi 1987; Muñoz-Orozco 2006). For instance, some Northern (from Matehuala, San Luis Potosí) drought adapted corn varieties now perform better further south (Northern Michoacán state), where reductions in annual precipitation have been observed (Muñoz-Orozco 2000). Other alternatives to adjust to drought include altering the planting ratio of beans and maize or adjusting the planting density of crops (Liverman 2000). In extremely harsh and dry years, some communities rely on traditional sources of food such as cacti, *Agave*, and mesquite fruits (Minnis 1991).

For semi-arid regions some technological programmes recommend the establishment of *Opuntia* orchards to profit from fruit or cladode harvesting. *Opuntia* is a native species in the Chihuahua Desert, adapted to low precipitation and unfertile soils (Mondragón-Jacobo/Fernández-Montes 2000). Additional adaptive alternatives for agriculture in rain-fed agriculture include mixed cropping with diverse seeding arrangements. These systems maintain productivity but help to reduce weed infestation, improve the space use, and reduce water losses compared to mono-specific crops (Arévalo-Valenzuela 2000). It is also advisable as an adaptation strategy to diversify with drought resistant crops such as sunflower, garbanzo beans, lentils, amaranthus, etc.

In addition to all these diversifying alternatives, practices such as organic farming, reduced tillage, and conservation mulching which are devoted to protect the soil surface are becoming the best alternatives to reduce soil erosion, ameliorate other factors such as soil temperature (e.g. soil surface temperatures exhibit up to 15 ºC difference between soil covered by litter and bare soil) and to cut back on CO_2 emission to the atmosphere (Valero-Garza 2000). Agroforestry systems on the other hand, also allow improving soil conditions through increasing soil organic matter inputs, carbon storage, nitrogen fixation, soil water infiltration, reduction of soil compaction, and increase in soil biological diversity, etc. These agroforestry alternatives for arid and semi-arid conditions include the incorporation of traditional crops (i.e. corn, beans, etc) combined with shrubby species (Atriplex, Prosopis, etc.) and the seasonal introduction of grazing animals (Del Rosario y Terrones-Rincón 2000). Finally, government emergency relief and temporary

subsidy programmes should provide temporary support to maintain human welfare in extreme situations.

51.4.2 Mitigation Options to Reduce Desertification in Northern Mexico

For the arid and semi-arid regions of Northern Mexico, government agencies dealing with agriculture are the *Secretaria de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación* (SAGARPA), with social development the *Secretaria de Desarrollo Social* (SEDESOL), and with desertification the *Comisión Nacional de Zonas Áridas* (CONAZA), that have developed mitigation strategies to help withstand drought and ecosystem degradation (box 51.3).

These strategies include planting of windbreak barriers and live fences, cross-slope physical or biological conservation work, agroforestry systems, development of germplasm banks, dam construction, run-off management, planting of drought resistant plants, reduced tillage, conservation mulching, crop rotation, composting, manure application, fallowing, soil salinity control as well as changes in land use patterns (CONAZA 1994; Lal/Kimble/Follet/Cole 1998; Lal 2002). Many of the strategies are designed to control deleterious effects associated with rain-fed agriculture.

However, many of these strategies need to be carefully tested and adapted to local environmental conditions and farmers needs (Hellin 2006). Integrated knowledge on ecosystem function is rarely used as the baseline for the development of mitigation strategies and alternative management options, however by supporting alternative soil management techniques (e.g. zero tillage or conservation tillage vs. conventional tillage) non-provisioning ecosystem services can be encouraged, such as soil C sequestration, that will ultimately benefit soil structure, soil water retention, and overall soil quality (Etchevers/ Prat/Balbontín/Bravo/ Martínez 2006).

When comparing crops with different tillage requirements for weed control, Osuna (1997) observed less soil loss in wheat which does not require weeding compared to corn and bean which require frequent weeding. For crops that incorporate alternative weeding technology such as disc plough a strategy to reduce soil erosion should consider maintaining permanent soil cover i.e. mulching.

Practices of integrated soil conservation are essential to maintain sustainable agriculture in arid and semi-arid regions. Carbon sequestration in form of *soil organic matter* (SOM) is advocated as a profitable win-win strategy for reclaiming degraded lands, particularly in semi-arid regions of the developing world, thereby mitigating global climate change, and improving the livelihoods of resource poor farmers (Tschakert/ Khouma/Séne 2004).

Also, the increasing number of abandoned crop fields in Northern Mexico could be back-converted to grasslands to reduce land degradation (Echavarría-Cháirez/Medina/Gutiérrez/ Serna. 2004) and promote multiple non-provisioning ecosystem services which will eventually positively feed back on the production systems in Northern Mexico.

Box 51.3: The GGAVATT (*Grupo Ganadero para la Validación y Transferencia de Tecnología*) model to implement sustainable farming technology in the aridlands of Northern Mexico. **Source:** Sánchez-Arroyo (2000).

In most small holder production systems in arid and semi-arid Northern Mexico, agriculture and livestock raising are tightly linked. For instance, in many locations basic crop (corn, beans) production for human consumption has been replaced by forage crops allowing the maintenance of large cattle herds which function as saving accounts for smallholder farmers. Under these circumstances peasants invest into increasing the size of cattle herds in spite of surpassing the carrying capacity of the land. Cattle are kept at very low energy-diet by feeding them with traditional forage crops (oat and barley) but also residues or complete crops of corn. During the regional shift from an agriculture-based to an animal-based production system in Northern Mexico most farmers failed to adopt an integrated management approach and to incorporate technology aimed at conservation farming, intercropping, etc. to achieve long-term sustainable productivity.

In 1990, the *National Research Institute of Agriculture, Forestry and Animal Production* (*Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias* (INIFAP)) implemented the model GGAVATT, to facilitate technology transfer to farmers via extension of specialists. The GGAVATT is a participatory approach where governmental institutions help producers to get organized in groups with similar production systems. The group defines production strategies which are revised by technical advisors, tested in demonstration plots and implemented if the technology turns out successful. The model was first introduced and tested in Southern Mexico with successful results in Veracruz and Tabasco. Now, the GGAVATT model is being evaluated in Northern Mexico, mostly in the states of Chihuahua and Durango with promising results. Although GGAVATT is a model to primarily improve animal production systems, the approach is integrated in that agriculture and natural resources are favourably impacted. In addition, the model has recently been adapted for agricultural systems although it has not been transferred yet to the semi-arid regions of Mexico.

Box 51.4: Dryland Development Paradigm. **Source**: Reynolds/Stafford-Smith/Lambin/ Turner II/Mortimore/Batterbury/Downing/Dowlatabadi/Fernández/Herrick/Huber-Sannwald/Jiang/Leemans/Lynam/Maestre/Ayarza/Walker (2007).

The *Dryland Development Paradigm* (DDP) is a framework that builds on earlier efforts to tackle desertification (definition: land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities, UNCCD 1994a). Land degradation is present in 10 to 20 per cent of the drylands affecting an estimated 250 million people. The DDP recognizes those biophysical and socio-economic factors that favour land degradation in regions inhabited by the environmentally, socially, and politically most vulnerable population; this phenomenon has been identified as the 'drylands syndrome' (i.e. high climatic variability, low soil fertility, sparse populations, remoteness, distant voice). The DDP consists of five principles that integrate both earlier experiences and more recent efforts to tackle the dryland syndrome.

Principle 1. Dryland *human-environmental* (H-E) systems are coupled, dynamic, and co-adapting, so that their structure, function, and interrelationships change over time. These systems have no single target equilibrium point.

Principle 2. The critical dynamics of dryland systems are determined by a limited suite of 'slow' variables, both biophysical and socio-economic, that are critical determinants of H-E system dynamics. Slow variables have lengthy turnover times and are thus useful for gaining insights into long-term H-E changes, resource collapses, potential surprises. Fast variables on the other hand, exhibit rapid turnover times that introduce noise, therefore are poor indicators of land degradation or the need for intervention.

Principle 3. Slow variables possess thresholds and define different states of H-E systems that, if crossed, cause the system to move into a new state or condition. Thresholds may change over time, and so may also the underlying controlling processes responsible for thresholds.

Principle 4. The involvement of multiple stakeholders, with highly differing objectives and perspectives illustrates the need to pay attention to the multilevel, nested, and networked nature of H-E systems across multiple spatial and temporal scales.

Principle 5. The key to maintaining functional co-adaptation of coupled H-E systems is an up-to-date body of 'hybrid' environmental knowledge that integrates local environmental knowledge including management and policy experience with science-based knowledge, all of which must be mediated through an effective institutional framework.

There are two principal goals that the DDP pursues; i) one is conceptual and related to providing a holistic synthesis of the diverse lessons learned from previous studies and experiences on desertification and development, and ii) another goal is practical in that the framework can be applied and tested in specific case studies, where each of the five principles can be thoroughly examined for identifying the underlying causes of land degradation, mitigating land degradation, and restoring degraded land.

51.4.3 Decision Support Tools

Currently farmers, producers, and technical support do not have available a comprehensive guidebook or decision support tools for long-term sustainable integrated management of highly vulnerable production systems. However, this is urgently needed considering the increasing number of unpredictable, extreme climatic and land degradation events. In reality, to stop land degradation, poverty and out migration, the complexity of causal interacting biophysical and socio-economic drivers that act at varying spatial and temporal scales, have to be considered simultaneously.

Hence, the *Drylands Development Paradigm*[3] (DDP), an integrated framework, was developed for the holistic analysis and development of highly vulnerable drylands of the world, where drought, poverty and desertification affect the livelihood of their peoples. This DDP addresses precisely this complexity of nonlinear relationships, interactions, and feedbacks between the socio-economic and biophysical dimension of the problem. Hence, it could serve as an excellent tool to first identify the multiple causal interrelationships leading to desertification and then by merging different knowledge systems (box 51.4) to analyse potential long-term solutions and alternatives to substantially improve the livelihoods of people in

3 See for details: Reynolds/Stafford Smith (2002) and Reynolds/Stafford-Smith/Lambin/Turner II/Mortimore/Batterbury/Downing/Dowlatabadi/Fernández/Herrick/Huber-Sannwald/Jiang/Leemans/Lynam/Maestre/Ayarza/Walker (2007).

Northern Mexico who depend on one of the world's most vulnerable farming systems.

51.5 Conclusions

Drylands in Mexico comprise almost half of the country's area. The natural and agricultural ecosystems characterizing these arid regions represent a large proportion of the biological richness of the country. In spite of natural limitations for the development of agriculture, both irrigated and rain-fed agriculture have developed at large scale due in part to the high human population it has to sustain. As an arid environment recurrent drought is one of the challenges farmers have to face with increasing frequency.

The future of agriculture in the drylands of Northern Mexico under current GEC scenarios is uncertain for irrigated and rain-fed agriculture. One principal cause of this uncertainty is linked to the unavoidable and yet highly unpredictable regional effects of climate change as they may be expressed by increasing temperatures, reduced precipitation, and higher frequency of torrential storms and other extreme events (long periods of drought). All of these factors are expected to provoke severe erosion and continuous nonlinear loss in soil fertility, and soil water recharge capacity, and ultimately in the collapse of agricultural systems which are the fundamental life-support systems in the drylands of Mexico.

Impoverishment of agricultural soils and degradation of natural resources trigger poverty, jeopardize food security and human health and consequently exacerbate the downward spiral of degradation of the human environment systems. However, the continuous advance in degradation of natural and social systems in the rural areas of Northern Mexico is not only related to direct effects of overexploitation and climate change. The complexity of these systems is rooted in the dynamics and multilevel interactions within and between biophysical and socio-economic drivers and processes that may be acting at various temporal and spatial scales, and thus be favouring strong yet unexpected feedbacks enhancing degradation at even larger scales.

International, national, regional, and local policies affect agricultural decisions in Northern Mexico. A change in the international livestock market has promoted cattle production even in the marginal ecosystems of arid Mexico. The NAFTA trade agreements have caused the abandonment of traditional crops and the promotion of fewer but more profitable crops (in this case produced with irrigation agriculture) and livestock production. Even well intended national government subsidy programmes (ex. PROCAMPO) for smallholder farmers have accelerated soil degradation. This is an example where environmentally friendly conservation practices derived from traditional agricultural knowledge that helped to protect soil surfaces and incorporate organic matter, have been substituted by the use of tractors, mechanized tillage, and use of chemical fertilizers. At the household level, the economic support from immigrants through remittance has also favoured the adoption of agropastoral production systems, further enhancing land degradation.

Given the high uncertainty with respect to the future outlook of agriculture in the drylands of Northern Mexico, the development of alternative adaptation strategies are paramount as baselines for long-term integrated and sustainable natural resource and ecosystem management plans. For the strategies to be successful und functional, their development has to consider all potentially involved stakeholders from local, community (ejido), municipal, state, national, and international institutions. Thus, strategies for adaptation may include diversification options, strong consideration of traditional or novel local environmental knowledge in addition to expert knowledge, guidelines on how to cope with global markets, how to open regional markets, evaluate the ecological and socio-economic impacts of subsidies, and powerful tools and indicators to identify and combat drivers leading to degradation. Converting desertification in sustainable dryland development in Northern Mexico is an enormous challenge. It has to be tackled as a mutual responsibility by all directly and indirectly involved, and these efforts will hopefully emerge in novel opportunities to secure the long-term livelihood of the people living in this part of the world.

52 Traditional Knowledge in Coping with Desertification

Pietro Laureano

52.1 Rural, Urban and Cultural Desertification

The misuse and the overexploitation of resources are the main causes of desertification which according to the United Nations Convention is defined as: "deterioration of the lands in the arid, semiarid and semi humid dry areas due to different factors including climate changes and human activity" (UNCCD 1994, article 1a, 1995, 1995a). The definition highlights two fundamental aspects of desertification: a) desertification is not the creation of a desert but of soil degradation; and b) human intervention is a fundamental factor besides the role of climate conditions.

Therefore desert and desertification are two very different things. The desert constitutes a precise environmental model that occurs in a specific climatic context with its own laws, biological activities, and an appropriate human use. Desertification produces an environment in full decay and totally devoid of ecological balance. The difference lies in a specific variable: time. The natural establishment of the desert has followed the very long geologic times enabling the species to follow the changes with a process of transformation and evolution, and therefore allowing the creation of environments that in spite of the harsh climate are rich in adaptation and in the biodiversity of the species.

On the contrary, the processes of desertification and the climate changes triggered by human intervention are rapid. The biological and physical structure of the planet has not had time to adapt to them, resulting in desolation and decay. A socio-economic and cultural degradation corresponds to the physical one. Poverty, emigration, and the loss of identity cause the disappearance of the cultural heritage related to the knowledge and management of places.

In order to understand the desertification phenomena the key factor is the soil (Rubio 2002). In geology what is commonly defined as soil is the superficial layer of the earth's crust where the organic and inorganic components mix together, swarmed with bacteria, worms, and other micro-organisms (Bennet 1939). The intense biological activity turns it into humus, a colloidal compound saturated by organic substances deriving from the decomposition of animal and vegetable waste. It is the soil that makes plant life possible, the presence of which is so common in temperate areas that it is taken for granted. Life is instead the complex result of the continuous interaction between chemical, physical, and above all biological factors and, besides protecting the soil, it ensures its constant regeneration. Vegetation, and in general all biological activity related to the availability of water and to climate conditions, determine the soil features and constitute the prior conditions for the existence of topsoil. Seeds can put down roots in the soil and derive sustenance from it. For their part, plants protect the humus and ensure that it is constantly regenerated, thanks to dry cast-off plants. Surfaces which are bare of vegetation are exposed to the harsh atmospheric agents, to the brutality of erosion which crushes the rocks and produces sand. All of this in turn reinforces the erosion factors and worsens the drought in that hard silicon particles are blown away by the wind, thereby becoming an abrasive force which can destroy even the hardest of rocks. Sand contributes to the disappearance of running surface water by settling in and filling up river beds, thus forcing the water to change its course and to become stagnant over vast surface areas where the water can evaporate or seep below ground.

This is how the constantly increasing degradation circuit of desertification is triggered. Soil, water, and vegetation are interconnected in such a close way that the absence of any of these factors can cause the absence of another factor with a multiplying effect. Interfering with each one of these components triggers the desertification process that may occur under all climate conditions, but will variously develop depending on the ecosystems' degree of vulnerability (Safriel 2007).

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Thus, it may be asserted that even the desert can undergo a process of desertification. Precisely in the environments with a more critical and difficult balance, characterized by a strong interaction between the processes, each intervention from the smallest to the most macroscopic one may produce lasting devastating effects. In the Sahara the traces left by vehicles during the Second World War are still evident on the characteristic microvegetation of the soil that sixty years later has still not recovered. In general the environment reacts to the roughness of the seasonal differences and to the cyclical climate alterations. Once the period of crisis has passed, the environment has the potential to return to its initial situation. Because of overexploitation due to human action, which intensifies its destructive activity against the species and the residual varieties just when the resources are becoming rarefied, any capability of recovery disappears even when the favourable conditions have been re-established.

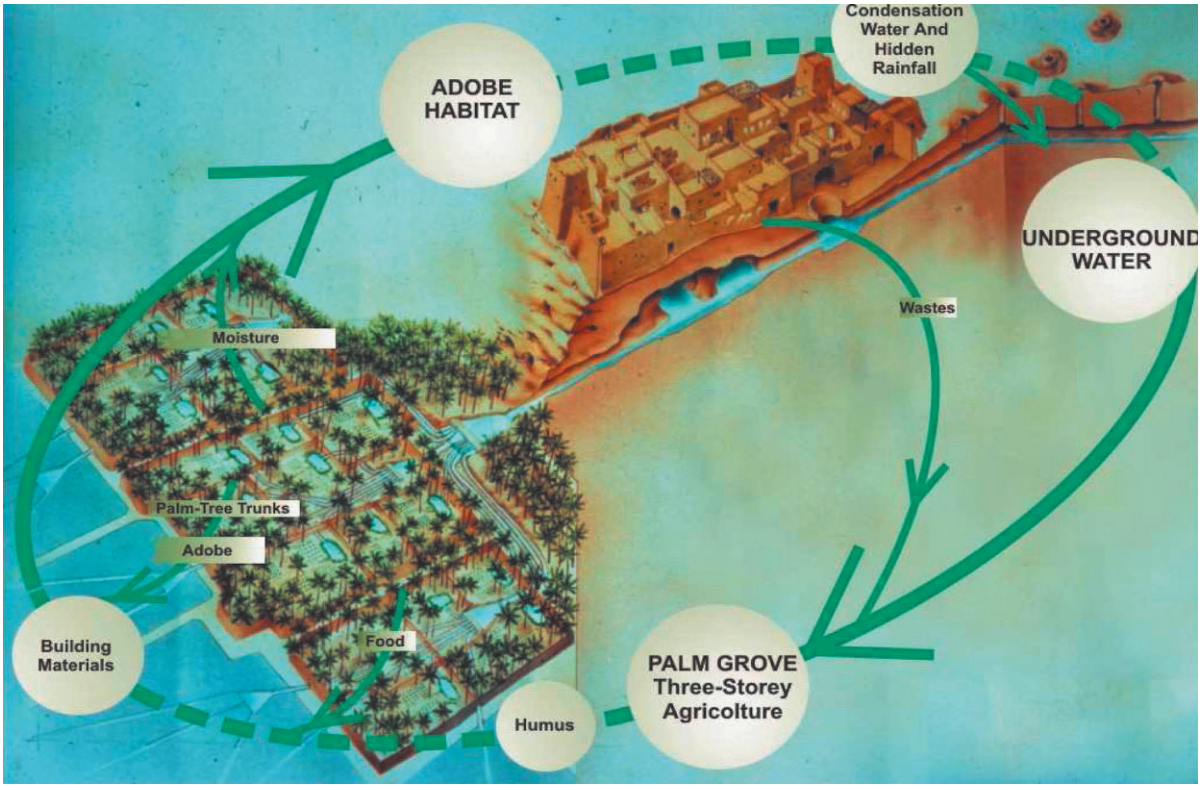
In the agricultural environment the process manifests itself through the following phenomena: water erosion with the creation of cracks and fractures, loss of fertility, alkalization and salinization of the soil; destruction of the humus; disappearance of the plant cover; formation of sand, mud and calcareous layers; exhaustion of the aquifers and drought; decay of the slopes and landslides. The chemical and physical degradation of the soil, induced by biological and physical mechanisms, reduce the vegetation and the original bio-productivity disenabling any kind of use. In the Sahel zone in the Sub-Saharan area, these processes start in a climatic area that receives more than 200 mm of rain per year, and also in a deeper strip in the south where the rains may reach 800 mm per year, i.e. areas that cannot be properly defined as desert. It is estimated that in these countries one million hectares of tropical forests are destroyed and 100,000 hectares of soil are irremediably covered every year with the advance of the sands produced by wind erosion. In Africa, altogether more than one billion hectares have been damaged by this phenomenon. Millions of people have been forced to emigrate elsewhere (Renaud/Bogardi 2006: 24). In Mali and Burkina Faso one sixth of the inhabitants have been forced to abandon their villages. In Senegal two fifths of the population of the upper valley of the homonymous river have been forced to emigrate. Mauritania is invaded by the sands. Here, the population established in the capital, Nouakchott, has increased from 9 to 41 per cent in twenty years, while the nomadic groups have fallen from 73 to 7 per cent (UNCCD 1995). Therefore, non-natural factors trigger an environmental mechanism of degradation which must therefore be ascribed to a single factor: human intervention. The process affects subtropical as well as temperate areas (Brandt/Thornes 1996; Mairota/Thornes/Geeson 1998).

While the traditional landscape with its small plots of land surrounded by dykes and ditches, tree rows or stone and mud walls, constitutes the optimal defensive device against weathering, the industrialization of agriculture based on heavy machinery needs vast homogeneous surfaces. The transformation into a monoculture also involves the slopes, the marginal and karstic areas where the natural harshness and vegetation provided shade, biological richness, and protection from erosion. Chemical addictives like pesticides and fertilizers transform the soil which becomes waterproof. Maintaining the aquifers becomes impossible and agriculture becomes increasingly dependent on artificial irrigation through the construction of big hydraulic basins.

The demographic growth, the abandoning of archaic techniques and social habits even though they were in harmony with the environmental potentials, as well as the imposition of new crops according to the requirements coming from the world market and the dissemination of the monoculture, are only some of the causes of degradation. Above all, the settlement of people gathered in small areas, according to the necessity of the modern economies, causes the increase in energy demand, which is satisfied with a massive devastation of the arboreal and forest heritage. The wounds inflicted on the woods trigger processes of continual and substantial collapse of the biological variety, quality, and productivity. Animals and plants are decreasing and the number of species is falling so much that they are no more able to provide a genetic answer to the altered circumstances, and are therefore destined to disappear.

Also the urban areas are affected by desertification. In fact cities contribute both directly and indirectly to the process. Directly, the massive urbanization may be considered in itself a form of desertification due to the spread of concrete over large natural surfaces; but also indirectly through the absorption from the soil of the natural resources and their destruction in the areas with a high demographic concentration. A close relationship between urbanization and desertification may be found both in the non-industrialized countries and in the most developed ones. In the first case, the process of decay is triggered and extends starting right from the areas undergoing a modern and accelerated urbanization

Figure 52.1: The traditional oasis ecosystem. **Source:** Pietro Laureano (2001: 372). The oasis is a self catalytic system in which the first supply of water condensation and moisture is increased by the installation of palm trees which produce shade, attract organisms, and form humus. The palm grove determines a humid microclimate fed by hidden precipitations, water condensation, and underground drainage through the underground passageways of the foggaras. The adobe habitat does not waste wood for firing bricks, it is kept cool by the underground water passageway and provides waste to fertilize the fields. The system runs the water resource in a cycle of use which is not only compatible with the renewable quantities available but also increases them.



which impoverishes the surrounding territory. In the advanced economies the spread of the process of desertification is directly linked to the crisis of the historic city centres and the traditional arrangement of the landscape. The building systems that have a strong natural component and low consumption of resources have been substituted with a model based on massive building operations that waste energy and pollute the environment.

Thus, a process of physical and social desertification begins with the exodus of the population from the ancient centres and the consequent disappearance of the local systems. The impoverishment of the human resources corresponds to the architectural decay and to the erosion of the mountain, hilltop, and slope systems. Emigration, the loss of identity and values, are associated with the socio-cultural aspects of desertification.

52.2 The Knowledge of the Desert

The aridity of the desert is interrupted in specific cases that create niches and microenvironments that contrast with the general situation. A slight depression collects dampness, a stone shade and seed flourishes. Thus, favourable dynamics develop: the plant generates its protection from sunbeams, concentrates water vapour, attracts insects, produces biological material and the soil which nourishes it. A biological system used by other organisms bringing their contributions is created, and a microcosm is generated as the result of their coexistence. By using these processes people from the Sahara have developed oases. Originally, a single palm tree is planted into a hollow in the ground and surrounded by dry branches, which protect it from sand. As the time goes by, large tilled fields develop along terraced canyons or on green archipelagos among the dunes, thanks to complex and

diversified techniques of water production, territory arrangement, and microclimate formation. An oasis can be defined as a "human settlement living in harsh geographic conditions and exploiting rare local resources, to trigger a growing amplification of positive interactions and fulfil a fertile and self-sustainable environmental niche, contrasting with its hostile surrounding" (Laureano 1995: 24–25).

Therefore not only the palm groves constitute the oasis but the entire landscape formed by the habitat and all the architectural and environmental components. The organization of the ecosystem was realized by the people of the desert through the use of traditional techniques that consist of:

> practical (instrumental) and normative knowledge concerning the ecological, socio-economic, and cultural environment. Traditional knowledge originates from people and is transmitted to people by recognizable and experienced actors. It is systemic (inter-sectorial and holistic), experimental (empirical and practical), handed down from generation to generation, and culturally enhanced. Such a kind of knowledge supports diversity and enhances and reproduces local resources (UNCCD 2005: 109).

The way they are applied differs totally from modern technologies (table 52.1).

Table 52.1: Characteristics of modern and traditional knowledge**. Source:** The author.

Modern Knowledge	Traditional Knowledge
Specific solution	Multifunctional
Immediate efficacy	Functional over a long period
Specialization	Holism
Dominant powers	Autonomy
Separation	Integration
External resources	Internal inputs
Confliction	Symbiosis
Monoculture	Connection and complexity
Uniformity	Diversity
Inflexibility	Flexibility
Costly maintenance	Self-regulation and intensity of work
Internationalization	Consideration of the context
Costliness	Saving
Attention to mere technical details and rationalism	Symbolism and full of significance
Dependence	Autopoiesis

These in fact seek immediate effectiveness through a deep specialization of knowledge managed by dominant structures capable of involving resources external to the environment. Traditional knowledge measures its functionality in the long run using a shared knowledge that was created and passed on from generation to generation through the social practices, and uses internal renewable inputs. Thanks to modern technology, for instance, very deep wells have been dug out to pump water up to the surface. The results have immediately been visible, but have dried up bordering resources, and sometimes by drawing water from fossil pockets, with time they completely exhaust them. On the contrary, traditional knowledge uses systems for harvesting meteoric water or exploits run-off areas by using the force of gravity or water catchment methods, like the drainage galleries, allowing the replenishment and increasing the durability of the resource.

Modern technological methods operate by separating and specializing, whereas traditional knowledge operates by connecting and integrating. According to the usual meaning of words such as *forest*, *agriculture* and *town*, they are completely distinct from each other and meet similarly different needs: *wood*, *food*, and *housing*. They correspond to specialized scientific systems: Silviculture, agriculture, and town planning. Local knowledge does not make an artificial distinction within the world of plants between the forest supplying commercial wood and tilled land supplying food (Shiva 1993a: 18). Forests, fields, and dwellings are unitary ecological systems. Forests and other marginal apparently non-productive areas, such as steppes and marshes, provide large quantities of food and water resources, and fodder and fertilizers for agriculture. They are also convenient to live in. The traditional town, in its turn, integrates with agriculture by replacing the forest in desert areas, by collecting fertilizers produced by the inhabitants' organic waste, and through its production of water collected on the roofs. This principle is so close to the way in which nature works, where everything that remains of a system is reused by other systems and the concept of waste and the possibility of resorting to external resources do not exist. It has allowed human beings to survive throughout history and is today proposed again by the modern theoreticians of sustainability (Pauli 1999).

By this logic, to the strong cohesion among society, culture and the economy, also aesthetic and ethical values are added. Traditional procedures operate a harmonious fusion between the landscape and the tra-

ditional aesthetic canons. A device for collecting or conveying water is never merely a technical structure but also has its own beauty. Fields in the oases are systems of production and relaxing places for contemplation as well. Little agricultural fields in desert areas are called *gardens,* just as in Southern Italy, eliminating the separation between the vegetable garden and the pleasure garden. Often, the works and procedures have a deep symbolic meaning and are a continuous game of suggestions and analogies between techniques, art, and nature. Systems of water distribution in the Sahara are reproduced in carpet drawings and in women's hairstyles. They are part of a complex symbolism linked to life and fertility. Spiritual principles make rules sacred and guarantee their perpetuation as in the case of the African sacred woods with their restricted access and of the whole set of taboo-objects, practices which guarantee the regeneration of forests, the saving of environmental resources and the land as reserves for nature and human communities.

Therefore, traditional techniques are an integral part of a strongly consolidated network of links and relations, supported by a global framework of signs and meanings. They work within a socially shared cultural structure: the historical system of science and local knowledge. It is therefore wrong to isolate each single technology, which is always highly contextualized, not only linked to an environmental situation, but to a precise historical moment and a complex social construction. The totality of traditional practices for managing resources constitutes the mediation through which a certain social form interacts with nature in realizing its technological dimension, an integral part of its cultural complexity, and view of the world. Thanks to this knowledge populations are able to gain greater resources from the environment compared to the ones naturally offered. Both factors, the cultural dimension and the environmental conditions, change continually in time and from place to place, thus creating and amplifying the cultural diversity.

52.3 Validity, Innovative Use, and Integration with Advanced Technology

The validity of traditional knowledge and the use of practices derived from it, variously named as endogenous knowledge, appropriate technologies, local knowledge, indigenous techniques, nature-based knowledge, sustainable knowledge, folk knowledge, and cultural knowledge (Gupta 1989; Warren/Rajasekaran 1993; Tahoun 2003), have been asserted for many years at various levels. In the scientific field, research on traditional knowledge has been implemented for more than twenty years with the specific aim of overcoming the top-down approach to the transfer of technologies as well as the problem of achieving a participatory relationship able to foster sustainability (Brokensha/Warren/Werner 1980). Many international bodies such as the *International Labour Organization* (ILO) (Bhalla 1977; ILO 1985), the *Organisation for Economic Co-operation and Development* (OECD) (Jequier/Blanc 1983), the *Food and Agriculture Organization* (FAO) (Saouma 1993), the *United Nations Educational, Scientific and Cultural Organization* (UNESCO 1994, 1994a, 1994b), the *United Nations Environment Programme* (UNEP) (Dowdeswell 1993) and the *World Bank* (Vernon 1989; Davis 1995) have declared its validity in research and documents. The interest of the United Nations' conventions is clearly highlighted in the report entitled *Building Linkage between Environmental Conventions and Initiatives* (UNCCD 1999).

Despite this full commitment and interest, the fields of application and the innovative dissemination of traditional knowledge are still below their real potential, the reasons may be summarized as follows:

- The lack of awareness that environmental damage, soil degradation, and desertification mostly result from the loss of traditional knowledge;
- The lack of information as to the validity and benefits of traditional knowledge from the experts responsible for national planning;
- The limited understanding of the role to be assigned to traditional techniques and their way of operating;
- The lack of communication and exchange of successful experiences;
- The unawareness of the innovative use of traditional knowledge.

It is necessary to clarify the modalities of use, the validity, effectiveness, the innovative force, and the possibility for integration of the traditional technologies with the modern ones.

52.3.1 Multifunctional Use and Cultural Integration

Traditional knowledge as an integrated learning organization constitutes a complex system with multifunctional characteristics and an integral part of the construction process of the collective identity as well

as of social cohesion. The rice cultivations in the Philippines and Indonesia which cover the mountain sides with an extensive system of terraces constitute a wonderful landscape created by the people. The beauty of these terraces does not result from aesthetic choices but depends on the harmonious application of the traditional engineering techniques in order to organize catchment areas, gather flowing waters and rainfalls, create terraces on which flows are channelled, and preserve the ground from washing away or eroding.

Traditional techniques relating to water management in the Ladakh region in India are another example. These enable fertile mountain oases to be created in otherwise arid lands. The techniques for using the water resources provided by seasonal snow melting are based on a system of rights and rules closely linked to the social structure, to the norms regulating the traditional division of work between sex and age groups, as well as to the ecological situation of each oasis village. The great social cohesion and spiritual motivation has enabled these people to apply modern techniques such as methods for using solar energy, in harmony with their ideals, and to reject others such as chemical fertilizers regarded as harmful for the soils (Wacker 1997).

52.3.2 Technological Effectiveness and Productiveness

Traditional technologies are not less competitive than modern ones. They achieve results differently and consider a series of contextual factors omitted by modern techniques. The procedure is sometimes less immediate and needs more work. However, this is not a negative feature in many countries that face the problem of unemployment. Indeed, the application of a technique determines effects both before and after the use of the necessary resources and has more general consequences on the entire economic, social, and environmental model. These interactions are not taken into account in the application of a modern technique based on specific and immediate yield criteria. On the contrary, traditional techniques are selected and accepted through a process of environmental, historical and social considerations, appraised according to their validity in the long term, their contextual benefits, and their overall sustainability.

Failure to evaluate these aspects has led to unsuccessful projects for development cooperation which have not taken into account the necessity of proposing technologies that could be managed through the local knowledge system and the social categories, mainly women. Within this framework, the case of the irrigated perimeter of Ras Djebel in the northeastern part of Tunisia, 30 km from Biserta, is a significant example. Here a traditional kind of cultivation is applied, following the oasis model and the Maghrebian and Andalusian models of arboriculture and vegetable gardens. Fields are divided into small plots according to complicated procedures of inheritance and marriages that continuously divide and re-compose the properties. In this way, 2,000 hectares of land can be divided into 4,500 plots. Traditional irrigation is carried out through harvesting subterranean waters by means of family-managed wells or irrigation, thanks to superficial channels running all over the agricultural area. A project aiming at modernizing the system created a 15,000-m^3 tank, fed by a lake located on a hill. The agricultural perimeter was then subdivided into larger parts, each supplied by a modern water drawing system that irrigates large areas by sprinkling. Such a perimeter involved the removal of small property boundaries. The peasants distinctly rejected the new division of the plots and the new methods of irrigation on the basis of social, productive, and symbolical reasons which can be summarized as follows:

- The use of family wells enables each owner to manage his own water independently. Such water was previously free whereas there is a charge for the water provided by the project.
- The division of small land plots responds to ancestral structures which extend the domestic space into the agricultural one. In this way, women can work in the fields and at the same time feel at home.
- Irrigation through sprinkling is considered negative since it 'favours the burning of the leaves and the appearance of new diseases'.
- Groundwater is commonly considered as 'alive since it originates from the earth and feeds the plants', in opposition to the water of the project which is held as 'a dead water coming from a stagnant basin and thus harmful to agriculture'.

Despite these oppositions, the project was carried out with disastrous consequences. Indeed, after the project was implemented, a 20-meter lowering of the water table as well as a 3 g/1 increase of salinity were verified (Bouayard-Agha 1997: 22–23).

52.3.3 Validity and Application

Traditional techniques are generally considered valid only for the less developed economies. This stance is contradicted by the fact that situations in which traditional technologies persist, and their role in the economy and society is consolidated and stabilized, can be proved specifically in the more advanced countries. The values of tradition, manufacturing practices, and the craftsmen's skills are the basis on which the great added value of economically important productions for many advanced countries is founded. In particular the typical food production (oil, cheese, wine, etc.) safeguards both the aesthetic and environmental quality of the landscape, since the old production systems are available thanks to the maintenance of traditional soil management techniques, as for instance is the case of the regions of Valais in Switzerland, the Loire Valley in France, and Tuscany in Italy. Thus, it is wrong to consider traditional knowledge as marginal compared to the great economic and technological processes under way. Even from a quantitative point of view, their use still supports most of humankind which is distributed throughout the less industrialized countries. Paradoxically, in these places where traditional techniques are still used in a massive way, these are considered by the modernist thought as a phenomenon of backwardness, whereas, in advanced countries, they create an image and provide added value. Tradition is then a fundamental component of successful modernity and creative industry. Traditional knowledge constitutes a dynamic system capable of incorporating innovation valued through local wisdom: today's appropriate innovation is tomorrow's tradition.

52.3.4 Paleo-technology and High Technology

Traditional technologies do not have less technological consistency than the modern ones. Sometimes they are the most refined technologies, other times they are very simple but still more appropriate, that is ecologically compatible and locally manageable. Furthermore, traditional knowledge is re-proposed through every possible innovative use that is in conjunction with modern technologies, which can operate within the same logic. In the moist areas to the west of Calcutta, the traditional fishing and agricultural practices cover approx. 10,000 ha of territory. Here the world's largest network of urban sewage water re-use is in use. Thousands of peasants convey millions of litres of sewage water from Calcutta towards their land. They consider these waters as an advantageous nutrient supply and not as something harmful they should get rid of. At the same time, they provide an extraordinary contribution to the waste water drainage system of Calcutta completely free of charge.

In Liguria where in the Cinque Terre region there is one of the largest systems of *terraced slopes* in the Mediterranean, this traditional practice that protects the soils, and catches and channels the waters, has been perpetuated through innovative agricultural mechanization. Agricultural work on terraces is hard due to tiring transport systems which are operational only on foot. Traditionally there were techniques of transport by means of sledges drawn up the hill by ropes. Already at the beginning of the century these were substituted with mechanical funicular systems on rails. The same technique is re-proposed today with appropriate *monorail* systems that enable the ascent of the slope without disturbing the landscape or the ecosystem.

In Burkina Faso *zai* is a particular traditional technique able to regenerate highly degraded soils. The soil is dug with holes that fill up with water in the humid season and are used as dump sites for rubbish and manure in the dry season. This practice attracts termites that digest rubbish, thus its absorption by the plants' roots. Furthermore, the tunnels dug by the termites increase the soil's porosity. Seeds are then sown in the holes, giving very high crop yields. Innovative practices which promote original forms of symbiosis between humankind and animals or micro-organisms are today re-proposed to rehabilitate degraded soils or soils made suitable for human living in extreme areas.

52.4 Knowledge from the Past for a Sustainable Future

The enormous hydraulic resources deriving from the river basins of the Nile, Mesopotamia, the Indus, and river systems of China, determined the formation of the great empires that have been defined by Karl August Wittfogel (1957) as *hydraulic societies*. The socio-economic model is the one of an increasingly expanding empire supported by a massive population growth triggered by the agricultural potential and maintained by an imperial conquest, the income coming from the exploitation of a vast quantity of workers and by spending resources on monuments or wars. The long term results of this are the hypertrophy of the population and of the territory, authoritarianism, state cen-

tralization, and the increasing destruction of the environment leading to an ecological catastrophe.

Within the great empires, in marginal areas with scarce resources, or in the fringes of the empires in protected areas, oases and cities were created in inaccessible places and transformed into self-supporting centres. These *autopoietic societies* use the gathered experience of traditional knowledge and become centres of innovation for the amplification and proper use of local resources. This is the way the desert communities were organized and in general those societies often based on hydraulic systems, those which developed in harsh natural conditions (Laureano 2001).

The geographical continuity of the desert areas, extending from China to the Mediterranean and Africa through the three most ancient continents, favours the elaboration of appropriate solutions through the exchange and increase of knowledge.

Complex ecosystems are created based on the use of the local resources, but which assume a larger dimensional scale by exploiting their position to control the trade routes and convey huge economic incomes. This is how the fantastic hydraulic and soil management systems were realized in Petra (Jordan), and in Marib (Yemen), ancient capitals of the Arabic desert now only archaeological remains, and in the Saharan oasis-towns such as Ghardaia that are still intact and vital. The ever increasing effort to organize space depended on the economic benefits ensured by the role undertaken within an international exchange economy: the caravan gold routes in the Sahara, the incense route in Arabia, the silk route in Palestine and in the East.

The community's acceptance of the necessary tasks for preserving the geographic positions depends on delicate environmental, economic, and cultural equilibria. When even only one of the aspects of the holistic conception of the world or a ring in the chain of the resource management is missing, the entire system is destined to collapse. This is the cause for the collapse of various ancient civilizations, a current issue today because of the menace represented for contemporary society by climate change (Mays 2007; Diamond 2007a)

However, the knowledge is not completely lost. It survives among the populations living in the apparently undeveloped areas or the interstices of the advanced society and the places protected for their cultural value. Knowledge is a great potential because the local know-how, which improves under the harshest environmental conditions, and the existence of intact ancient structures are a valuable heritage on which new models of sustainability have to be based. The historical settlements, the traditional landscapes, and the local knowledge provide solutions to be safeguarded and which can be re-proposed, adapted, and renewed by means of the modern technology. It is not a question of reapplying or transforming the single procedures but rather of understanding the logic of those models which have allowed societies to positively advance their status and to make technical, artistic, and architectural implementations, fundamental in the history of the civilizations. Knowledge about the most distant past can lead to the founding of new technological paradigms: the capability of enhancing the inside resources and managing them at a local level; the versatility and the interpenetration of technical, ethical, and aesthetic values; the production not per se but for the good of the community and based on the principle according to which each activity has to start up another one without waste; and energy use based on cycles in constant renewal.

53 Prodromes of Desertification in the Oasis of Tafilalet (Morocco) and Specific Local Solutions

Monique Mainguet, Frédéric Dumay, Lahcen Kabiri and Boualem Rémini

53.1 Introduction

Although a few natural oases exist – for example the tufts of Doum palm trees in the Egyptian desert – the majority of the oases are human creations where humankind adapted to climatic fluctuations and preserved balance between its activities and the environment, until the 1950's. Then climatic fluctuations occurred, which were noted through systematic weather measurements and recurring droughts in the North and the South of the Sahara.

Trying to make an inventory of the specific features of desertification in oases, the authors concluded that it was a hopeless endeavour because the causes, the mechanisms, and the manifestations of desertification seem not to be specific to these areas. Thus, desertification has become a planetary phenomenon in dry ecosystems.

Despite the abundance of more than 150 definitions and confusion between desertification and desertion, the term 'desertification' is used in this chapter with the meaning adopted by the United Nations: "The degradation of the grounds in the arid, semiarid regions and subhumid dry in consequence of various factors, among which climatic variations and human activities." But this definition is insufficient if it is not specified by two other assertions: the adaptability of humankind and the irreversibility of environmental degradation (Mainguet 2003).

Mechanisms of evolution that required several millennia to reach observable thresholds of transition have accelerated in the middle of the 20th century, resulting in a change of scale of time. Thus, within one or two generations a third generation of dunes appeared in the North and South of the Sahara that have been exceeding the capacities of the people in the oases to adapt. The acceleration of these processes requires to replace the concept of desertification in a time scale, by stressing that since the 1950's – thus within half a century – a shift in the speed of evolution processes has occurred. Now desertification refers to inadaptability of human activities with regard to these new geomorphologic rhythms of evolution given these new environmental data.

Starting from a low degree of degradation at the beginning of the 70's, the irreversibility has now become so severe that it is not any more economically profitable to even try rehabilitation as the threshold of desertification has been crossed. When degradation transgresses the stage of a deterioration of the vegetation cover and results in the impoverishment of the soil due to water and/or wind erosion, and chemical impoverishment, the stage of irreversibility has been reached. The soils in the oases are sandy and thus vulnerable. However, after two years of good rains, new feather grasses grew at the top of palm trees that appeared to be dead, thus the degree of irreversibility had not yet been reached, as the new palms indicate.

In this chapter, the authors analyse in a case study the fight against the exodus from the Oasis of Tafilalet in Morocco. After an inventory of environmental degradation which can reach the threshold of irreversible desertification (53.2), the second part will discuss the adopted measures to combat desertification that were developed by the people in these oases (53.3), and it will address those questions which the people in the oases have tried to cure. The conclusions address the difficulties which have to be overcome (53.4).

Our purpose is to bring in these analyses descriptive and objective case studies and to avoid the theoretical and political context and to contribute, with as few interpretations as possible to enlighten, the local perception of the 'prodromes' of desertification (first signs) and the first popular efforts to combat them. We also try to base our first considerations more on up-to-date observations and interviews than on scientific literature.[1]

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Figure 53.1: Map of Morocco with location of the Study Area. **Source:** <http://www.voyages-tourisme.com/maroc/grande-carte-maroc.jpg>.

53.2 The Oases of Tafilalet and Their Many Difficulties

The living conditions have been severely degraded in the oases of Tafilalet within one generation. Some 20 years ago, the situation of the oases of Morocco (figure 53.1) was described as being in 'crisis'; it has now reached the situation of 'dangerous struggle for survival'. An inventory of the many environmental and social difficulties in the oases of Tafilalet (figure 53.2) was made during two missions of three weeks each by relying heavily on the villagers and the village associations.

According to the numerous classifications of desertification and to avoid scattering, we proposed to classify the events producing desertification in three rubrics: 1. natural events (changes in climate, mainly drought); 2. anthropogenic deterioration – overuse, overgrazing and 3. psychological mechanisms.

This chapter is partly a follow-up of the conference organized by the University of Errachidia (Morocco) in September 2006 on "*Avenir des oasis face à la désertification*" [The oases facing desertification]. The combination of these environmental observations and the human data was carried out within the framework of the NATO Programme on: "Use of indicators for desertification in oasian settlements." The first part discusses the three problems of the oases of Tafilalet: a) sand encroachment (53.2.1), b) the severe water deficit (53.2.2), and c) the difficulties of social change (53.2.3).

1 See for selected previous scientific publications of the authors: Mainguet (1991, 1995, 2003); Mainguet/Chemin (1979); Mainguet/Dumay/Guang/Georges (2003); Mainguet/Dumay/Kabiri/Remini (2007).

Figure 53.2: Map of the Location of the Oases of Tafilalet in the Moroccan Sahara. **Source**: Michelin 959 Morocco 1: 1 000 000. Reproduced with permission of the copyright holder.

53.2.1 Sand Encroachment: A Recent New Danger

Statements that were collected in the oases document a recent threat which is not yet perceived as a major danger. Although sand encroachment is omnipresent, it only worries the people in the oases during the genesis of sand dunes when sand is present in their houses and dust causes eye problems.

Figure 53.3: The road from Errachidia to Erfoud crosses the 'corridor of Yerdi', a strip of intense sand transit where the road is regularly covered by sand. **Source**: © Photo taken by the authors, F. Dumay and M. Mainguet.

When the authors drove on the road from Errachidia to Goulmima (figure 53.2) they observed a powdering of sand only 17 kms away from the town of Errachidia on the slopes of small hills, as well as many sand deposits accumulated in the lines of concentrated rill wash. *Sif* (linear dunes), fastened on a slope of hill, worked by the Sahéli wind, appeared at the end of 2004. The *nebkas*[2], another tangible proof of wind transport, directed SW (230°), confirm the effectiveness of the *Sahéli* wind and the extent of the volume of the blowing sand which advances forward on the *hamadas* (limestone plateau), vast surfaces of deflation. These *hamadas* are difficult to take in account in the strategies to combat desertification because they are the grazing areas for the pastoralists who don't wish to see obstacles to their displacements.

In Tafilalet, strips of mobile sand exist, like the so-called '*corridor of Yerdi*' (figure 53.2), where the dunes threaten a portion of the road between Errachidia and Erfoud (figure 53.3).

In 1981, the Moroccan National Forestry Commission launched a project of mechanical fixation of dunes 'by checkerboarding' (squares of palisades) that was accompanied by a biological programme of plantation by tamarix trees. Two phases of reactivation occurred in 1989 and in 1993: sand transported by the wind, from south-west to north-east, filled the checkerboards and during the sandstorm of March 2006 sand covered the roadway within one day. In this sector, our research team identified three wind directions: from NE to SW (*Chergui*), from SW to NE (*Sahéli*) which is the dominant direction, and from NW to SE. These three wind directions build *ghourds* (pyramidal or star dunes) and crescent dunes which have a dynamic of reverse dunes. In the plain of Yerdi (N 31°32' W 04°11'), at the foot of the hamada of Cenomano-Turonian limestone, the pebbles coming from the decomposition of the basic conglomerate allotted to Quaternary have a surface status with aeolian polish

2 Arrow of sand upwind of small obstacles (vegetation or stone).

Figure 53.4: The palisades of asbestos cement set up in 1981 were buried and broken in 2006 (N31°32′ 80 O4°10′ 9).
Source: © Photo taken by the authors, F. Dumay and M. Mainguet.

and vermiculations which is an evidence of the intensity of the past aeolian sand transport of this sector. Asbestos cement palisades of NW-SE direction (figure 53.4), set up in 1981, are presently completely buried with the arrival of abundant sand from SW-NE (*Sahéli*)

On the Rissani-Alnif road, at the foot of *Djebel* Amelane (N 31°16' W 04°20'), mobile barchanic dihedron, with a SW-NE 220 axis and height less than 2 metres, reach the road. The small size of these sand dunes explains their mobility. A set of palisades along the SW-NE 240 direction was built parallel to the road but without a biological fixation. This device is already observed on several locations to protect the roads without paying attention to the principal direction of the wind; in this way it is not very effective to prevent sand encroachment. Due to the absence of biological fixation and the lack of maintenance of the palisades, a great part collapsed and the sand accumulated near the road and thus became an increased threat (figure 53.5). This supports the observation that the majority of the protected sites that were built in 1980 must be rehabilitated.

The sand encroachment increased since a study undertaken for FAO in 1979 (Mainguet/ Chemin 1979). The peasants confirm our observations, in particular in Chtam (N 31°33' W 04°57'), where sand encroachment started 15 years ago and now threatens traditional palm tree plantations, forcing the farmers to move their cultures. The new dunes that are 3.5 metres high are barchans and the responsible wind is *Sahéli* (SW-NE 212°). The aeolian sand originates from the Wadi Sat which, until the 1970's, ran upwind of the cultivable land of Chtam. Today, this wadi is dry and has become a source of sand. The increase in the volumes of sand exported and/or removed by the wind is also obvious in Bouia-Kraïr where, in 2006, the barchanic edifices studied by Kabiri, Boudad, Krimou, Khardi and Elmrani (2003) have disappeared. The palm tree plantations, a major obstacle for the aeolian transport of the sand, suffered from the increased arrival of sandy particles and became the privileged locations for dune genesis. Ait Ben Omar (N

Figure 53.5: The checkerboard of protection of the Rissani-Alnif road is completely filled and in a state of advanced decay. This device, not followed by biological fixation, took part in the accumulation of considerable sandy volumes which are now an immediate danger for the road. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

31°32' W 05°02') oriented NW-SE has walls NW-SE limiting the plot of land at a 90 degree angle to Sahéli. These walls are covered by aeolian sand which already penetrates the most exposed plots of land (figure 53.6).

In the south-west of Ait Ben Omar (figure 53.2), a band of checkerboards of several hundred metres long, directed NW-SE 330° at a 90 degree angle to the *Sahéli* was carried out in feather grasses of palm trees. It comprises three squares leeward of which six to nine lines of tamarix were planted in staggered rows in small holes. Built in 2002, the first square upstream-wind is already filled with sand, proof that this protective strip plays its part and that the volume of sand in transit is high. The plantations leeward of the checkerboards suffered from a lack of watering and the 'dead' seedlings were not replaced, proof of the indifference of the oasians which is regrettable because this system offers an interesting strategy only in the medium term, by biological fixing.

In Boudnib (N 31°56' W 03°37'), the school has been threatened by sand encroachment. A worker clears daily the accumulated sand in front of the main entrance. A perforated palisade of asbestos cement of NE-SW 220°direction, parallel with *Sahéli* wind prevailing in this sector was set up 5 years ago by the ORMVAT "*Office Régional de Mise en Valeur Agricole du Tafilalet*". In bad condition because of lack of maintenance, it has been completely submerged by the accumulated sand on both sides; it acts like a railroad and thus fails to block the sand. A second phase was completed in 2005 by the National Forestry Commission: an impressive length of checkerboards built but, still with a wrong W-E orientation and not at a 90 degree angle to the Sahéli wind. After three months the filling of the system worked badly and sandstrips appeared.

According to the inhabitants of the oases the major problems are the water shortage while the wind risks, probably more pernicious, are taken into

Figure 53.6: Aït Ben Omar. Wall of protection against sand encroachment. The wall plays an effective role in stopping the sand. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

account only when the intervention becomes necessary by sand encroachment of agricultural areas, roads, villages or urban areas. This combat is local and has not been integrated into a regional approach: the source areas are not defined, wind dynamics is not understood. Success and durability require that the mechanical combat is systematically linked to a biological action.

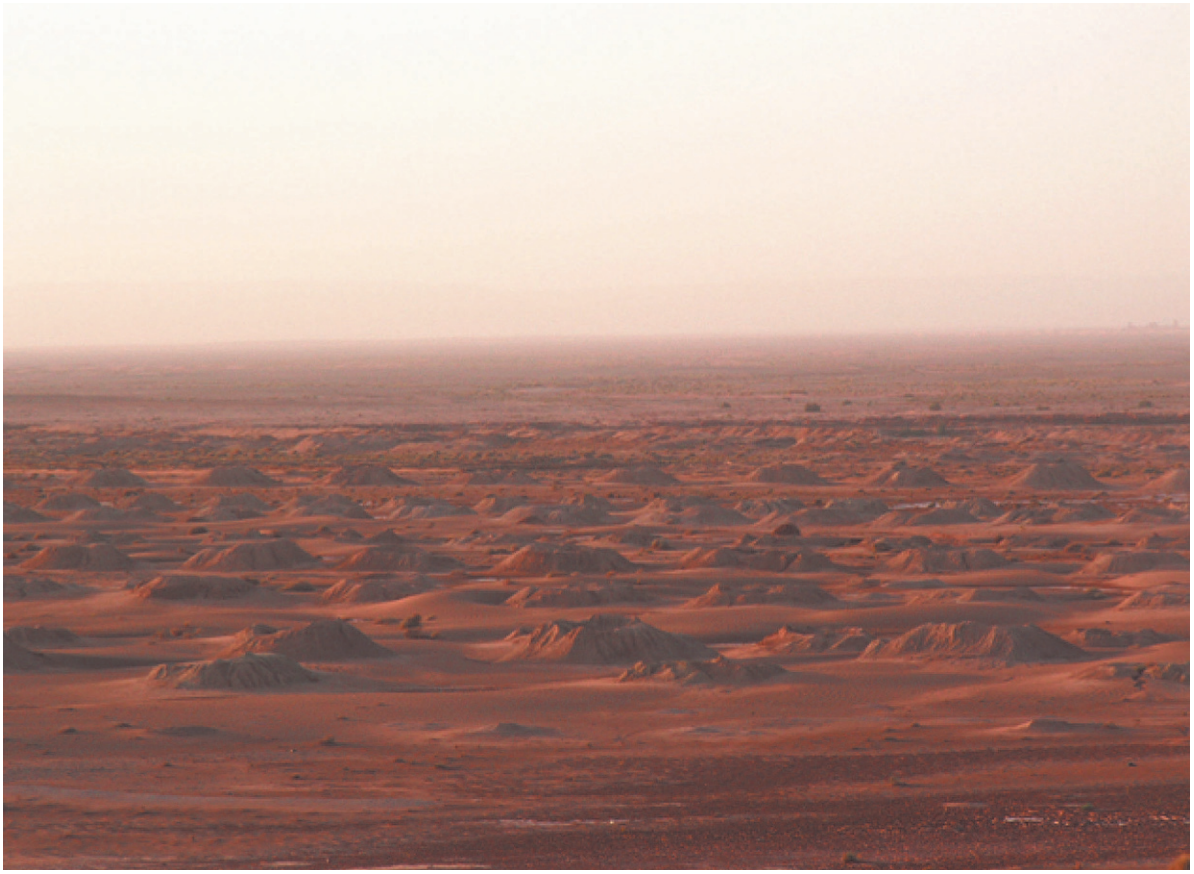
53.2.2 Difficulties Due to the Water Deficit

In the oasis region of Tafilalet, as in the whole semi-arid zone of the Moroccan Sahara, the problems involving water are twofold: water surplus during devastating flash floods, and shortage during the summer heat (June, July, August) and the recurring phases of drought.

The oases between Ouarzazate and Errachidia (figure 53.1) are located in the plains of the wadis, whose floods are violent. On 12 September 2006, intensive precipitations of 50 mm within 30 minutes generated a flood with a speed of 3 m/s and a flow of 500 m^3/s. During these flash floods, the water carries fine and abundant, red material, which increases its competency; a strong 'smell of clay' fills the atmosphere. The flood wave takes on average two days to run out in the wadis of the plain and severe inundation and damages results. The drying out after the floods is fast: in Tinejdad (figure 53.2) on 13 September 2006, after the torrential rains of the day before, water had invaded the road; but on 16 September 2006 the situation became normal again.

The capacity of transport of the wadis is strong: a block of 80 cms was abandoned onto the roadway at the exit of Goulmima (figure 53.2). In May 2005, after large storms, several hotels were destroyed in Merzouga (figure 53.2). In Wadi Rhéris, the width of the floodplain and the abundance of well rounded pebbles in the mean-water channel document the violence of the flood which involves severe undermining of banks, on which are built the ksours surrounded by their cultivated soils. The phases of recurring droughts affect also the oases of Tafilalet; however precipitations of these last years are better: in 2005, it

Figure 53.7: The *khettaras* of Jorf (N31°27′42 O4°25′19). This sector rich in *khettaras* is an area of intense Aeolian sand drift. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.



even snowed in Erfoud, which had not occurred since 1965. Since 2005, Tafilalet experienced two annual floods, whereas the previous decades recorded a flood every four to five years.

The recurring droughts of the two last decades of the 20th century contributed to the increase of pumping stations, involving a lowering of the quaternary underground water level and a diminution of the flow of the resurgences collected for irrigation. Droughts and excessive pumping are responsible for the drying up of many *khettaras*[3], as in the oases of Ferkla, 80 kms south-west of Errachidia.

The *khettaras* which supply palm plantations in the South of Morocco suffer from the decline in underground water and sand encroachment (figure 53.7).

In Jorf (51 kms west of Erfoud), 4,000 ha are still irrigated by *khettaras*. After the recurring droughts of 1980 to 2000, they dried up and sand covered a total of 68 khettaras, and only 16 remained active. The palm tree plantations of Jorf, located upstream of the catchment area, suffers from lack of water. Only 50 per cent of the palm plantation benefits from irrigation. As in many villages, an association manages flood water and the collective clearing out of the underground channels. To combat sand encroachment of the *khettaras* locally, a mechanical fixation was achieved on four hectares. On the other hand, the inhabitants of the ksar of Ouled Ali (figure 53.2) informed us that the tamarix, planted to create a green barrier, caused a drop in the flow of the *khettaras*, which shows that no simple solution exists.

The irrigation water comes also from small permanent dams, like that of Tifounassine supplied with resurgence in Turonian limestone. From the dam, water is conveyed by an underground channel towards the palm tree plantations located downstream. The major problem of these dams is the fall in storage capacity due to silting.

After the flood of 1965 which caused large damage for palm tree plantations of Wadi Ziz, the Moroccan state set up the Hassan Haddakhil's Dam. According

3 Underground canal surmounted by open wells

Figure 53.8: The palm tree plantation of Aoufouss on three levels: palm trees, fruit trees, cereals and gardens. **Source:** © **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

to the inhabitants of Jdid Mdaghra (figure 53.2), located downstream of Ziz, the dam played a positive part regarding water erosion, putting an end to undermining banks which existed on the affluents of Wadi Ziz and taking part in the refill of the underground water level. Two days after the flood the level goes up in the wells. The irrigation water comes from the dam by a principal irrigation channel from where it is forwarded to the fields. The release of water from the Hassan Haddakhil Dam (on the Wadi Ziz upstream of Tafilalet) should be undertaken in dialogue with the farmers. It is the *Jemaa* (the council of wise men) that manages the distribution of water. Downstream, the palm tree plantation of Aoufouss is located (figure 53.8), one of the large palm tree plantations of Morocco, made up to 100 per cent of palm trees, especially *Mejhoul* (a type of dates of high quality), whose harvest of one palm tree can support the life of a family for a year; dense, this palm tree plantation is composed of three levels of vegetation, irrigated by the dam water, the oasis is luxuriant. Only a central strip of the bed is unoccupied to manage the violence of the flow during the floods. The habitat is located at the base of the slopes in the vicinity of surfaces managed for drying harvest. There is no water problem; the limiting factor here is the availability of arable land. The surfaces of the lower part of the slopes of the wadi are not divided yet; new extensions are envisaged there... whereas it would be necessary to manage the water of the rill wash on the slopes.

Downstream, in the oasis of Erfoud, the irrigation by release of water from the Hassan Addakhil Dam (1 to 2 per year) remains insufficient: it is achieved field by field, the palm tree plantation cannot be irrigated in its entirety and the upstream has priority, times of irrigation are too short, and there is not enough release of water. The release take place in July and high heat is responsible for intense evaporation. The peasants wish for them in April and September. The irrigation is also achieved directly with flood water; it is, however, not organized, the upstream has priority and can keep whole or part of the water, contrary to the release from the dam which has a strongly organized distribution. The upstream part of the palm tree plan-

Figure 53.9: Palm tree plantation of Ouled Ghanen Essaouia with irrigation. The palm plantations are prosperous. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

Figure 53.10: Palm tree plantation of Ouled Ghanen Essaouia without irrigation. The palm trees are in bad condition but not dead. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

tation of Ouled Ghanen Essaouia (figure 53.2) is irrigated by flood water; the downstream part, which does not benefit from flood water, is dying (figures 53.9 and 53.10.

In Rissani, cultivation can be achieved only when the flood water reaches the palm tree plantation, approximately every five years. In this oasis, the poor drainage of the palm tree plantation led to intense salinization. Near Goulmima, four ksours also practise this possible opportunist agriculture every three or four years. In Goulmima, underground water level in the infra-Cenomanian rocks has a salinity from 0.7 to 2 mg/l and 14 mg/l at Erfoud, which makes it unsuitable for irrigation of palm trees. The palm tree plantation of Tinejdad suffers from the insufficiency and bad quality of the water.

The vice-president of the association Ouled M' Bareck for the Rural Development of Erfoud estimates that the lack of water is the main difficulty of the oasis, before both sand accumulation and salinity; the drinking water comes from Errachidia; the underground water, formerly 6 metres deep, is now 20 metres deep in the paleozoic schists and water is strongly mineralized (salted water). There are other underground water levels to 70 and 500 m of depth: the disadvantage is the cost of drilling.

The lack of water is mainly a result of the drying up of *khettaras*, which where a collective access to water and irrigation is remplaced nowdays by motor pumps, individual, irrational and devastating management of the resource. The dispersion (wide distribution) of the fields increases the difficulties of irrigation and leads to the multiplication of motor pumps. The president of the *Bougafr* association for the cultural, social development and the environment of Alnif told the authors that the use of the water is the problem rather than the lack of water and the dryness. He referred to the overexploitation of groundwater and the abusive use of motor pumps. Water was formerly 6–7 metres deep and *Oughrour*, wells with animal traction, were used; the water is now deeper and the roots of the palm trees do not manage any more to reach it: in some fields, it irrigates only 2 or 3 palm trees, from where arises the complaints of oasians who would wish to see a distribution according to the effective needs. The muddy deposits of floods cause a serious rising in fields compared to the irrigation channels, where water runs out by gravity. However, there is unanimity for saying that flood water is the best for irrigation.

53.2.3 Social Transformations

Facing the increasing environmental difficulties, the society in the oases has opposed the ancestral practices which became insufficient and must seek for new solutions for which it very often lacks the power and the financial means. The improvement of rainfall in the last years did not reactivate the traditional organization of the oasis. In spite of these difficulties, all local markets abound in fruits and vegetables produced in the palm tree plantations. In this oasian system, agriculture accounts for 90 per cent of the activity and employs 60 per cent of the population. The demographic pressure is alarming, more especially as the population in the oases is young: 40 per cent are between 0–14 years and in this region the fertility rate was 4.3 per year compared with an average of 3.2 in Morocco (El Meskine 2006).

The strict state control during the past three decades has weakened the traditional *Djemaa* (the council of wise men), the only authority that is respected by the population in the oases. The *khettaras*, which remain an effective means for water harvesting for irrigation, are not yet definitively abandoned but for their maintenance and their use the *Djemaa* must restore its authority and consolidate it with the rational use of modern means of water access.

The irrigation canal of the Djam Djama (figure 53.11) that is 10 kms long and 1.5 metres deep and was built in 2000 costing more than 3 billions dirhams (265.000.000 €), has never functioned, it rapidly silted up to half of its height (80 cm) within six years. It was built to recover 300–400 ha of degraded soils and to irrigate several thousands of palm trees in the palm tree plantation of *Moungara*. These particles must be removed but this cannot be done without the support of the *Djemma*. It will be equipped with bypass valves to convey water to the fields by respecting the right distribution from upstream to downstream. On the edges of this channel, the palm trees are in good shape. Recently a test was made to release water (during a flood) and to try to clean the canal with its hydraulic force. This clearing will required about thirty people; its cost and maintenance will be supported by a tax on the seeds of 1 dirham for each kg of seeds. The protection of this channel against sand encroachment is a major problem, but the upwind area is a grazing land and the nomads are opposed to a grazing interdiction, which makes the installation of biological protection difficult. In 1999, after localized rain in this area, the nomads came with their herds and within two months the pastures were totally exhausted. The state aid of some barley bags was consumed by the nomads. The efforts to combat sand encroachment become more difficult because the nomadic grazing areas are often located on the sur-

Figure 53.11: Djam Djama irrigation canal that is 1.5 metres deep and two metres wide. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

faces which should be treated, and this has made the situation more difficult.

To these problems of authority other questions of land rights are added. Many peasants do not have property rights and the fields are divided among the children. The people in the oases told the authors: "because of the problems of heritage in the oases there will be no more fields but only limits.. The common law has been an obstacle for the current well-being of palm tree plantations. Associations have tried to combine traditional with modern operations of palm tree plantations. The division of the fields was worsened by the numerous houses in breeze-blocks that were set up in the palm tree plantations at the expense of arable lands. These constructions are often the property of migrants who have returned for their retirement to the village. An emigrant supports the survival of four people who remain in the 'village'. In each family there are one or two soldiers, who also contribute to the family mutual aid. In fact, this extra income from the civil service, emigration, and begging sustains the survival of the oases.

Tinejdad experienced high emigration rates during the last decade because of the aridity and the lack of work for young people who did not know the prosperity of the oasis since this disappeared during the 1970's. Each family had beforehand two to three cows, a donkey and some sheep, whereas, in the '*ksar*' (traditional village) of 1,260 houses, only two cows remained and more nomads lived in the sector – the majority were settled during the drought in the 1990's. Only some shepherds remained who sold their herds and settled in the oasis. In the village, there have been more new inhabitants than departures as a result of these settling processes. The newcomers are not adapted to the life of the oasis, their concern is that of daily subsistence: they are farm workers and receive 50 per cent of the harvest; the children are provided education at little cost.

Despite these difficulties, the village associations play a major part. The association of *Gourama* organ-

ized the collection of household waste every Wednesday evening. In the oasis, the inhabitants got rid of their waste by throwing it into the bed of the wadi, which was cleared during the next flash flood, but this waste has polluted the ground water. The people thus solve a problem without worrying about the people living downstream and about the future. The current waste collections have been insufficient and result in a multiplication of the rat population, which has an impact on diseases. It is a problem that must be solved if ecotourism should suddenly develop; this is what the people in the oases are looking for. Many associations were created to combat the disappearance of community practices for the benefit of individual practices incompatible with a civic management of the problems in the oases. In Ifri, the people in the oases replaced unproductive palm trees with olive trees, what indicates that they do not wish to leave the oasis.

An investigation on the development of the Association of Achbarou reflects the current psychology of Oasian people. The drought discouraged them so much that when they had sufficient rain for two years and increasing water in the wells, they lack the will to return to their agricultural activity. Quantified values were given to the authors, for example that the palm tree plantation of Achbarou (figure 53.2) has died by 90 per cent, that of Alnif by 50 per cent, but these values are debatable because the people refer to the values that were recorded during the drought and they ignored the successive years with good rainfall that permitted the rejuvenation of many palm trees.

53.3 Countermeasures of the Oases Against Desertification

The oasian population is not passive in facing oasian degradation. They always try to improve the water collection, to develop associations, and unfortunately solve also their difficulties by emigration. Emigration is certainly the main problem because the young people do not benefit from the knowledge of palm trees cultivation. Unfortunately, the new technologies mainly for water collection are very expensive and beyond what the local population can afford. More modest solutions the farmers can afford are unable to solve the problems, given the drastic environmental changes.

Desertification has been introduced above as a threat, but it is also a challenge for improving traditional technology and introducing modern technology. For humankind it is a strong opportunity to think about a new relationship between a vulnerable environment and a growing population that negatively affects the environment.

53.3.1 Research on New Water Supplies

Since the 1970's, the recurring droughts and the decline in the level of underground water has been the cause of the desiccation of the khettaras. The available water resources enabled a cultivation of the alluvial soils of Tafilalet in the basins of Guir, Ziz, Rhéris and Maïder (figure 53.2).

Each area has its specific water conditions. In these dry areas, the underground water is the most secure due to the scarce rainfall. In the oases of Tafilalet, the water deficit had various forms. The volume of water used in the basin of Tafilalet is calculated at 572 millions m^3/yr, 352 millions m^3/yr is surface water and 220 millions m^3/yr underground water (Kelly/Mahboub 2006).

In Morocco, the surface water which feeds the oases comes from the mountains; thus, with less precipitation the surface water declines. The management of the hydrological basins by creating benches and small dams on the slopes of the hills by gabionnage[4] with local material, is not yet envisaged nor the combat against erosion, which must also be combatted by improvements of the slopes. It is also necessary to consider the storage of the water, making it possible to have reserves of water for periods of water shortage.

Two types of irrigation coexist in the palm tree plantations: a) the traditional one by irrigation channels, and b) a modern one using motor pumps. Taking the tensions into account due to the decline of the underground water level and the needed conservation of the water resource, a third technique of irrigation – drip irrigation – is used in the region between Tilouine (figure 53.2) and the South of Tinejdad (figure 53.2). To introduce these new techniques, the farmers asked for support.

The achievements supported by the association of the Oases of Ferkla are manifold: a) a hill dam at 25 kms from Tinejdad provides 30 per cent of the irrigation water for the palm tree plantation; b) the construction of an irrigation channel on the foot of the slope which collects the surface waters; c) the building of a small dam on the foot of the slopes to create

4 Anti-erosion structure composed of blocks or rocks enclosed in a wire mesh form

Figure 53.12: The peasants of the oasis of Has Ouali set up a system of derivation of water of the Wadi Ziz after the flood. (see figure 11 sketches of interpretation). **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.

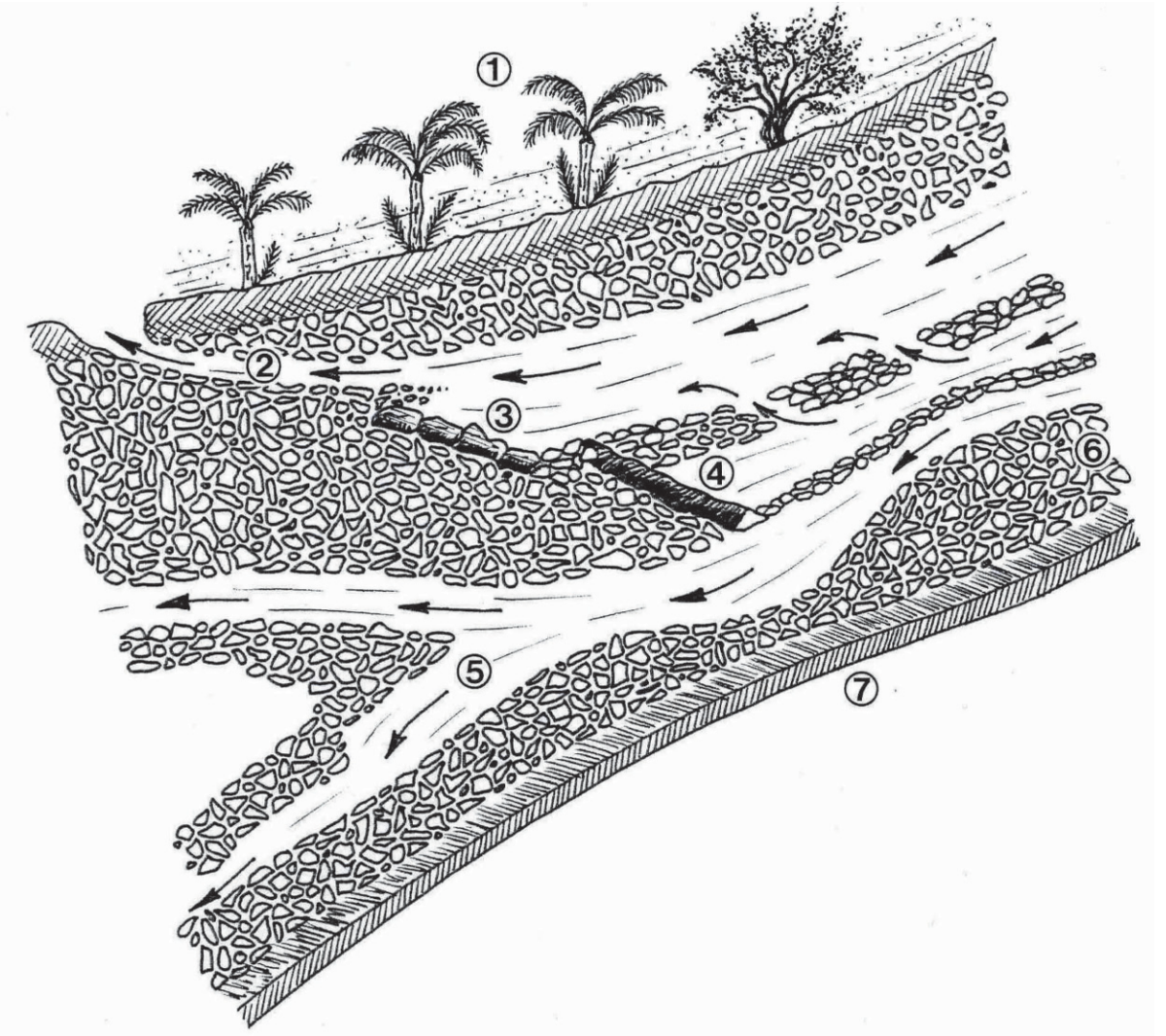
basins and small terraces to limit water erosion; and d) finally the recovery of rainwater with less acidity than the water of the wells, in particular for the irrigation of alfalfa. Pumping techniques have been created but the subdivisions of the fields complicate the water distribution. The refilling of the *khettaras* requires basins such as that built in *Rissani*, with a dam that collects the flood of the Wadi Ziz, where water is retained for 2 to 3 months. There are also 13 dams of derivation in Rissani, which rise about 40 cms every 40 years, but the inhabitants of the downstream community of *Tinrheras* have opposed them.

For refeeding of the underground water level, the *Sarata* (natural hole of infiltration of water in the sand) was suggested as a model and the digging of wells into the flood plain of the wadis. These 10-metres-deep wells would be covered with air bricks to support side infiltration and to avoid their filling; they should be placed at the bottom of a small diversion canal at the opposite side of the current of the wadi. The cost for this is estimated to be from 5,000 to 10,000 dirham (440–800 €).

Along the road of Errachidia-Rich towards Gourama, the authors observed the digging by people from the oases of a derivation of the water of the Wadi Ziz near the oasis of Has Ouali. After each flood, water thus derived is forwarded to an irrigation channel dug in the bed of the wadi to benefit from the flow related to last precipitations (figures 53.12 and 53.13). Nine groups participated in the irrigation work undertaken by a chief, helped by parents and volunteers from outside the oasis, which is spread out over 11 kms, and the water access returns every 15 days; each family irrigates two parcels of land.

Despite these activities, there is water shortage in the summer (from June to August), without a motor pump and drip in this oasis; only three irrigation channels irrigate the olive plantations. The problems that were stressed by the inhabitants are: harmful effects due to the rodents and undermining of banks. A

Figure 53.13: System of derivation of flood water. This figure is an interpretation of the photography of the Wadi Ziz shown in figure X.11. **Source:** © Photo taken by the authors, F. Dumay and M. Mainguet.



1 : Oasis Ait Ouali south of Rich; 2 : Main water diversion to the oasis; 3 : Bags alignment to partialy stop flow; 4 : Small pebble dikes to create small balancing; 5 : Part of the river not harnessed; 6 : Major bed with pebbles; 7 : Two levels of canals are perched as a result of bed hemming

wall in breeze-blocks was built but the inhabitants preferred *gabionnage*. During this time the women wash the carpets for the end of Ramadan.

In Erfoud, thirty-three ksour (traditional villages) met to carry out projects to combat desertification and to benefit most from available water resources. They proposed: a) the protection of underground water and monitoring of motor pumps, b) the drilling of artesian wells, c) the creation of artificial lakes like water tanks to refill the underground water levels, d) the derivation of the Wadi Rhéris to the Wadi Ziz at Douirat, and to avoid that the four to five annual floods are lost in the desert, e) the development of the infrastructure: bridges, roads, and d) the improvement of cleaning.

The inhabitants of Erfoud also wanted the installation of diversion canals of flood water of the Rhéris. The authorities opposed the passing of water of the Wadi Ziz by modern channels, even when the flood of Ziz involves serious inundations of Merzouga before being lost in a closed basin. There the inhabitants underline a problem of management of the floods. The only large irrigation channel, the '*Chabourat*' which is 1,200 metres long, 3.5 metres deep and wide and feeds Erfoud is full of sand and vegetated. The inhab-

itants claim mechanical means to carry out its clearing.

When the quantity of water from a well of 60 metres depth became insufficient; a second well of 103 metres was carried out, but the available pumps were too weak and the water was salty. Currently the Association of Erfoud wants an old tank to be rehabilitated to practise drop irrigation. The *metfia is* the traditional basin that was used since antiquity to collect the water of the flood and to use thereafter for various domestic needs of the population. This basin and the channels which flow there will be rehabilitated to store the water brought back by motor pumps of the Paleozoic underground water level of poor quality, and to treat it before using it for drip irrigation. This project has been developed in 2007 by a subdivision of Erfoud (ORMVAT), in partnership with the beneficiaries and the association users.

It is also a question of creating AGR (generating actions of income) like small ovine cooperatives, developing apiculture, benefiting better from the production of dates and developing the stone cut. In Erfoud, every year in September a market of dates is organized where many companies of conditioning and transformation of this fruit are present. The association also tries to train users not to waste water, what is too often regarded as a gift of God, and thus: 'I do with it what I want'.

53.3.2 Efficient Development of Associations in the Oases of Tafilalet

The field investigations in the oases of Tafilalet conclude that in the oasis the associations are an interesting response to the effects of desertification or its first steps. This will be shown by a few examples.

The ORMVAT of Erfoud and the *Association of Combating Desertification and Environmental Protection* of Jorf in partnership with the IFAD (International Fund for Agricultural Development) created an experimental station where four farms buy water stored in an artificial plastic sheet basin. In the winter, when the flow to the *khettaras* is increasing, a portion of this water is stored in this basin and sold in the summer to four plantations that practise drip irrigation. The disadvantage of this system is the loss by evaporation.

In the valley of Guir, in Gourama, the *Association Oasis of Guir for the Development and the Environmental Protection of Gourama, Rich, and Errachidia* participated in 2005 to construct a wall to fight against the undermining of the river banks. It organized meetings to sensitize women and the children for the environmental protection, and it distributed bags to collect waste. The Association rented a truck which collects the domestic waste previously thrown into the Wadi Guir downstream of the village. The association also participates in campaigns for planting and protecting trees. According to its president, the new extensions and the abusive development of the motor pumps threaten the underground water level. The governor was alerted and a meeting was organized as a sign of protest.

There is no problem with drinking water in Gourama that is distributed by the *National Office for Drinking Water* (NODW). The major problem is the processing of the waste water. About 15 per cent of the families are connected to the system collecting waste water that is delivered to the wadi downstream from Gourama, the others have pits. The president of the association said that between 2005 and 2006 the precipitation was good. The floods usually take place in November, December and January, but in 2006 there was an exceptional flood in September. The president pointed to these most urgent problems: 1) water erosion and the undermining of the banks along the high and middle Guir Valley; 2) the first indices of sand encroachment which start to appear in the streets of the village, carried by a south wind (exceptional in 2005–2006); and 3) the bad management of domestic waste what resulted in cases of leishmaniose in connection with the increase of rats.

In Jorf, the khettaras are still under the responsibility of a voluntary *Sheik* who manages all questions related to water (water turns, maintenance of khettaras, and management of conflicts). Each tribe is represented by the *Mazal* or the council of the wise men. The *sheik* is elected every year by the group of *Mazal*. The Association of khettaras of Jorf takes part in the life of the palm tree plantation in several ways: the development of drip irrigation, combating desertification, improvement of the breeding in the oasis, diffusion of information in the ksar.

The badly conceived water processing pollutes the underground water. A collection system for waste water is under construction. The Association of Jorf intervenes in the collection of domestic waste, including the idea to reward the children of the village that participate with tickets for access to the sports ground and the library. It asked for monthly meetings with the municipality to solve the problems of everyday life, e.g. to fight against the smuggling of palm trees.

In Tinejdad, the *Association of the Ferkla Oasis for the Environment and the Inheritance* tries to set up projects to find complements of resources for the young people: 1) the creation of a dairy cooperative and incentives for bovine breeding; the incomes of which are subject to less fluctuations in the market than those of ovine breeding. In Errachidia and Tineghir, the people living in apartments buy fodder to be able to have their own cow; 2) the building of a small factory for date jam; 3) the sale of garlic powder instead of garlic cloves.

The Association of the Oases of Ferkla also participates in the development of citizens' education by organizing ecological meetings for sensitizing schools and families, in particular for saving water, helping with planting trees in the villages, and helping with the maintenance of the khettaras. As a result 1,200 trees were planted, parks were built, sheep and chicken were distributed, and scientific workshops on topics of development were organized. Foreign students find accommodation in the buildings of the association.

In the province of Errachidia, the well developed association does not take over from the Djemaa because they do not have the same authority to manage natural resources, especially water, irrigation, land distribution, grazing .... These associations propose modern functions and profits from the wisdom of the old men of the Djemaa, and they participate in the education and information of the people in the oases.

53.3.3 Emigration: The Worst Solution

Rural migration started in 1960, and it has increased since 1973. By 1971, 87,000 rural people left the Tafilalet, and from 1975 to 1982 100,000 departures were recorded with a high of 20,000 in 1980. The towns of Fez and Meknes attracted 43 per cent of the migrants. The first migrants were young men. Thus, in Jdid Mdaghra during the difficult periods of the end of 1970 and from 1983 to 1989, many inhabitants were fascinated by the urban lures and left for Meknes, Fez and Casablanca (figure 53.1). The cities of the North are perceived as golden cities; the return of the pensioners to their village who earlier emigrated to work in Europe induced many young people in the oases to give up agriculture and participate in the loss of transmission of knowledge of the oases. The young rural people prefer emigration to farming because they consider the work too difficult with poor financial results.

53.3.3.1 Emigration in the Oasis of Achbarou

The palm tree plantation is in a bad state but there are some signs of improvement after the good rainfall during 2005 and 2006. An interview with Hassan Benelmadani, a teacher, and Mohammed Boumdiene, also a teacher and treasurer of the *Association of Achbarou for the Development*, starts with this sentence: "the oasis does not go well." Approximately 1,800 persons live in Achbarou. The old ksar that was abandoned in 1968 is already strongly damaged. The inhabitants suffer from lack of water. Three decades ago the ground water was 16 metres deep, it is now 60 metres. In 1987 soldiers built a small dam near the village on the Wadi Gaiz, which now makes it possible to obtain drinking water from 40 metres.

Before the drought the primary activity of the oasis was the cultivation of palm trees. The irrigation was provided by a system of four *khettaras*, the last was active in 1991. Then the villagers used underground water but the motor pumps exhausted the groundwater. Of the 125 families, 20 per cent had a motor pump that was bought with the money of emigrants.

The traditional family unit consists of three or four women at the house who deal with the domestic tasks in turn. An association was founded in 1998 to create work for women who are not any longer collecting wood and grass. A house for women will be completed where weaving and embroidery will be done. Although the khettaras are now dry, the Djemaa always exists and collects the money to pay the Imam. Nowadays, almost all the motor pumps have stopped and agriculture is non-existent any longer.

Many people left the oases for North Morocco and Europe, in France primarily to Nancy, Montpellier, Saint-Etienne and Mulhouse. Now, marriages are arranged in the month of August with the French children of the first wave of emigration, thus allowing the inhabitants of Achbarou to obtain French nationality by marriage. This is organized in France by the Association of Chabraoui.

The drought discouraged so many people who do not react any more to the return of good rainfall. It seems that the idea of cultivating the land has been abandoned. While the palm tree plantation is still in a reversible status, the problem is a mental one. The inhabitants live in the palm tree plantation but without practising agriculture there, what in the province of Errachidia has been their first vocation. The only resource is the money coming from outside. "Here it is

like an hotel" one of our interviewees told us. There is no local answer to desertification.

53.3.3.2 Emigration and Its Noxious Consequences for Jorf

In Jorf the emigration to Europe has been high and irregular because generally the young children are sent there where a majority is waiting to get naturalized; then they return to marry 'in the village' to allow the spouse to qualify for naturalization. The migrations concern especially the rich families and they are related to the subdivision of the fields among the next generation. The migrants leave to work on construction sites in Fez, Meknes and Casablanca but the women and the children remain in the *Ksar*. With the money of the emigrants, houses in breeze-blocks are built in the palm tree plantations. These constructions constitute an aesthetic damage and an environmental trauma because they require sand whereas the traditional houses were built with silt and clay. Jorf assumes that until 2025 about 60 hectares will be used for the construction of these new houses within the palm tree plantations.

Presently, the bed of the Wadi Ferkla in Tinejdad is emptied of its sand; this has lowered the bottom of the bed of the wadi. The flash flood of 1979, with the sand covering the bed of the wadi, reloaded the underground water level. In 2006, the flash flood was stronger but the refill of the underground water level was deficient due to the thinning of the fluvial sand sheet that was collected for construction. In 2007 there was a sand shortage, a cubic metre cost more than 150 dirham (13 €), whereas a few years ago it was only 50 dirham. A regulation is essential: to create sand pits and gravels far from the wadis and to prohibit that they are taken from the beds of wadis.

53.3.3.3 Emigration from Alnif

The region of Alnif has been most affected by illegal emigration to Spain from Ait Atta. In Barcelona a quarter/neighbourhood is called Nighreme which means 'door of the village' in the Tamazight language. All *ksour* lost between 150 and 300 persons, primarily to Spain. People live here from the remittances of the emigrants, and from the income of cumin, henna, and the dates which are sold abroad. Emigration is a response to the lack of water and the difficulty to deepen the wells. The area of Alnif used much dynamite for drilling wells.

While the recurrent droughts since the 1970's have been push factors for emigration, the arranged marriages during the holiday season in France (in August) are pull factors. Emigration is an individual topic without links with the necessary participative behaviour of the population and collective actions to reach a better standard of living. Emigration does not allow poor people to work for their own and to integrate at a regional and national level.

53.4 Conclusion

The situation of the oases has become difficult in the world in general, in the southern part of Morocco, and in the Tafilalet in particular both for human and natural causes. The first have accelerated and intensified the effect of the second due to recurring droughts and intensive rainfall that was worsened by the degradation of the vegetation cover.

The oasis system combines two ways of life: the palm tree plantation (which is being substituted in Tafilalet with olive trees on the lower slopes of the mountains) and breeding. This combination has resulted in advantages and disadvantages, for example in the combat against the negative effects of the wind where the grazing areas should be controlled, what is unacceptable for the nomads. Competition for vital space is linked to questions of authority. The obsolete practices combine a) the non-existence of property rights, b) the dispersion of the field by the system of heritage, and c) new concrete constructions on the arable lands of the palm tree plantations. The excessive division of the fields due to an ancestral right leads to the dispersion of scraps of fields of which only the borders remain.

The oases do not have any longer an oasian function: the people do not live there any more from their own work. The recurring droughts discouraged them and led to massive emigration. When the climatic situation temporarily improved and the level of underground water rose (during the last few years) the people in the oases no longer responded as farmers. Due to the recurrence of droughts since the 1970's, many young people whose parents were not working any longer as farmers lost the traditional knowledge, and for them it has become difficult to work the soil.

During the last decades, state control replaced the traditional capacity of the Djemaa which gradually lost its authority. Today, the state has pulled out with the rise of the difficulties and has become conscious of the weight of the traditions and the necessary reactivation of the local Djemaa. The associations whose role is of primary importance have tried to reconcile

the tradition and the modern evolution in the oasis. The major problem has been the lack of water and drying up of many khettaras, the collective form of water collection. The increasing development of irrigation with motor pumps and thus to individual means of access to the resource has resulted in a fast exhaustion of the aquifers due to an irrational management. The disappearance of community practices for the benefit of individual practices is unsuitable for the oasis. Due to the lack of water, the over deepening of the wadis and the raising of fields compared with the irrigation channels has become a major danger that will have to be considered soon. The silting of small dams, such as that of Tifounassine, remains a problem.

The general decline in the underground water level, which does not any longer permit the roots of the palm trees to reach it, was instrumental in making many people in the oases become discouraged and inactive. Several responses should allow for survival in the oasis without external assistance and offer opportunities for development. The case of Achbarou referred to a bad option of an unsustainable development. The NGO 'AGIR' of Epinal participated in the financing of a socio-cultural home with the goal of keeping occupied the women considered to be idle. But much of the embroidery and knitting work produced in this framework was out of fashion and thus non-marketable. It would have been better if these women would have again taken up gardening, especially when the rainfall conditions were good in 2005 and 2006. It is deplorable to occupy people artificially and to lean on the benevolence of charity organizations, in a complete socio-economic shift and without links to basic needs. The craft industry cannot be an activity in response to local needs.

In addition, all development solutions aiming at promoting ecotourism must be moderate as the oasis has been by definition a fragile area. Efforts must be improved, like a) the collection of the waste and its treatment, as waste often pollutes the oasis, b) the combat against diseases like leishmaniose, rage, and their vectors due to rats and dogs. To improve the quality of the drinking water in all oases, it is now necessary to develop effective systems of water treatment, and not to reintroduce the waste water directly into the wadis.

Among the main changes in the oasian system is the loss of insularity due to new developments that affected the oasis: 1) electricity, telephone, computer, roads with bus and car traffic; 2) new structures of market from a closed market to a regional and open global market. The consequence is also too often an anarchic urbanization with houses of breeze-blocks instead of clay houses.

Migration from the oases is only one aspect of global population mobility. A review of the economic reasons for migration reveals many positive individual results: discovering a new world, new lifestyles, escaping family conflicts, new apprenticeships, and a possible return to the homeland when getting old, but fewer collective results in support of the local economy and for the maintenance of the fields by a part of the family. It appears doubtful that migration can be a sustainable solution for combating desertification and helping the development. Does migration allow them to reinforce their livelihood with non-agricultural activities?

Giving up agriculture means for the oases the collapse of the whole ecosystem. Sustainability of the oasis requires making the agricultural activity sustainable by developing activities and all natural resources of the dry areas: mixed agriculture, controlled rural ecotourism, water storage and management, flood prevention, control of water and aeolian erosion, and a better marketing of their products.

54 Agriculture in Drylands: Experience in Almeria

Andrés Miguel García Lorca

54.1 Introduction Justification[1]

The fundamental basis for security and peace in a territory is linked to the absence of internal and external conflicts. Situations of internal conflicts in modern societies normally have their immediate origin in social inequalities and are expressed in an unjust distribution of wealth. The causes that determine these inequalities may be derived from environmental situations, as is the case with the exhaustion of natural resources which assured the existence of a community; they may also be due to the abandonment or isolation of social groups who are then deprived of the possibility of developing their own capacities to access resources, as a result of administrative or political irredentism. They may even derive from the installation of external models of socio-economic exploitation, as is the case of 19th century colonialism, which drained the resources of territories without promoting the socio-economic development of their inhabitants.

These causes have all been present in recent centuries in the area of Almeria, and were responsible for the poverty of this province until the mid 1970's. Historically, this situation has been improving due to emigrations which served as an escape valve, with occasional violent episodes, the highest expression of which was the Spanish Civil War of 1936/1939. The geo-strategic position of Almeria, on the northern shore of the Mediterranean Sea opposite the coast of Africa, involved the province in external conflicts, sometimes due to direct conflicts, i.e. of colonial wars in Africa in the first 30 years of the 20th century, and as a region of tension during the Cold War.[2]

In the post-Cold War era, among the external tensions are the processes of clandestine inmigration and drug trafficking originating from North Africa, for which a main entry to Europe is the coast of Almeria. This province is a buffer as the first place of contact between two highly differentiated socio-economic worlds. In the region of Almeria many immigrants initiate their process of integration and assimilation into the new host socio-economic space. This reality is not without tensions and problems, which may result in potential and actual conflict situations. The historic process of the territory of Almeria began from a situation of inequality, poverty, and marginality within Spain, not exempt of external risks, which might have increased territorial differences.

The Almeria model offers a reference for tackling security problems in a globalized world. It is becoming a space for reflection which allows the sensing of opportunities for development that enable greater social adjustments with access to a higher income for many countries where the rate of human development is not only low, but of a middle level. It favours social stability and more efficient management of natural resources.

Thus, the land development that has been induced by the Almeria agricultural model has already become a referent for the whole planet. It is based on intensive agriculture under plastic covers. This model stresses the development capacity of a society in a financially depressed and poor land, and in an arid natural environment. Within the course of a few decades it has been able to catch up socially and financially with advanced territories of the European Union.

1 This chapter contains part of the results of the Ministry of Science and Technology Research Project, REF.SEC2001-3776, of the National Research + Development + Innovation Plan. It was co-financed with European Regional Development Funds.

2 The incident of the thermonuclear bombs that were dropped by accident in Palomares (Almería) in 1965 comes to mind. For background on the circulation of Russian nuclear submarines in the Alborán Channel, see: García Lorca (1985): 267–296.

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Figure 54.1: Map of the Almeria province in Andalusia, Spain. **Source**: Elaboration of the autor.

It is indeed an endogenous development model, derived from the effective mobilization of local productive factors, natural resources, work and capital; although the latter has been of reduced importance given the low relationship between capital and labour. With the necessary adaptations this model may be applied to other countries without an industrial transition. This is confirmed by the continued and increasing interest this model has elicited in many American, Asian, and African countries.

This model of productive development has achieved a very high level of social redistribution of wealth that has reached the whole population and allowed overcoming poverty, marginality and the cultural delay of its people, while simultaneously integrating a large number of immigrants from all continents.[3]

54.2 Territorial Context

The territorial sphere of development of the intensive agriculture model is the province of Almeria in Andalucía (Spain) between the 37º latitude and the Mediterranean Sea. This is the Southeast of the Iberian Peninsula, and it is one of the most arid regions of the Mediterranean basin, with a sub-desert environment equivalent to regions of North Africa, the Middle-East or the Aral and Caspian basins (figure 54.1).

Physiographically it comprises the alluvial belts of the hydrographical systems and a set of neogenous plains, which are bordered by a system of alpine mountain chains, with important limestone formations which enable the accumulation of subterranean waters. In its origin, no agricultural aptitude was seen in the scarce and undeveloped land, which was stony and largely affected by a limestone exudation crust, only allowing for scarce herb or bush vegetation.

3 This chapter is based on the following sources: Analistas Económicos de Andalucía (2005); COCA (2006); Consejo Económico y Social de Andalucía (2006); Ferraro García (2000); Fundación Cajamar (2006); García Lorca (1977, 1995, 1998, 1999, 2002, 2003, 2005); García Lorca/García Fernández (2005); García Lorca/Márques Ibáñez (2003); Hernández Porcel/García Lorca (1999); Instituto Cajamar (2004); Instituto de Estudios de Cajamar (2002); Pizarro (2005); Rivera Menéndez (2000); Ruíz Rodríguez (2005); Uclés Aguilera (2005).

From the point of view of its climate, the area has a very severe pluviometric deficit, below the 300 millimetres isohyet, with annual and inter-annual periods of extreme drought. Rainfall appears as intense cloud bursts which favour strong and rapid surface runoffs. It exhibits an exceptionally benign average annual temperature from 17 °C to 21 °C, the coldest month of the year reaches average values of 12 °C. Winds are fairly constant throughout the year. Solar radiation is very high, with approximately 3,200 sun hours yearly. The correct manipulation of these climatic factors is one of the keys of the development process. In general terms, the territorial environment was that of an arid, desertic zone with scarce agricultural use, and mainly goat husbandry. Irrigation was limited to the few wells in the area, while use of runoff water was problematic due to its variability and intermittence.

These climatic circumstances implied a very depressed socio-economic situation with a low household income, and territorial resources that were incompatible with its demographic development, resulting in emigration pressures.

54.3 Origin and Development of the Model

Although in the mid 19th and early 20th century attempts were made to promote agricultural development in these territories, it was not until the end of the 20th century that the process began. Its origin can be traced back to the 1939 agricultural policy after the Spanish Civil War when the INC was created to promote and initiate an agricultural reform aiming at the transformation into irrigation with the final goal to increase agricultural productivity and raise the level of income of peasants. Thus began an important process of agricultural development which was expressed legally in the *Law of Foundations* (Ley de Bases) of 26 December 1939 for "the colonization of large areas" and its subsequent development in legislation by means of a set of regulations like the "Colonization of local interest" Law of 20 November 1940. Both laws were instrumental for furthering the agricultural transformation. Among their objectives was an effort to stimulate private initiatives in the development of agricultural structures.

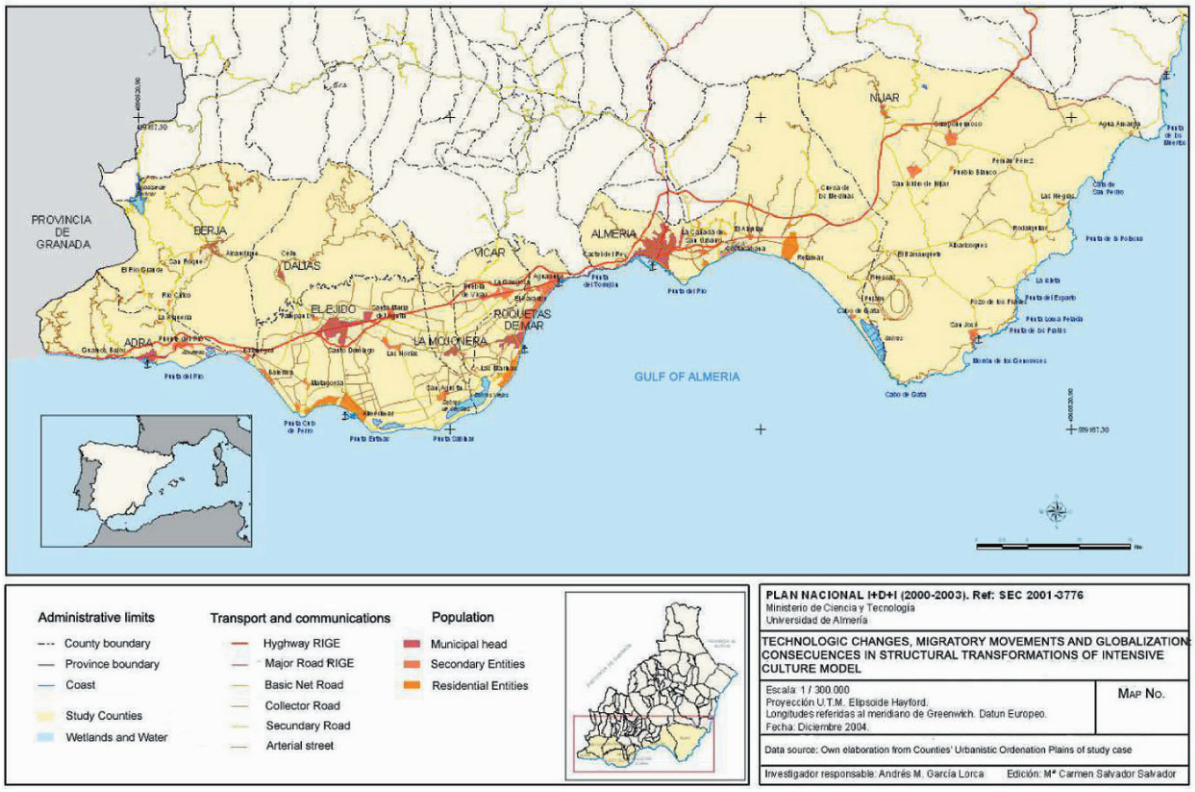
Since initially no adequate response occurred, the state took over the management and promotion of development through the INC. In order to facilitate the action of the new institution and finally initiate the colonization, the Law on the "Colonization of areas with irrigation potential and distribution of property in areas with irrigation potential" was adopted in 1949. These legal instruments launched the process which rapidly fostered private initiatives.

Actions occurred in two zones, in the *Campo de Dalias* and in the *Campo de Nijar* that basically aimed at: a) the transformation of soil for agricultural activities with legal instruments that facilitated, in cooperation with owners, the purchase or compulsory expropriation; b) the construction of an electricity network and communication structures; c) the probing for drilling wells to guarantee sufficient water, and elevation of water storage and its distribution, and d) the construction of new villages. A total of 13 villages were founded with 970 houses where 967 settlers selected from nearby villages came to live with their families. Initially, settlers were given plots of 3.5 to 5 hectares and later of 1 hectare, once 'cultivation on sand' was introduced. The real surface of these actions reached 6,947 hectares in *Campo de Dalias* and 3,346 ha in *Campo de Nijar*. The settlers were offered a low interest 20-year loan that paid for the house, the land, and the proportional part of the road works, general irrigation infrastructures and probing. The public administration offered them counselling and tutoring during the first five years in agricultural matters.

The efficient and honest work of state technicians enabled the success of the model which initially had two important features, the introduction of the system of cultivation on sand, and protection of crops with traditional structures and plastics.[4] Both developments took place very early, cultivation on sand in 1957 and the first plastic protected crops in 1960. Since then, agricultural development has been continuous, paired with constant structural transformations and technological changes (figure 54.2).

4 The 'cultivation on sand' technique consists of creating a soil basis out of vegetable earth, organic fertilizer and sand. This soil allows for irrigation with brackish water, and improves the root temperature, thus enabling better performance and earlier crops, which means a better market option. Traditional grape cultivation in grapevines (a wooden structure with wire-supported crop) already existed in the area. These structures were covered with transparent plastic supported by a wire network. Results were impressive, increasing performance and precocity of production.

Figure 54.2: Zone of study: Zonal scoping of the agricultural plot study. **Source:** The author holds the copyright.



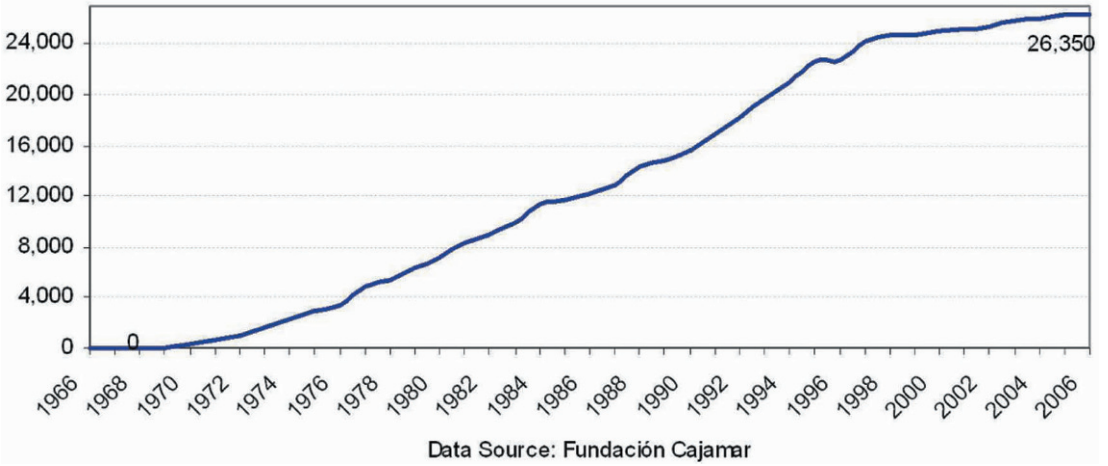
54.4 Features of the Intensive Agricultural Model

From the start, this productive model was defined by several features that still apply.

- It is a very intensive work model, also known as *'delicate agriculture'* due to the constant and continuous attention required in the production process. Although at present one hectare requires at least 2.5 manpower units per agricultural campaign, previously the rate was even higher, what was solved by the inclusion of all members of the family into the activity, including whole family networks for some operations.
- Another important aspect is the socialization of the model, both from the point of view of landowner structure and of *association* and *cooperatives*: In a registered surface of 31,932 hectares, there are 32,581 owners[5], and the number of cooperatives in the area under study is 309, with 38,995 members. These cooperatives have focused on promoting productive efficiency, reduction of costs by an economy of scale, concentration and standardization of production and technical counselling, as well as servicing.
- *Moderate capitalization*. Large investments were not necessary in order to initiate production activity, as land and also the crop protection systems were inexpensive. In the early 1980's, the price for starting a crop, including the purchase of the land, was around 3 million pesetas per hectare (18,000 €). This aspect explains the growth and territorial expansion of the greenhouse, and also the social mobility from employees to shared farmers and later to landowners.[6] This is now also happening with immigrants, although the costs for developing a greenhouse are much higher, reaching approximately 200,000 €.

5 These figures for surface and owners differ from official figures. They have been obtained by direct evaluations applying different more complex methods than those used for the census, together with the analysis and photointerpretation of the orthophotos of the Regional Environmental Authority.

Figure 54.3: Evolution of greenhouse surface in Almeria (in ha). **Source:** Elaboration of the autor.



54.5 Evolution Process of the Model

In 1979 a Spanish financial company publication alerted about what it called the 'Almeria miracle'; analysing a number of national, regional, and provincial economy indicators, it verified that the agricultural income of Almeria changed between 1955 and 1975 from being the last to the first in the region, with a growth rate seven times higher than the average in Spain. Then its consolidated development process was confirmed and it evolved as a consequence of stimuli of different origins and intensities. The most significant case was the difficulty with tariffs for exports to the European Common Market. This forced farmers to improve their efficiency to compete and to overcome the price increase due to customs. When Spain joined the EEC in 1981, the Almeria horticulture grew rapidly despite the international crises and regional problems. This required a constant process of evolution and transformations in order to respond to market demands and improve benefits.

54.5.1 Structural Transformations

They affected the entire productive model both in the production phase and also in post-crop and commercialization; but it is very significant that they appeared in the most stable structures as the cultivation surfaces, plotting structure, property regime, and plot size. Cultivation size throughout the time period under study has experienced substantial qualitative and quantitative changes.[7]

The *first* transformation, as mentioned above, was from dry farming to irrigation, a transformation which continues at present in marginal lands inadequate for farming, mainly heaths and practically dry grassland. Obtaining water has varied and diversified; initially water came from superficial aquifers, today it is obtained from deep aquifers, and also from desalination of seawater and re-use of recycled residual town waters, as well as from surface runoff water. The *second* great transformation was the protection of crops with windbreaks and cultivation on sand; this entailed an increase in crop productivity and security. The *third* transformation was the development of 'greenhouses'; the plastic protected surface has systematically increased from 0.5 ha in 1963 to 26,350 ha in 2006. These transformations in crop surface have been accompanied by other technological transformations (figure 54.3).

6 An employee learns the growing techniques in a few years and with that knowledge he associates with a landowner, contributing his manpower and part of the production costs. Benefits are shared, normally 40/60 per cent or 50 per cent each. With the capital gained in a few years and with bank credits he purchases his own land, normally marginal land, transforms it, and begins his own activity as a new landowner.

7 The statistical references are based on these sources: Instituto de Estadística de Andalucía; at: <http://www.juntadeandalucia.es/institutodestadistica>; Instituto Nacional de Estadística; at: <http://www.ine.es>; Consejería de Agricultura y Pesca; at: <http://www.juntadeandalucia.es/ agriculturaypesca>; Ministerio de agricultura; at: <http://www.mapa.es>; Cámara de Comercio de Almería; at: <http://www.camaradealmeria.es>; Fundación Cajamar; at: <http://www.fundacioncajamar.es>.

Figure 54.4: Evolution of agricultural production. **Source:** The author

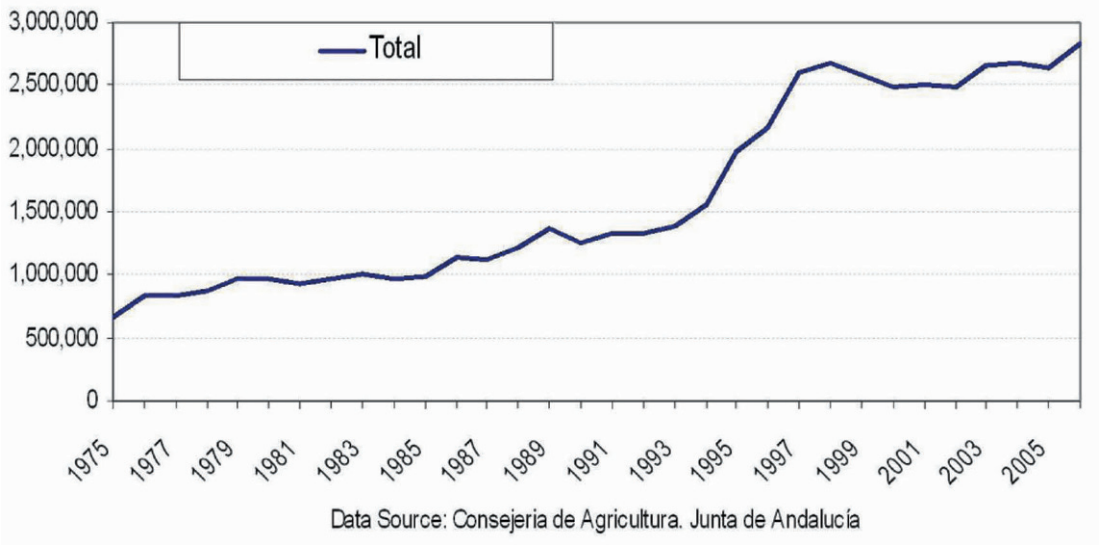
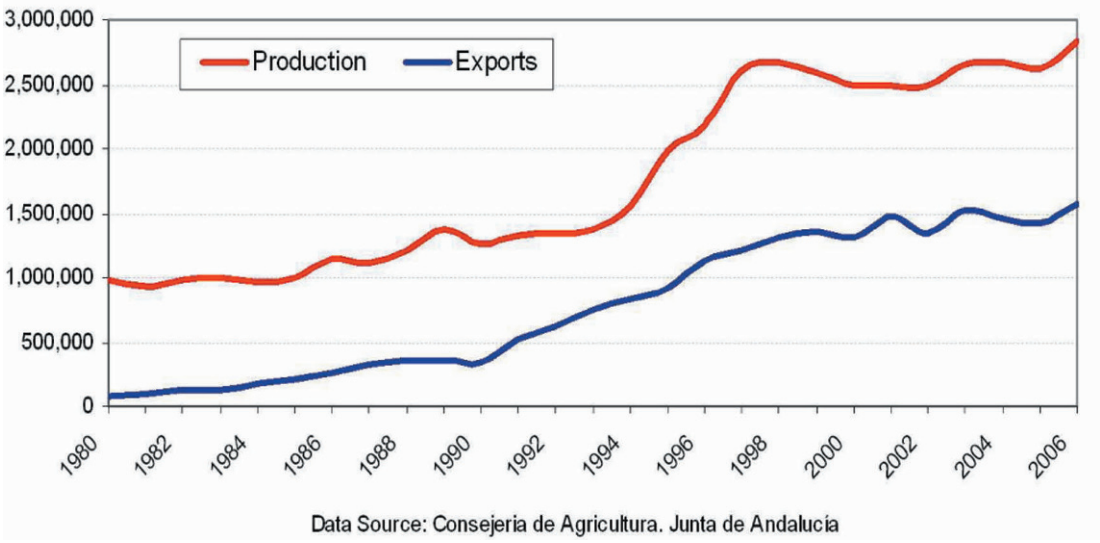


Figure 54.5: Evolution in agricultural exports. **Source**: The author.



Change in property structure is a very complex phenomenon, given the territorial reality from which it started. The INC developed a number of agricultural structures with a given size of plots, but was soon overcome by the conditions of the model. It should not be forgotten that it is an intensive agriculture with regard to production but also for manpower and capital employed. This resulted in a fragmentation of property to unsuspected levels.

In 2005, 28 per cent of the farms under study were still below 0.5 ha. Obviously this situation of small property accounted for a reality which was the conversion of many employee farmers into property holders, since with a 5,000 square metres surface greenhouse it was possible to maintain a family unit. Changes in economy, new possibilities offered by technology, and the transformation in the agricultural society together with a constant arrival of immigrant manpower, generated a tendency towards a more professional business model without abandoning the basis of the agricultural family company. This has determined a change in the structure of property, which although it continues to be based on family farms, which at present account for 63 per cent of the farms, a new type of middle-size company with employees is appearing, accounting at present for 32 per cent of the farms. At the same time another model of capitalist companies is emerging with strong investments

and with a cultivation area above 10 ha, accounting for 4.5 per cent of the agricultural companies, a paradoxical situation, as attempts to create large companies in the 1980's were unsuccessful (García Lorca 1983).

54.5.2 Technological Transformations

The constant innovation process and the capacity of the model to incorporate self-developed or third-party low cost technologies, or which substantially improve production efficiency, production quality and consolidation or widening of market areas, constitute the objectives of the model. But these innovations have always been incorporated following very pragmatic criteria. The Almeria model has its own *know-how* based on observation, knowledge of technology, possibilities for their incorporation, and common sense. The main process may be summarized in the following features:

- *Intensification of Production*: A higher performance per surface unit has been fundamentally reached by means of control of the vegetable development of the plants, using crop protection systems and also new methods and technologies of organic irrigation and pesticide treatment. The average performance varies from 120,000 to 160,000 kg/ha (figures 54.4, 54.5).
- *Improvement of vegetable genetics*: New varieties of fruit and vegetables were introduced to reach better performance and resistance to diseases. These varieties are the result of the application of research using Mendel's genetic techniques, together with micro-grafting of the varieties which are most resistant to the action of pathogenic elements; they have enabled said increases in production and their adaptation to environmental conditions of the different crop zones, improving the safety protection of the production avoiding pesticide treatment.
- *Improvement in crop practices*: Cropping methods and agricultural manipulation are fundamental for quality and production, such as pruning techniques, irrigation timetabling and pesticide application, together with the manipulation of wastes and the environment health control, have led to a significant improvement in production quality, performance, and hygiene – the latter is of important commercial significance. This improvement in crop techniques is supplemented with the use of new and more efficient tools for farming labour which also enable mechanization of certain activities, with the consequent decline in expenditure for manpower and an improved process control. This has been the case of irrigation automation or environmental control.
- *Introduction of pest control systems*. The need to control plagues and diseases, with the consequent avoidance of pesticides plant protection products and the improvement of product safety, is imposing the use of biological depredators. This also includes the use of pollinating insects, with the consequent disappearance of auxins for fructification development.

Table 54.1: Technological additions to the productive process in Almeria. **Source:** The author.

Year	Introduced Technology
1950	Sand culture
1970	Almeria-type greenhouse
1980	Hybrid seed
1981	Drip irrigation
1984	Thermal plastic
1986	Integrated drip-line
1990	Soiless culture
1991	Bumblebee pollination
1992	New seed variation
1997	Invernadero industrial
1999	Automatic drip head
2000	Automatic climate control
2005	Biological culture

- *Efficient water management*: Agricultural growth could not be understood without the constant innovation and improvement of irrigation networks and devices, such as the modernization of the irrigation network with constant pressure tubes, and the extension and automation of drip irrigation. During the 1970's, over 8,000 cubic metres of water/ha/year produced between 50,000 and 60,000 kg/ha/year; while in 2008 the average production is between 120,000 and 160,000 kg/ha/year using 3,500 to 6,000 cubic metres/ha/year.

As for the technological development of the post-crop process, i.e. from fruit recollection to the final consumer, transformations have signified an important challenge for cultural adaptation and farmers' responsibility, the most significant ones being standardization of production according to market standards

and traceability, the assignment of a code which enables identification of the product and the producer until the product reaches the final consumer. At the same time an extensive system for vegetable health has been developed. It would not be an exaggeration to say that this may possibly be the territorial sphere in which the highest number of analytical controls has been performed in the whole world.[8]

54.6 Impact of the Model on the Territorial System

The territory is a system where all elements interact. The capacity to impact on the territorial system of the model is manifest if each and all subsystems of the territorial system interact. Only its most significant dimensions will be discussed next.

54.6.1 Environmental Problems

The struggle for natural resources, especially of water and land, had multiple negative impacts, among them are increased salinity in aquifers due to excessive pressure from water consumption, severe alterations of hydrological systems due to the occupation and modification of the riverbeds, and alteration and pollution of soils due to an intensification of crops using chemical fertilizers. As a consequence of the territorial expansion of the model, natural resorts were lost which, although they may have had little or no agricultural value, were rich in biodiversity.

From a positive perspective, the concentration of the agricultural activity on the coast has reduced the human pressure on the entire territory, favouring natural recuperation of forest areas and marginal crops which had been under severe desertification risk. At the same time, other areas in the territory have recuperated their traditional agricultural activity although in a different sense, i.e. as recreation areas, not as production zones as they had been. The reasons are fundamentally sociological and are based on the benefits generated by the intensive system which are transferred to the traditional model; the traditional agricultural areas have transformed into leisure and recreation areas. Also the contribution of the model to the reduction of atmospheric CO_2 has been significant as it is a high consumption system, given the extension of chlorophyll mass.[9]

These technological transformations initiated by water and land management have reduced the pressure on resources due to market and production efficiency, eliminating many of the previous actions which had important negative impacts.

Water management produced significant progress for the use economy, and also for its diversification and re-use. Water supply has diversified, thus reducing the pressure on aquifers and balancing the water deficit within the zone. Regulations require the harvesting of rainwater in greenhouses, which takes advantage of runoff water. The present tendency is to promote water supply by desalination – the capacity already installed in the intensive culture zone reached 60 hm^3 (cubic hectometres) per year by the end of 2006 – and to re-use urban residual waters using depuration and ozone processes, with 15 hm^3 per year from plants already installed in Almeria, and new plants are under construction.

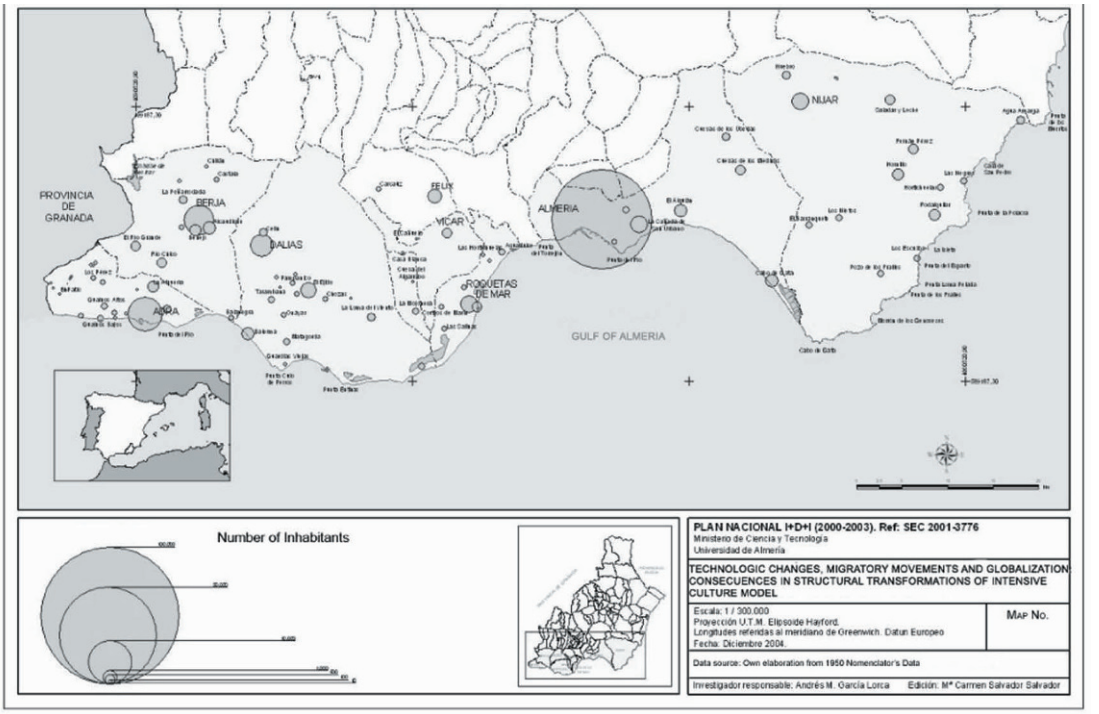
So far land management offers an uneven balance. While the model has created agricultural lands in desert areas, at the same time, and to a lower degree, it has degraded other land by an irrational use of agrochemical and plant protection products, particularly in the earliest greenhouses due to the accumulation of residues. This situation has improved, in some cases by abandoning the cultivating surface, changes in land-use (from agricultural to urban), and in others by the adoption of soil-free (semi-hydroponic) production, and finally by the incorporation of environmentally correct practices. At present more than one third of all the agricultural exploitations comply with regulation UNE.155.001 (European quality control norm), to which those of integrated production and ecological production may be added[10], which guarantee quality maintenance of the land. This concern is the result of a commercial competition for maintaining market positions. During the first decades of development the use of chemical fertilizers and plant protection products reached inadmissible levels, generating problems in land pollution and for human health. Market vegetable health requirements provoked a favourable

8 In 2005, the number of residue analyses of vegetables by laboratories in the province of Almeria was 36,000.

9 One square metre of vegetables consumes an average of 30 g of CO_2/day.

10 A field study performed by the author at the beginning of the 2006/07 agricultural campaign detected 1,100 ha with biological control using depredator insects to fight against plagues, avoiding the use of chemical plant protection products. A total of 9,000 ha were considered to have passed census at the beginning of the 2007/08 campaign, according to the journal F&H: *Frutas y Hortalizas* No. 155, year VIII, pages 18–25.

Figure 54.6: Population of the area under study in 1950. **Source:** Census 1950. Designed by the author.



reaction towards more sustainable models like the present ones.

Environment hygiene and residue management are other significant aspects expressed in the disciplined application of legal regulations, with recollection, treatment, and recycling of plants for both vegetable and inorganic residues But there are still some problems related to these residues, so a number of lines of Research+Development+Innovation are being developed to transform residues into organic fertilizers.

54.6.2 Demographic Impact

Based on census data, the increase of population in Almeria was higher than the average in Andalusia and in Spain as a whole due to the higher vegetative growth and a positive balance in migration. There has been a sustained demographic evolution due to the young age of the settlers and to the migration phenomenon, both aspects arse closely interrelated. In 2004/05 the population growth rate in Almeria was 5.3 per cent, while it was 2.11 per cent both in Andalusia and in the whole of Spain, according to I.N.E. data (figure 54.6, 54.7)

The data for 2005 show a very significant migratory balance, with 4 per cent in Almeria, compared with 1.2 per cent in Andalusia and 1.5 per cent in Spain as a whole (National Census, I.N.E. 2006). This increase of immigrants has accelerated in recent years, with figures above 100,000 that were very unevenly distributed territorially (figures 54.8, 54.9).

From a descriptive analytic perspective this immigration process can be summarized in three phases according to the origin of the immigrants.

- Phase 1: *Intermunicipal movement*: 1954–1970. This coincides with the colonization phase, i.e. the settlement of new farmers in the plotted land and in the new villages. These settlers proceeded from the same town or from neighbouring villages, and were gradually joined by friends and other settlers as a result of the development of the production model. The settling process extended to the end of the 1960's.
- Phase 2. *Interprovincial and regional movement: 1971–1989.* In the context of the Spanish economy the recognition of the success of the agricultural model in Almeria raised investment expectations in the area. Also emigrants returned to Almeria from Catalonia and Europe with their savings and settled around intensive cultivation, together with new residents from other Spanish regions.
- Phase 3. *Intercontinental movement* in the era of globalization (1990–2008). During this period immigration from abroad grew very intensely, at

Figure 54.7: Population of the area under study in 2006. **Source**: Census 2006. Designed by the author.

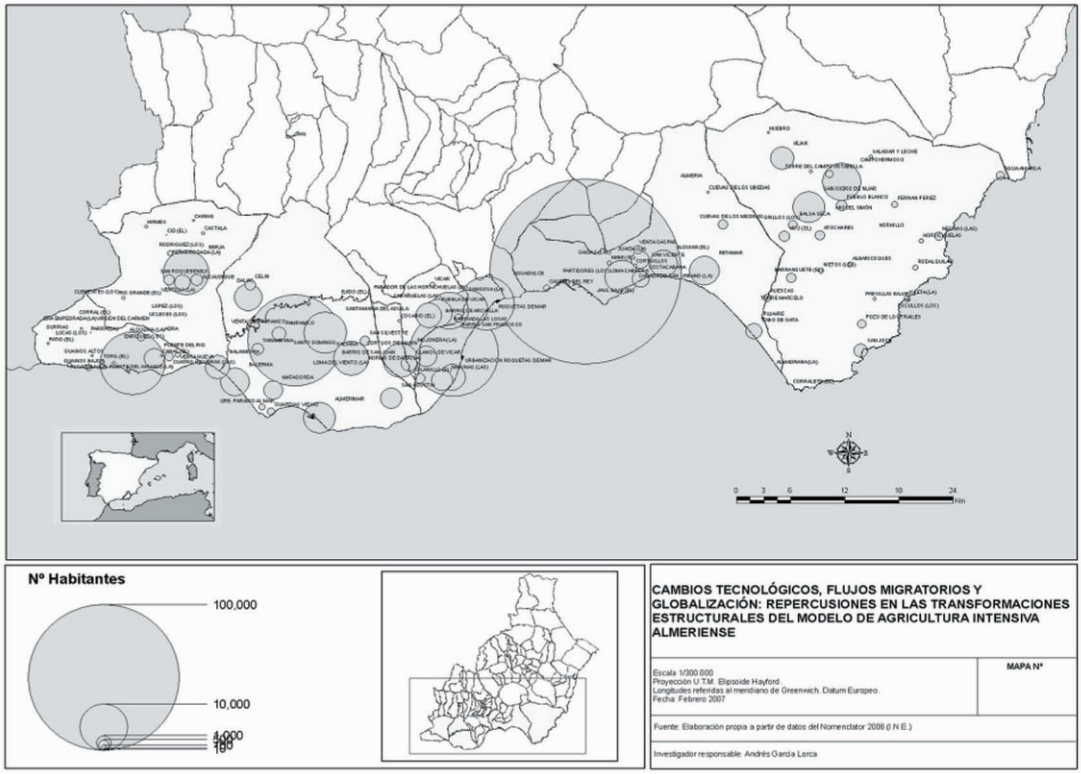
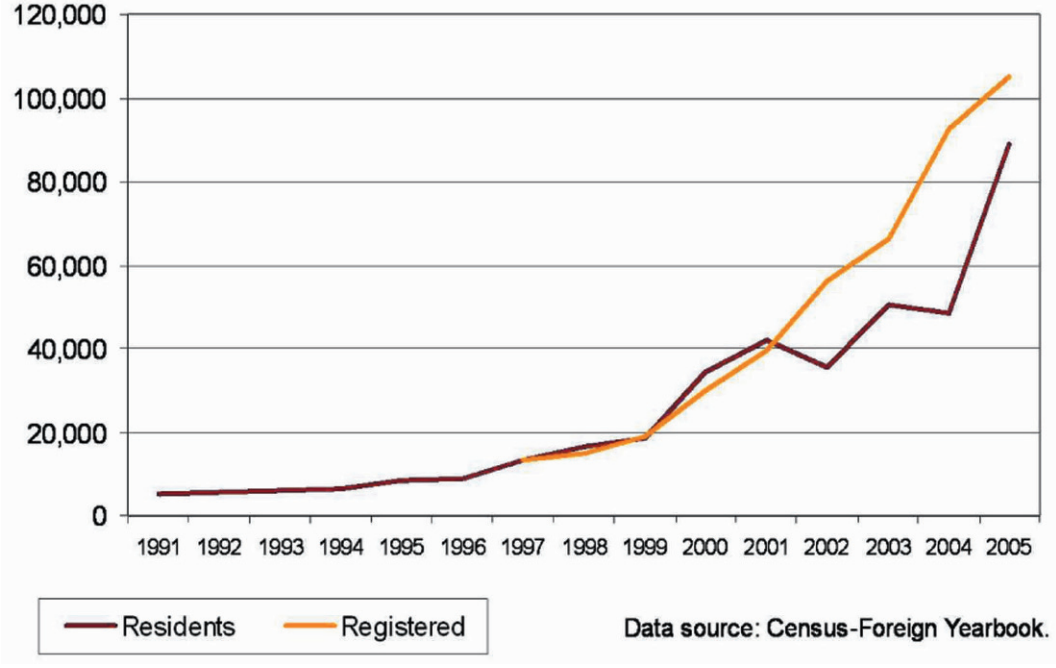


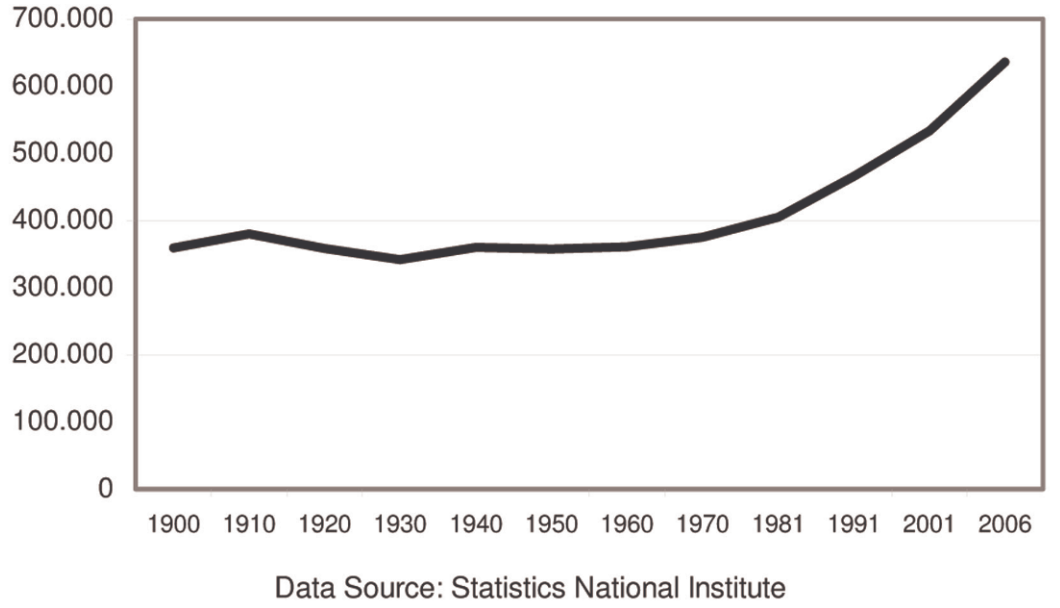
Figure 54.8: Increase of foreigners in Almeria. **Source:** Census-Foreign Yearbook.



first mainly from neighbouring Morocco, but today it comprises 118 nationalities.

Two types of immigrants can be distinguished: a) *labour immigrants* who come to Almeria to earn their living; and b) those who want to improve their quality

Figure 54.9: Demographic growth in Almeria. **Source:** National Institute of Statistics of Spain.



of life by moving to areas with better environmental quality; this group could be called *environmental immigrants*. The former come from Africa, Latin America, Asia, and Eastern Europe, while the latter come from developed countries in the European Union.

For *labour immigrants,* the migratory process in the zone has very specific features. Immigration is based on the demand for manpower in agriculture, but also on opportunities to find a first job which may open the doors to the EU labour market. This explains the constant renewal of personnel which complicates the development of stable and trained staff, and has also developed an informal manpower which makes real control of immigration extremely difficult (figures 54.10, 54.11).

The case of the *environmental immigrants* presents a very complex problem linked to the environment of the territory where they settle and their cultural origin. This has provoked environmental tensions in the consumption of natural resources, water and land (they want to settle in the countryside, in single-family houses with swimming-pool and garden), and if possible close to a golf course, apart from other territorial tensions, as they do not follow territorial and city planning criteria, thus generating problems in pollution, territory disarticulation, and also not contributing to the development of general territorial planning systems, road networks, water supply and sanitation, and public services. This has accelerated land speculation and produced severe losses of natural heritage. For example in towns like Arboleas, in the year 2006, of 3,042 inhabitants, the foreign population is 1,829 people, of which the English community with 1,477 people reaches 48.55 per cent of the total population.

Statistics distinguish between residents – legally documented foreigners – and those who are only municipally registered, who only appear in the municipal census, although many of them appear in the census but do not have a legally recognized status, either because they have no identity card, pending repatriation, or have entered the country illegally; in any case they are recognized subjects with respect to the access to welfare services, but they cannot sign work contracts. In order to understand this reality, and bearing in mind that young people emigrate, the welfare data offered by the S.A.S. indicate that during the 2000/2005 period 111,505 health cards were issued, 824,808 health actions were performed, and there were 99,540 hospital day cases.[11]

This model of immigration, with a constant increase in uncontrolled human flows, provokes a social conflict which is not exempt of a certain level of violence, given the precarious conditions of immigrants prior to their access to the labour market. There are also socio-cultural adaptation problems which complicate the integration processes.

According to the 2006 census, the structure of the immigrant population is quite revealing with regard to

11 Data from: Immigration Attention Programme, Health Authority, Regional Government in Andalusia (2006).

Figure 54.10: Increase of registered foreigners in Spain, Andalusia and in Almeria**. Source:** Census 2006.

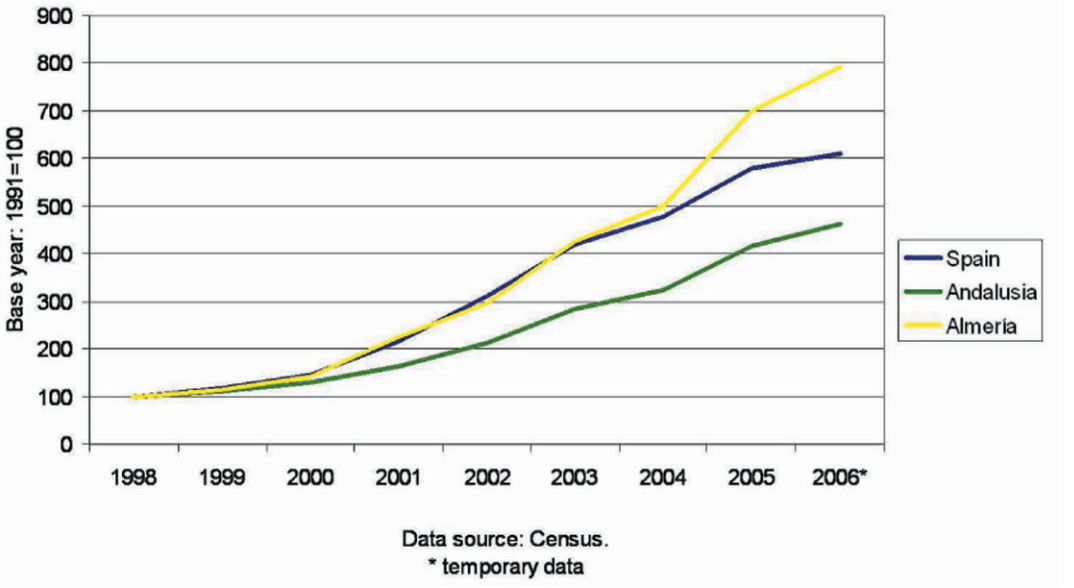
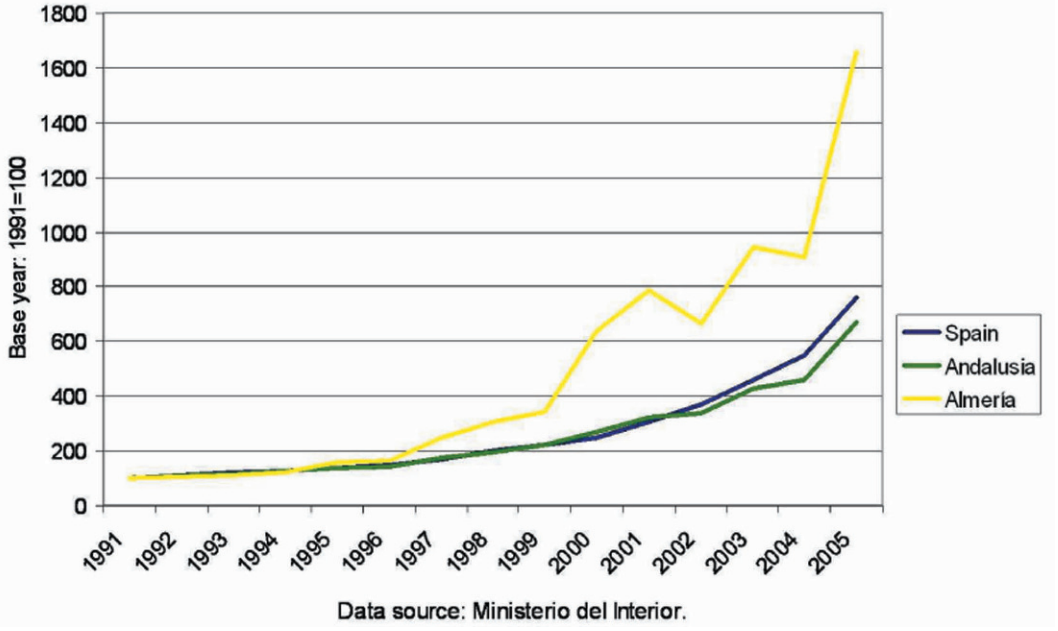


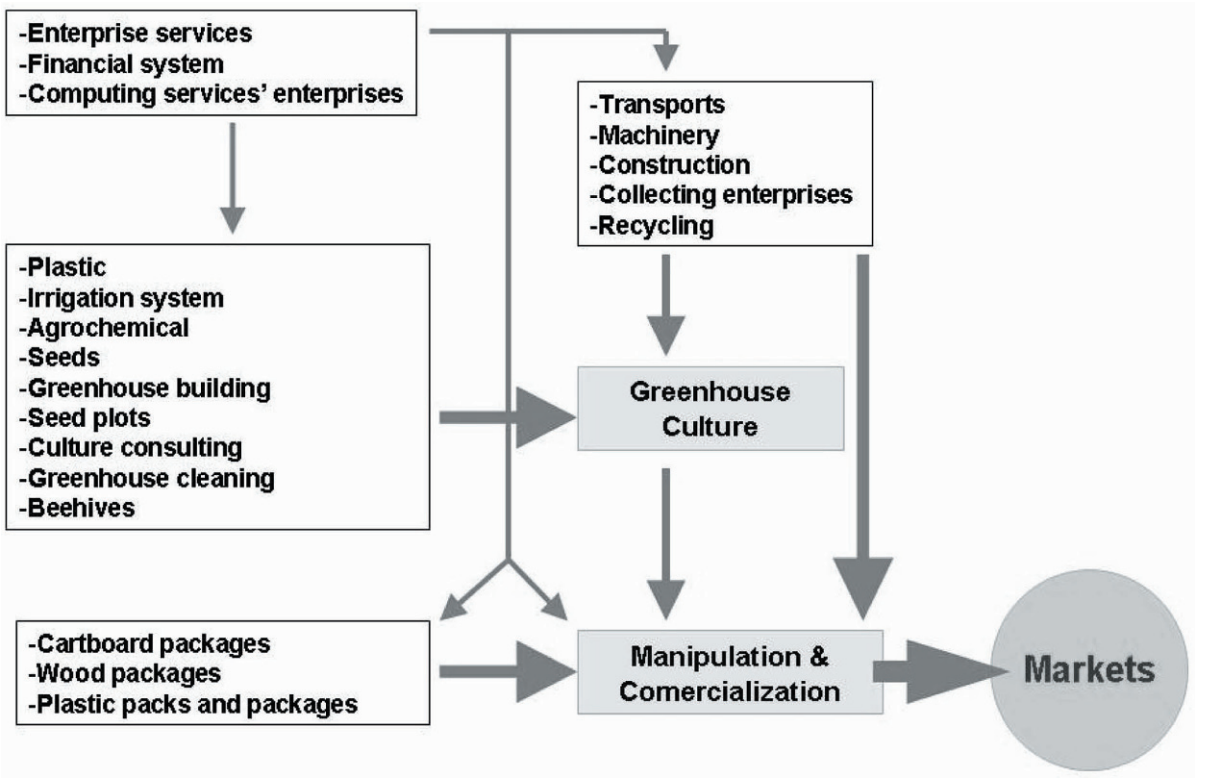
Figure 54.11: Increase of resident foreigners**. Source:** Ministry of Interior.



their origin. In 2006, 44,991 people came from Africa, of which 35,634 were Moroccans. The second largest group with 38,602 people come from EU countries, of which 16,540 are Romanians looking for work, while British immigrants reached 10,071 people, moist of them being 'environmental immigrants'. Latin America immigrants account for 17,205 people, of which 8,212 people come form Ecuador. About 1,715 people come from Asia, of which the Pakistanis are the most numerous group, with 812 people.

The migration policies of different governments have not produced satisfactory results. The constant flow of illegal immigrants combined with the lack of an administratively regularized work force, are responsible for an alteration of the labour market which has important consequences for the productive system and social stability. While the fact that many immigrants are Moslems has not provoked cultural clashes, it has generated the development of parallel societies. Some immigrant organizations are considered as dan-

Figure 54.12: Cluster of the agricultural model of Almeria. **Source:** Cajamar Foundation (2004: 25).



gerous for the security and stability of the host country. In Almeria some immigrants belong to '*Justice and Charity*', '*Tablig Al Dawa*', '*Moslem Brothers*', '*Former Salafista Group for Liberation and Combat*', while others are members of other associations aligned with *Salafía Jihadía,* which is known to be under *Al-Qaeda*. [12]

54.6.3 Socio-economic Development

In general, the intensive agriculture model has served as an impulse for all economic sectors of Almeria and its proximities. It has even generated endogenous business behaviour and methods in management and commerce. The existing demand in services and the equipment generated by the development of intensive agriculture led to the emergence and subsequent expansion of a business structure which has developed a leading role during the last decade, not only covering local demand but also extending to the regional and international sphere.

This business cluster may be defined as a self-developed model. Ferraro and Aznar (2005: 303) called it a *Local Productive System* (LPS) which they defined as

> ...a set of economic activities in a territory with commercial and cooperation links, with a shared labour market and a common know-how, which provides external economies for the territory, which are competition factors added to those pertaining to each company.

There were no technological or business precedents in the territory where the process has evolved. The model emerged and grew due to the impulse of the territorial needs, and as a result of the agricultural productive model. Although it is true that in the initial phases and even in those of the development of the agricultural model, some input was provided by local agents, the rest was marketed by foreign companies. As technological and equipment needs increased, there was a similar increase in the development of a locally based auxiliary industry, although it was unorganized and followed market impulses. It reached its present configuration and presence in the economic system during the 1990's. Now the sector is constituted by 250 companies from 14 productive sectors which may be grouped in four types of activities: in-

12 FLORES, F. *Foco Sur* nº128 October 2007 , pages 20–22.

dustrial, commercial, services, and research (figure 54.12).

Labour and production is important locally, as some 20,500 direct jobs have been generated, from which 12,000 are in the handling sector and the remaining 8,500 jobs are in other activities, the average productivity per worker being 145,000 €, although it varies much according to the specific activities. In 2007, 47.1 per cent of the economic activity focused on the local market, 44.3 per cent on the national market, and 8.6 per cent on the foreign markets. Its main clients are Morocco, Kenya, and Latin American countries, like Mexico and Chile that need non-complex and inexpensive technologies.

The Almeria economy is now based on services, agriculture, construction, and industry. For its population of 630,000 inhabitants, there are 57,208 business licenses for different sectors. Some sectors are highly consolidated, like tourism with hotel availability of 49,751 beds and close to 3 million visitors coming per year.[13] These data summarize the strength of the productive and financial system and indicate that the commercial balance in Almeria is positive. In 2005, Almeria had an export surplus of 272 per cent, compared with 81 per cent for Andalusia and 68 per cent for the whole of Spain.

54.7 Concluding Remarks

The primary challenges facing the agricultural model are not the environmental physical constraints, i.e. of water and land, but the human limitations, i.e. of transport policies and manpower. The increasing dependence on waged manpower, with a low level of efficiency due to its mobility and training, and also due to cultural differences and slow integration, has hampered productivity compared with the competition from nearby third countries with lower social and labour costs. The difficulties in using alternatives to road transport for vegetables, in light of transport restrictions and regulations for road transport in Europe, have increased transport expenses that reached 100 per cent from Almeria to European markets, what has reduced the competitiveness in production.

Despite the power of the productive sectors, and magnitude of the services (57 per cent of GVA [Gross Value Added], agricultural activity has been and continues to be the real leader in regional development, and has been responsible for the financial figures for Almeria that have been higher than those of Andalusia, equal to those in Spain, and close to those of the most developed EU countries.

The environmental and territorial risks mainly originate from the demand-driven town planning development model which often ignores the fragility of the environment although it bases its settlement criteria on 'environmental quality'. The environment has been preserved thanks to the absence of anthropic pressures. The housing and tourism sectors need extra resources to ensure higher standards of living, which endangers those very standards and the whole territorial model.[14]

13 Financial Studies Service of the Almeria Chamber of Commerce (2006): "Almería en cifras 2005". Chamber of Commerce of Almería and CAJAMAR Savings Bank.

14 In a study directed by the author it has been evidenced that in a coast town there are plans for building for urban use (residential tourist use) 85% of the town surface. Martin Garcia; J. "Cambios de uso del suelo en el litoral del Levante almeriense" PhD dissertation. University of Almeria. June 2007.

55 Land-use Changes, Desertification, and Climate Change Impacts in South-eastern Spain

Jorge García Gómez, Francisco López-Bermúdez and Juan Manuel Quiñonero Rubio

55.1 Introduction

The south-east of Spain is a semi-arid area suffering marked rainfall seasonality, with frequent and long dry seasons. Inappropriate human activities and developments in unsuitable areas have caused soil erosion and degradation that are expected to increase due to negative effects of climate change ranging from moderate to severe depending on the specific scenario. This chapter reviews current land-use changes and their effects on desertification[1] taking a specific regional climatic change scenario into account from the *National Ministry of Rural and Marine Environment* (MARM 2007, 2008) and the *fourth assessment report* (AR4) of the *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b) on agriculture and urbanization.

These two issues are studied and their economic impact on the area and their role as driving forces and pressures that affect land-use changes and desertification processes. Both are studied in the Campo de Cartagena in the surrounding coastal area in Murcia (Spain) where very intensive agriculture and marginal dry farming coexist, and where water availability is under risk. Moreover, a further intensive land-use change has occurred from natural or agricultural areas to urban settlements, changing the economic and social structure and increasing the need for water. The evolution of land-use changes, its causes and consequences are reviewed, together with the projected climate change for Murcia and the interactions among these factors. The conclusions suggest that the role of government in managing territories must be stressed since it is the only key actor that can manage in a coordinated way the different approaches of agriculture, urban development, and the environment.

55.1.1 South-eastern Spain Facing Desertification

The landscape of south-east Spain is a product of its geographic location, of its climatic and geo-morphological conditions, and of human history. These complex and functional territorial systems are the result of interactions of factors that vary greatly in nature and intensity, due to physical (weather, terrain, soil, water...), biological (wildlife), and human (culture, use, and management of land and its resources in history) drivers. In Murcia the physical environment heavily impacts on humans. But irrespective of the impact of physical factors on these ecosystems, for millennia human action has profoundly influenced landscapes, systems of land-use, and ecosystem degradation, particularly of soil and vegetation (López Bermúdez 1996, 1999).

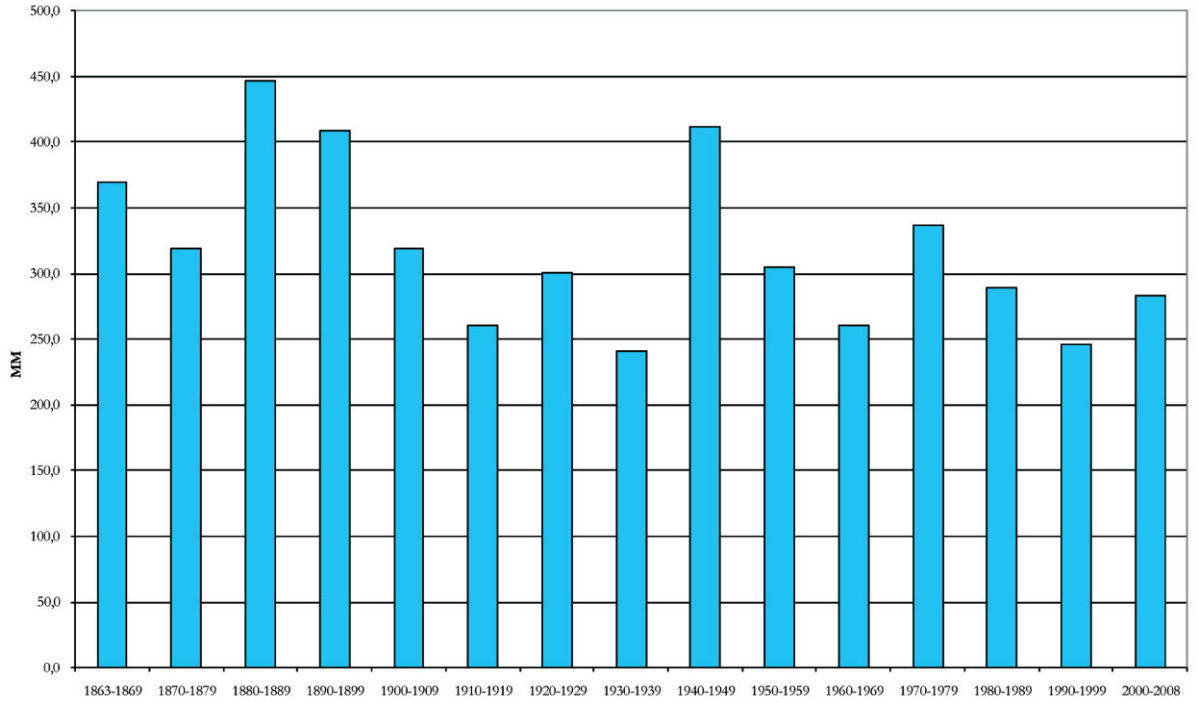
The south-eastern part of the Iberian Peninsula offers a large variety of geo-morphological and bioclimatic landscapes, due to its location in a transition region between North Africa and the rest of Europe, between the Mediterranean coasts and the continental mainland, and its terrain features and climate history. In this region a large variety of landscapes exists that are defined by a constant dualism of coastal plains vs. coastal mountains, of river valleys vs. highlands, of topographical depressions vs. mountains above 2000 metres, of sharp contrasts between shady or sunny exposures and upwind and downwind orientations. There are also strong contrasts between irrigated and dry rural landscapes as well as densely and scarcely populated areas.

Many ecosystems and agrosystems are seriously degraded or are at risk of degradation due to a combination of drought recurrence, soil and water degra-

1 According to the UNCCD convention, 'desertification' is defined as "land degradation in arid, semi-arid, and dry sub-humid areas, resulting from various factors, including climate variations and human activity."

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_55, © Springer-Verlag Berlin Heidelberg 2011

Figure 55.1: Average rainfall in the Region of Murcia, by decade (1863-2008) in mm. **Source:** *Regional Statistics* (Murcia: Regional Ministry of Economy and Treasury, 2008).

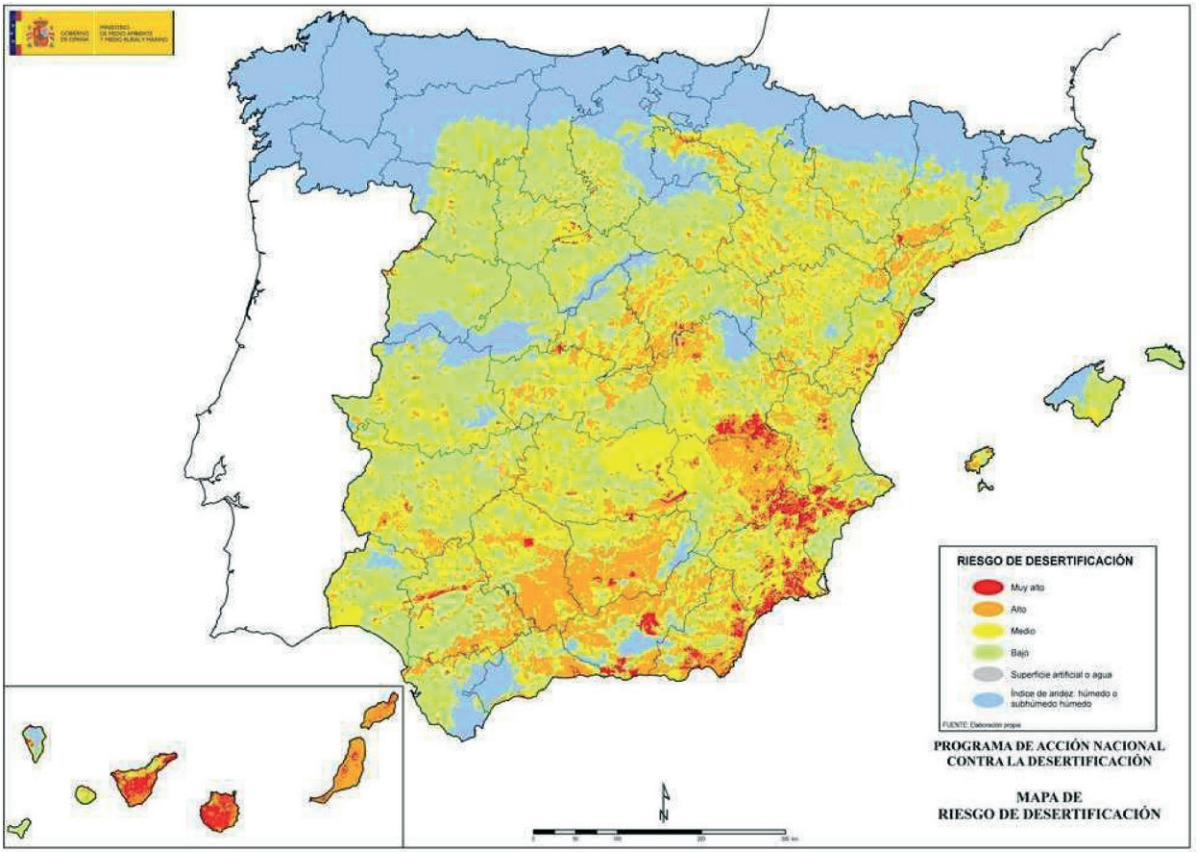


dation, wildfires, land clearance for cultivation, groundwater overexploitation, soil and water salinization, wetland drainage, abandonment of traditional practices of soil conservation, littoralization of greenhouse-based intensive agriculture and of population, discharge of dangerous chemicals, reclassification of land for speculative housing developments, etc. The result has been a worrying increase in ecosystem degradation at several scales. This complex process is known as desertification, and it prevents the preservation of basic resources in terms of quantity and quality, as well as sustainable development.

The south-east of Spain is a climatic region (Vilá 1971; Geiger 1973; Font Tullot 1989) that is mainly determined by its aridity. It is the driest and most arid region in Europe, where most of the territory obtains between 170 and 350 mm in precipitation. The strong and long summer drought can be observed in the annual totals. However, rainfall is best defined by its strong variability, about 50 per cent, with the highest volumes recorded in autumn, sometimes concentrated on a few hours. This strong intensity causes important water erosion in bare or sparsely covered soils, water course overflow and floods, with heavy economic and environmental impacts (chap. 90 by Quiñonero-Rubio/López-Bermúdez/Alonso-Sarría/Gomariz-Castillo). Extension, frequency, intensity, and duration of wet and dry periods are key factors in south-eastern Spain. Other features of this climate are: strong solar radiation and albedo, average annual temperatures between 15 °C and 19 °C, high potential evapotranspiration and highly negative moisture balances during most of the year.

The dry nature of most of the region severely constrains the development of vegetation and rain-fed agriculture. In the south-east, there are clear limits to the development of a continuous tree layer, as well as a mosaic structure of vegetation determined by orientation, exposure, soil, and lithology (Barberá/López Bermúdez/Romero Díaz 1997). It is the broad extension of soft lithologies, unfavourable soils, and centuries of human activities that have hampered plant development and facilitated the effectiveness of erosion processes, by both rainfall impact (splash) and surface runoff, as evidenced by the profusion of rills, gullies, ravines, and wadis. These processes have created a landscape that prevails throughout the Mediterranean region: the 'badlands'. Since the 1950's a process of environmental change has occurred where the impacts of climate change and desertification processes can increasingly be observed.

Figure 55.2: Desertification risk in Spain. **Source:** *National Ministry of Rural and Marine Environment* (MARM): PAND National Action Plan against Desertification; at: <http://www.mma.es/portal/secciones/biodiversidad/desertificacion/>. Colour range goes from very high (red) to low (green) and humid and sub-humid areas (blue).



55.1.2 Historical Evolution of the Environmental Crisis

South-east Spain has been under ecological stress for centuries, as most dry Mediterranean regions. However, the present economic system that has favoured certain types of inappropriate farming (clearance of forest land, irrigation with poor quality water, frequent abuse of agrochemicals), overexploitation of groundwater, forest fires, and discharges from industry and tourism, have caused more ecological changes and damage than has previously occurred during human history. An increasingly strong interaction between human activities and geo-ecological equilibria can be observed that have degraded large areas where almost sub-desert conditions prevail. This is defined as desertification, a process of environmental change due to the alteration of the ecobalance by excessive or inadequate human pressures on ecosystems that have been weakened by drought and aridity, i.e. an imbalance between the natural resource system and the economic system using them (López Bermúdez/García Ruiz 2008; López Bermúdez/Barberá 2000; Puigdefábregas 1995; Puigdefábregas/Mendizábal 1998).

Many studies show that degradation of ecosystems by human activities has been neither linear nor irreversible over time, but that they are related to factors like climatic fluctuations, population density, level of social organization, and the systems used for resource exploitation (Dregne 1983; Ibáñez/Valero/Machado 1997; Brandt/Thornes 1998; López Bermúdez 2001). To address the respective impacts related to natural processes or human activities has been a difficult task due to the complexity of the process and the similarity of the impacts, which are not easily identifiable in the landscape.

In the Mediterranean regions of the Iberian Peninsula, pollen diagrams have shown significant changes in the vegetation structure and a growing presence of xeric plants from the Holocene up to modern times

(Gilman/Thornes 1985; Follieri 1996; Burjachs/Febrere/Rodríguez/Buxó/Araus/Julia 1997). The causes have been attributed to climatic fluctuations towards a more arid climate and to pressures from Neolithic populations on vegetation cover due to the emergence of agriculture and domestic livestock. At this early age of human technological progress, the evolution of landscapes was more conditioned by climatic fluctuations than by human action. The Roman colonization modified heavily the plant landscapes through abusive logging and extensive land clearance for agriculture (for cereals, vines and olive trees), grazing and mining.

The Muslim and medieval times seemed relatively stable and allowed the recovery of Mediterranean ecosystems in south-east Spain. Muslims introduced new agrarian systems and modes of land development and management. The introduction of new hydraulic systems for irrigation and of new species grown in irrigated conditions meant a profound break with previous agricultural traditions that were based on extensive rain-fed cultivation of cereals and implied deforestation and use of large spaces (García Latorre/Sánchez Picón 1998). Between 1501 and 1812, the livestock institution known as La Mesta enjoyed great privileges granted by the Kings. The millions of sheep and goats, moving along trails called *cañadas, veredas,* and *cordeles* appear as critical determinants of forest degradation and meant a return from irrigated agriculture to rain-fed cultivation of cereals, and vineyards, and to wool sheep ranching. Land clearance for pastures and cereals were conducted at the expense of plant cover. In addition, the boom in shipbuilding and mining caused the clearing of large forested areas covering the mountains of the south-east. Naked soils, stripped of protective vegetation, were exposed to severe water erosion processes (López Bermúdez 2001).

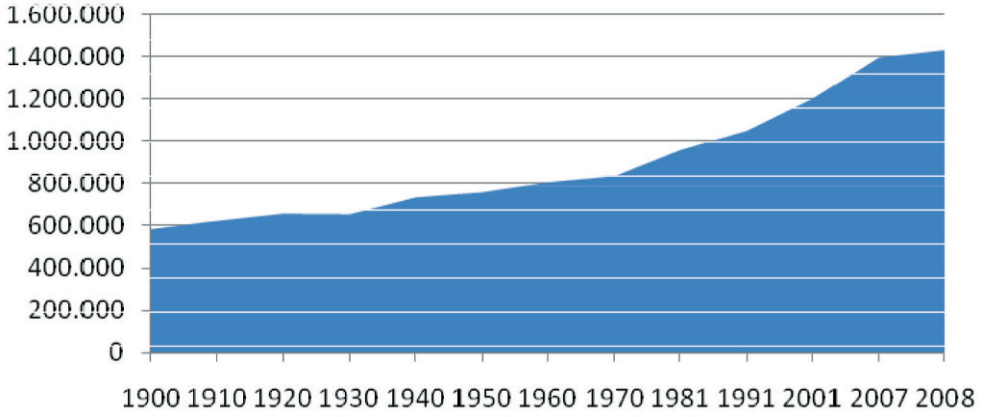
The demographic crisis of the 17th century slowed the clearing of forest land and allowed some recovery of the vegetation cover, however, deforestation was already well advanced in the 18th century and most of the land had become barren with little or no fertility. The degraded soil, devoid of vegetation, and the heavy rains recorded in this century activated, once again, the mechanisms of erosion and increased surface runoffs and flooding risk – severe floods hit the land and the populations. In the mid 19th century, the disentailment laws had serious environmental consequences because of the sale of public and church forests to individuals. This privatization resulted in the loss of more than four million hectares of forest in Spain (a considerable amount in the south-east) with dire consequences for forest soils. Intense rain and strong runoff mobilized millions of tons of soil that went to the bottom of valleys, lowlands, and the sea. The loss of vegetation cover left the soil unprotected and produced, once again, an acceleration of water erosion and the development of large bare areas, which, in turn, increased the risk of extensive inundations and flash floods (López Bermúdez/Navarro Hervás/Montaner Salas 1979; Canales 1989; Molina Sempere/Vidal-Abarca/Suárez 1994). The forests, providers of public goods (not entering the market) and environmental and recreational functions, were subjected to unsustainable exploitation by private owners. This has been described as the most tragic event in the history of Spanish forests (Bauer 1991).

During the second half of the 19th century and the first half of the 20th century, population growth and its food needs generated a strong demand for cereals that contributed to the expansion of clearings for rain-fed crops at the expense of marginal lands and forests. The consequences of this process became soon manifest: erosion processes were aggravated, with rills, gullies, and ravines thereby increasing their size and density, extending badlands landscapes. In conclusion, the centuries-old deforestation that occurred in the south-eastern part of the Iberian Peninsula and its implications (the alteration of the hydrological cycle, activation of erosion processes, significant loss of soil, degradation of ecosystems, increased risk of flooding, and other environmental impacts) have transformed this region into one of the most threatened by desertification and climate change in Europe.

55.2 Land-use Changes in the South-east of Spain

Land-use changes have increased in speed and intensity during the last three decades, which had a special effect on the Mediterranean (Margaris/Koutsidou/Gioura 1996). These human-induced changes have been more severe than nature-induced changes. Among all human activities many changes were triggered by regional policies that were often influenced by external factors, such as the EU's *Common Agricultural Policy* (CAP), which is linked to other processes due to economic activities and dynamics. These processes have introduced new driving forces and effects that need to be taken into account (like rural abandonment).

Figure 55.3: Evolution of the Population in the Region of Murcia (1900-2008). **Source:** *National Institute of Statistics* (INE) of Spain (1900-2008).



All these social, legal, political, and economic aspects have determined in recent years changes in land-use, and thus a large imbalance between the economic, social, and environmental sectors, leading to greater unsustainability of the system. This unsustainability has led, in many cases, to the emergence or acceleration of processes of land, environmental, and social degradation and, therefore, poses a serious problem that affects large areas of the Mediterranean region. For instance, the abandonment of dry farming cultivations (cereals, almonds...) or their conversion into irrigation farming, especially in slope areas, has led to an increase of runoff, soil degradation, and severe impacts on the value of the landscape.

The south-eastern part of Spain has experienced great changes during the last two decades. The strong population increase (from 2001 to 2007 the population grew from 1,190,000 to 1,392,000 inhabitants, or by 16 per cent) has been also associated with an increased use of resources, far greater than that of GDP (INE 2003). Therefore, the growth has occurred at the expense of a disproportionate use of resources, especially of the land, one of the most valuable resources (OSE 2007, 2008), which has faced strong irreversible processes. The two major developments in land-use change are:

- The intensification of agricultural crops, with the transition from rain-fed cultivation to irrigation, and the intensification of existing irrigation systems;
- The changes to an urban use of land derived from the unprecedented increase in the property business.

Another important phenomenon related to changes of land-use has been the abandonment of land. However, in the areas studied here (i.e. of coastal or intensive agriculture) this phenomenon is irrelevant due to the high potential of land-use, since the irrigation infrastructure had already been built or the demand for recreational uses offered an alternative use for the existing land. These possibilities and demands act as true driving forces. Also, rain-fed crops tend to be the first to be abandoned, but in these coastal and intensive farming areas, the transition from rain-fed to irrigation cultivation date back to the 1970's and 1980's, with the water transfer between the rivers Tagus and Segura and the modernization of irrigation.

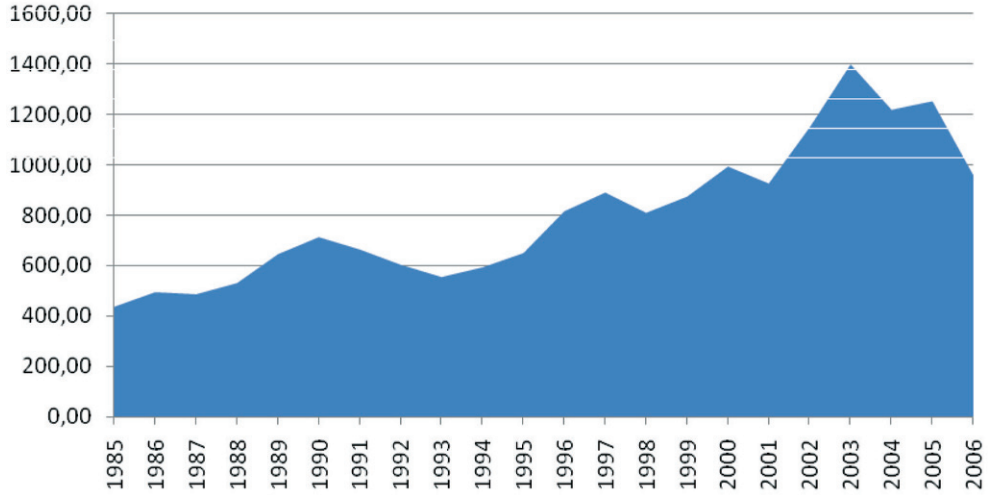
The Corine Land Cover 2000 project (EEA 2000) and the *National Action Plan against Desertification* (PAND) have summarized the changes in land-use (MARM 2008).

For *artificial areas* these changes were observed:

- accelerated development of urban areas and infrastructure from agricultural areas that were, in some cases, very productive; (In the case of Murcia this development is due to the arrival of immigrants and the increase of residential tourism).
- accelerated and intense artificialization of the coastal strip, especially in the first kilometre of the coastline;
- taxing artificialization because of the deterioration of wetlands;
- development of highly visible open cast mining areas from forest areas;
- smaller but highly significant development of urban areas from forest areas.

For *forest and agricultural areas* these changes were noted:

Figure 55.4: Evolution of the GVA (Gross Added Value) at market prices for the agricultural sector in the Region of Murcia. (1985-2006). **Source:** National Institute of Statistics (INE) of Spain (2009).



- continuous and uncontrolled development of permanent irrigation areas from rain-fed areas;
- development of forest areas from agricultural areas, usually due to their abandonment (marginal land) or afforestation;
- development of forest areas as a result of new forest crops;
- development of areas of scrub from burnt forest areas; and
- loss of high-quality forest areas due to wildfires and ecosystem fragmentation.

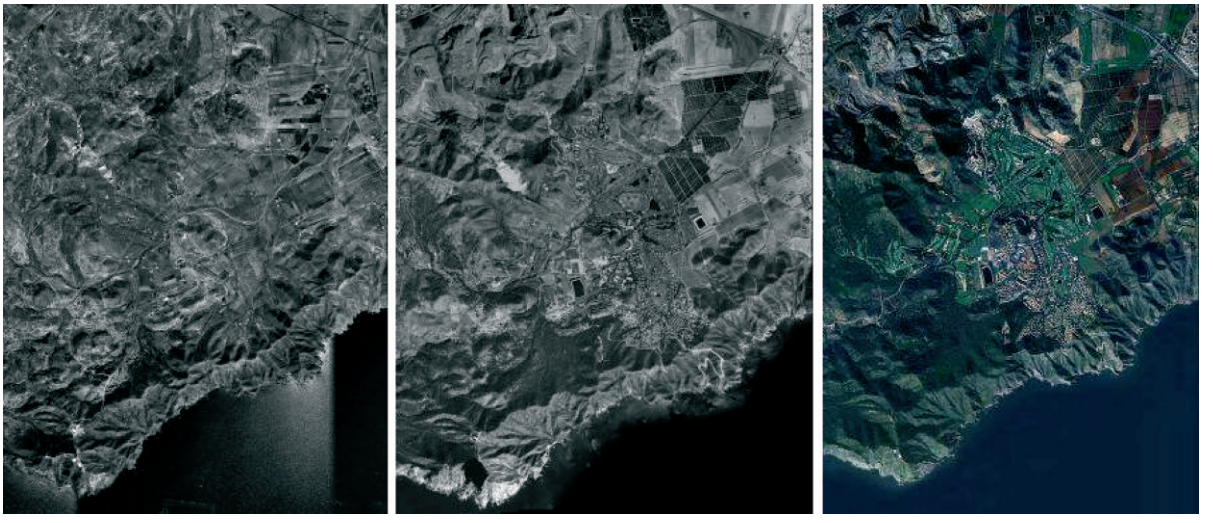
These land-use changes have produced these phenomena that can be summarized as follows:

- *Increase of artificialization:* there is an expansion of the artificial surface largely due to urbanization, which creates a mostly discontinuous urban fabric. The artificialization is especially intense in the first kilometre of the coastline and around urban areas, and it means also the loss of natural areas, which means the loss of quality and functionality in the ecosystems.
- *Increase of intensive irrigation:* from rain-fed or traditional irrigation areas. This increase implies greater pressure on resources and greater environmental stress, because humans modify it to fit to cultivation necessities instead of adapting cultivations to the soil and climate conditions. This, together with the increase of population, leads to an increase of water needs and water shortage.
- *Changes in the runoff and water retention and circulation patterns* and, in general, the hydrologic cycle.
- *Alteration of forest ecosystems*: the abandonment of marginal agricultural areas favours the spread of forest areas through colonization. This phenomenon occurs mainly in agricultural areas that were previously reclaimed from the forest. It is important to bear in mind that, in many cases, the abandonment of agricultural land (profoundly altered by man) does not automatically lead to the recovery of the forests but, on the contrary, may accelerate the processes of soil degradation, erosion, and desertification.

There is an area in Murcia where land-use changes have been really intense during the last 40 years: the 'Campo de Cartagena' along the coast. The arrival of water from the river Tagus (water transfer Tagus-Segura rivers) led to the development of an intense irrigation farming from the ancient dry farming, covering currently more than 40,000 ha in 7 municipalities (for a total area of 116,000 ha). In the same area an intense population increase and tourist development occurred during the last 25 years, with the construction of many new settlements and holiday homes. This example of human-induced land-use changes applies to many Mediterranean areas. This development is illustrated below (figures 55.5, 55.6, 55.7, 55.8), where it is possible to see the most common processes of changes in land-use in Murcia. The land-use changed from more sustainable and less resource demanding use to less sustainable and more resource demanding use.

Figure 55.5: New urban settlements in traditional farming or forest areas. Here it is possible to see the whole process of land change: dry farming to irrigation farming and then to housing development. The satellite images of the *Campo de Cartagena* coastal agricultural area were taken in 1956, 1997, and 2007. **Sources**: The 1956 aerial photo, taken from a USAF flight, is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).

Figure 55.6: In this case, the images (1956, 1997 and 2007) are located in the coastal area near the city of Cartagena. The house development process started at the end of the 1980's and continues until present. **Sources:** The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).



55.3 Climate Change Scenarios for Murcia in the 21st Century

The climate change scenarios that were assessed by the IPCC (2003, 2007a, 2007b, 2007d) and developed by MMA (2006, 2007a, 2007b) show, despite their different numerical values, a clear qualitative trend in the south-eastern part of Spain for this century. In short, their basic characteristics are:

Figure 55.7: Intensification of farming activities in traditional dry-farming areas. In this sequence (1956, 1997 and 2007), located near the town of Fuente Álamo, the change to more intensive farming activities is shown. **Sources:** The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1997 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2007 is from Ministry of Development (Ministerio de Fomento) PNOA (National Plan of Aerial Ortophotography).

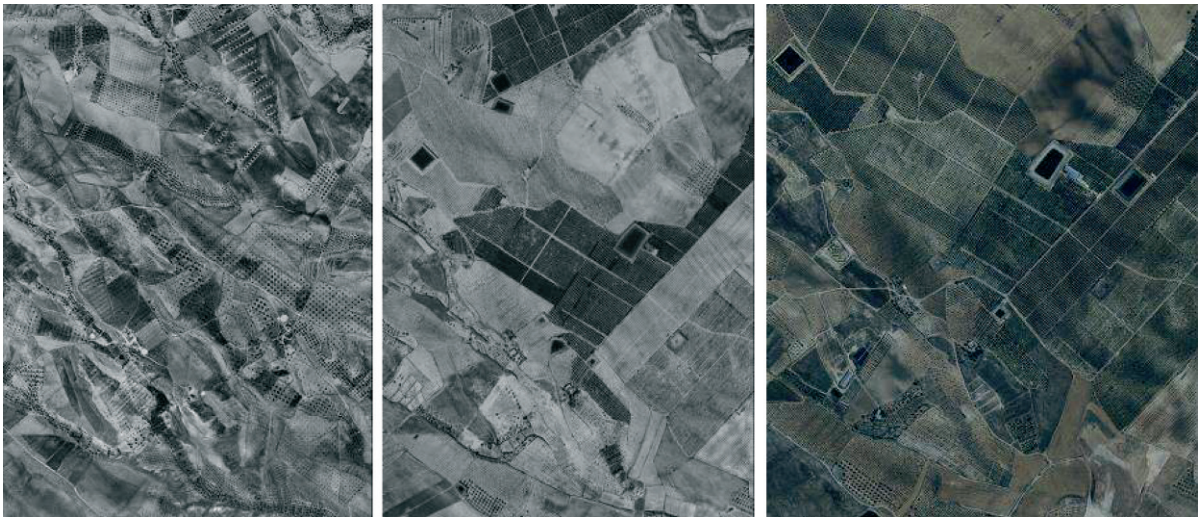
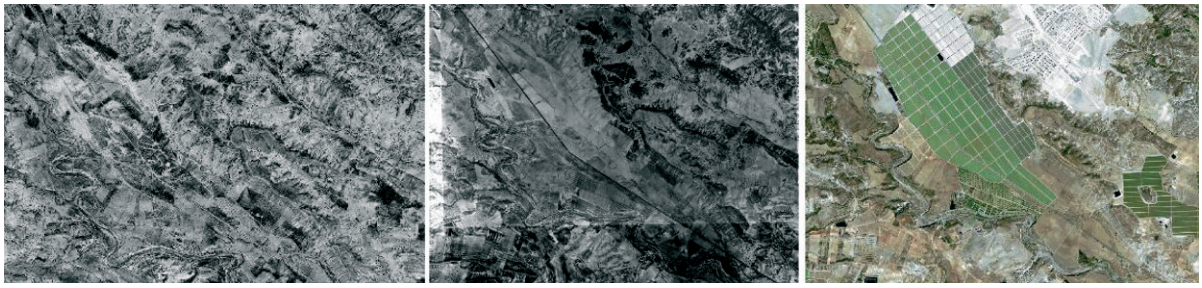


Figure 55.8: Irrigation development. Development of irrigation farming in Rambla de *Las Moreras*, Murcia (1956, 1987, 2003) **Sources:** The 1956 aerial photo is from a USAF flight and is the property of the Instituto Geográfico Nacional de España; the photo of 1987 is from the Ministry of Environment and Rural and Marine Affairs. Olive GIS mapping (SIG oleicola); and the photo of 2003 is from Regional Ministry for Agriculture and Water based on "Quickbird" satellite images.



- A gradual increase in surface temperature throughout the century, which is accelerating very sharply since the mid century in the case of scenarios of higher global emissions, with very significant differences in the average annual or seasonal warming between the various emission scenarios (differences of up to 3 °C), most noticeable in summer and less severe in winter. Spring is the season where the warming would tend to be higher.
- There is a trend for the daily thermal oscillation (difference between maximum and minimum temperature) to increase in various climate change scenarios, especially in those assuming high emissions. This trend would be lighter in winter and more pronounced in spring.

For the region of Murcia other studies (López-Bermúdez/García 2004, 2005) show that, for the period between 1863 and 2002, the annual mean temperatures show a growing trend of around 2 °C, based mainly on the rise of the minimum mean temperatures, which show a significant increase (of 2.1 °C for the studied period). These data differ from averages reported in IPCC reports, but are based on data obtained from measurements of temperature since 1863.

The scenarios on the change in annual precipitation present a less regular trend than for temperatures. A progressive declining trend is projected, which will be more pronounced after the mid century and even higher for the high emission scenarios. For 2011 to 2040, the projections show a similar reduction

in the total annual precipitation for the different emission scenarios, with values around 5 per cent. However, between 2070 and 2100, the contrast between high and low emissions scenarios is much higher, with reductions that would exceed 30 per cent in the A1 scenario and around 20 per cent in the B1 scenario. The seasonal mean values of relative humidity tend to decline in general and in all seasons, but with higher rates in the summer than in the winter.

Average insolation is projected to rise in all regions due to a lower cloud cover. In spring and autumn, the reduction rates are higher in the southern half of the peninsula, while in the winter the changes are less significant with regard to the current climate.

The regions most prone to an increase in the drought hazard are the Mediterranean regions, where the river flows decrease significantly, especially in the summer. However, other factors such as land-use changes, water management practices, and extensive water withdrawals have considerably changed the natural flows of water, making it difficult to detect climate change-induced trends in hydrological variables. In general, annual river flows have been observed to decrease in the south of Europe, a difference projected to intensify. Strong changes in seasonality are projected, with lower flows in the summer and higher flows in the winter. As a consequence, droughts and water stress will increase, particularly in the south and in the summer (European Commission 2008a).

Another very important aspect of the climate projections is the possible change in the intensity and frequency of extreme weather events. The Iberian Peninsula and especially its south-east have been affected by several major droughts during the last century and more recently a catastrophic drought was linked to a heat wave in the summer of 2005. The concern is that the impacts due to changes in climate extremes are usually more severe than those associated with the change of the average climate, because, although the frequency with which such events occur is relatively small, the damage they produce for the environment, socio-economic activities, or human health are often quite serious. In this regard, all projections indicate that there will be a marked increase in the intensity and frequency of extreme events related to temperature in all Spanish regions, which will be significantly greater in the highest emissions scenarios.

55.4 Interactions of Climate Change, Desertification, and Land-use Changes

Due to its geographical situation and its socio-economic characteristics, the south-east of Spain is highly vulnerable to both climate change and desertification that are closely linked and are both a source of risk. Moreover, both are influenced by (albeit at different scales) and also determine medium- and long-term changes in land-use. In this dry area climatic conditions and desertification feed each other positively and affect the land-use. Many ecological, economic, and social sectors and systems are vulnerable to climate change and desertification, such as biodiversity, agricultural and forest soils, water resources, forests, agro systems, mountain areas, river and marine ecosystems, tourism, urban development, industry and energy, transport and insurance.

The assessment of desertification and climate change is complex due to uncertainties. So is the prediction of land-use changes in the future. The forces driving these changes are highly dependent on human activities, rather than climatic conditions: the legislative and regulatory policy, the economic situation and external factors (that affect both agricultural markets and the housing demand for recreational use) have been central to the changes in land-use, its influence being more important as the level of economic development gets higher. In south-eastern Spain the economic situation (sustained growth and recurring positive future prospects) and the housing boom (also used as a safe way to invest and a saving by many people), supported by a favourable attitude of the authorities, created a situation that has provoked a profound change in land-use and a very important alteration of the landscape.

The current diametrically opposite economic situation and the exhaustion of the urban model, allow at least ensuring that in the near future, urbanism will not be a significant driving force, and if so, it will not be a global phenomenon but rather a local feature. As for the intensification of agricultural activity, with increases in water demands by 50–70 per cent in the Mediterranean areas (and this is projected to continue), there is an increasing competition for water between sector and use. Farming (at least with regard to intensive irrigation) is conceived at present as a conventional economic activity, increasingly disconnected from its social component, and thus increasingly subject to market forces, so that future decision-making will be analysed from a purely economic point

of view, taking production options, costs, and profitability into account. It can cause the migration of these activities to areas with fewer conflicts over resources and lower costs (e.g. in North African countries), a process that has already started.

Desertification contributes to global climate change through the loss of capacity for carbon sequestration and the increased albedo on the Earth's surface. The land can be degraded by frequent and intense droughts and by high-energy rains because of these extreme events associated with climate change. With a reduced availability of water and increased temperatures, the water balance will be substantially modified and water stress will increase in many areas that are threatened by desertification, such as the Mediterranean countries, in particular Spain and its south-eastern region. This will necessarily affect decision-making on land-use changes at the local level, what in turn can cause a worsening of environmental conditions.

The impacts of climate change on soil can be very important. Changes in the bio-physical nature of the soil are likely, due to projected rising temperatures, changing precipitation intensity and frequency, and more severe droughts. Such changes can lead to a future decline in soil organic carbon stocks and a substantial increase in CO_2 emissions. Adapted land-use and management practices could be implemented to counterbalance these impacts. Projected increased variations in rainfall pattern and intensity will make soils more susceptible to water erosion. Projections show significant reductions in summer soil moisture in the Mediterranean, and increases in the north-eastern part of Europe (European Commission 2008a). Soil degradation is already intense in parts of south-eastern Spain, and with prolonged drought periods it is already contributing to an increased risk of desertification. In many cases, desertification has become irreversible, leading to adverse social, economic, and environmental effects.

The projected climate-induced changes in the hydrological cycle will aggravate the impact of other stresses (such as land-use and socio-economic changes) on water availability, freshwater ecosystems, energy production, navigation, freshwater supply and use (in agriculture, households, industry) and tourism. Adaptation actions will be needed, such as improving water efficiency to mitigate water stress and enhance retention to reduce flood risk.

In agriculture, climate change affects the growing season and average yields while also key relevant land-use and management changes occur, making it difficult to detect climate change-induced trends. There is a need for adaptation of farm practices and land management to reduce or avoid adverse impacts. Some of the adaptation options such as irrigation may however increase emissions because of increased energy consumption.

55.5 Conclusions and Recommendations

All major changes in land-use in southern Spain in recent years have always evolved into situations where pressure on the environment and natural resources increased. On the other hand, the different options for climate change always involve a more complicated availability of natural resources and more fragile ecosystems. All this happens in a geographical area that is extremely vulnerable to desertification, with great dependence on water resources due to the economic and social importance of agricultural activities (about 8 per cent of regional GDP) and tourism (the building sector accounts for more than 11 per cent of GDP). Therefore all possible future situations seem to become more difficult for humans and for their development, and it appears that climatic conditions will be in the future more important in decision making processes related to land-use. The main resource for much of the current economic activity (water) will become increasingly limited, which will cause conflict among potential users that can affect decision-making in several ways.

To limit adverse impacts, adaptation is needed. Adaptation involves all levels of decision making, from municipalities to national levels. It is a cross-sectoral and transboundary issue which requires comprehensive integrated approaches. Economic sectors that are particularly concerned with adaptation include energy supply, health, water management, agriculture, tourism, and transport. Integration of adaptation into sectoral policies at the European and national levels is important in order to reduce, in the long term, the vulnerability of ecosystems, economic sectors, landscapes, health, and communities to climate change impacts. Future land-use change decisions will include in the future land abandonment (if no alternative use to intensive agriculture can be found) and other major changes in the economic activities (with, probably, initial unemployment and economic crisis stages). Administrations must be ready for this problem, designing measures for alleviating and supporting changes in the area. Currently the European regulations are the

main driving force that induces Regional Administrations to act. It is necessary that these Administrations, as key managing actors of the territories, develop their own territorial management, adapted to each specific area and taking into account the expected scenarios for the future. There have been positive management practices developed in Murcia during the last years that can be useful for coping strategies. On the other hand, it is also possible to remark negative practices that do not help to solve the problem and that can worsen the effects of land and resource use on degradation processes. Regarding positive actions to avoid or reduce land degradation in the future, it is possible to mention:

- *Environmental regulations in the agricultural activity*: the programme for fighting erosion (2007–2013) developed by the Regional Ministry of Agriculture and Water in Murcia. This action relates agricultural subsidies to conservation practices and, for the first time, includes also constraints for certain activities that have a negative effect on the environment. It includes compulsory soil covering in dry cultivations (almond, olive...) and limitation of the cultivation in slope areas (by eliminating subsidies for these cultivations if they are developed in plots on higher slopes than accepted but giving also the possibility to receive subsidies if farmers change the land-use to forests). Compulsory actions and limitations on subsidies on cultivations managed in non-appropriate areas are new in these regulations. It can be necessary when market and traditional driving forces are, often, more powerful than voluntary environmental regulations.
- *Development of plans for improving water efficiency*: Water for agriculture means 80 per cent of the water use in Murcia. A major effort was supported by Regional and National Administrations to modernize the agriculture and increase the use of drip irrigation. While the total irrigated area declined by about 10,000 ha from 2001 to 2008 (from around 163,000 ha to 153,000 ha) the area irrigated with drip irrigation increased from 74,500 ha to more than 122,000 ha (of which ca. 25,000 ha are in the *Campo de Cartagena* area), which means an increase of 63 per cent and represents 80 per cent of the total irrigated area. This improvement in the irrigation efficiency is essential to cope with fewer resources available in the future and to prevent conflicts among water users.
- *Development of clear protection and regulation programmes in areas of environmental interest*: The development of management plans for protected areas (areas of Community interests) are providing these sites with planning tools that include forest management and agricultural regulations that will protect the areas and avoid soil degradation. This action, necessary for EU protected areas, is the first territorial management practice that includes all activities and can help to avoid conflicts and to better manage these areas.
- *Afforestation measures*: There is a large tradition in afforestation activities in semi-arid regions like Murcia. These have evolved from aggressive interventions on the landscape (affecting shapes and using hard machinery) to activities that are more adapted to the area, taking real possibilities of development of afforested areas into account. This, together with a better management of forest areas to avoid forest fires (a major challenge and a severe damage to Mediterranean ecosystems) has led to an increase in the forest area by more than 17 per cent in 12 years between 1987 and 1999 (National Forest Inventory 2002).

But there are still significant gaps. There is no clear and adopted territorial management policy. Agricultural regulations are not enough in these economically dynamic areas, with other sectors affecting the environment. The regional authorities must be the key actor managing future resource conflicts but this has not yet been determined. The experience with the bad management of the building boom (where the economic profit was the driving force) must be used to improve the role of the regional administration in an area where many competencies of territorial management are developed by local administrations but ruled and controlled by the regional bodies.

56 Reconsidering Integrated Water Resources Management: Promoting Economic Growth and Tackling Environmental Stress

Jakob Granit

56.1 Introduction

Integrated Water Resources Management (IWRM) is today widely advocated by natural resources managers and the scientific community as the preferred approach to manage water. IWRM stresses the river basin as the single management unit and the integration of freshwater using sectors and stakeholders across society.

No doubt, effective water resources management and development are fundamental to achieve sustainable growth and to meet environmental objectives in all societies. Underinvestment in water management and storage in developing regions increases the vulnerability to rainfall variability and floods and droughts cause water related shocks to the society and the economy. In industrialized regions, on the other hand, where water resources have been extensively utilized for economic development through agriculture, hydropower, and industrial production, freshwater and marine ecosystems are showing increasing signs of environmental stress. This is clearly demonstrated by the spreading of dead zones in coastal seas. An underlying cause is water quality degradation due to euthrophication caused by excess nutrient runoff from intensive agriculture production and the burning of fossil fuels for transport and energy production.

Two case descriptions of the Nile and Baltic Sea Basin regions illustrate the dual challenge of both the need to develop water resources to contribute to economic growth and the need to manage water quality degradation because of development. This chapter asserts that IWRM needs to be re-considered and be broadened to better meet development and water quality concerns in the economy as a whole.

To verify this thesis, this chapter will offer an analysis of scientific, policy and development literature. *First*, it will assess water resources in an economic development context and illustrate tradeoffs from regional development. *Second*, it will discuss the evolution of IWRM and the emerging critique of its usefulness. *Finally*, it will suggest how the IWRM paradigm could be re-considered in three ways to meet economic growth and environmental management objectives at the regional level.

56.2 Water Resources in Economic Development and Environmental Trade-offs

56.2.1 Water as a Public and Private Good

Transboundary water resources management is considered a public good as well as a source of public goods (Jägerskog/Granit/Risberg/Yu 2007). Typical use of water resources as a public good include recreation, aesthetics, biodiversity, flood risk reduction and water quality improvement. These goods and services are 'public' because they benefit all and the consumption and quality of water to produce these goods and services does not limit the availability of water to other users.[1] At the same time, water transforms from being a public good to a private good when the use of water resources moves to the private domain and contributes to generate private goods and services. Examples of this include electricity generated from hydropower, agriculture products and water supply for drinking water and industrial production (GWP 2000; Jägerskog/Granit/Risberg/Yu 2007). When water is

1 The International Task Force on Global Public Goods describes public goods as goods that address issues which: (i) are deemed to be important to both the developed and developing countries that make up the international community; (ii) typically cannot, or will not, be adequately addressed by individual countries or entities acting alone, and, in such cases (iii) are best addressed collectively on a multilateral basis. See at: <http://www.gpgtaskforce.org/bazment.aspx> (19 March, 2009).

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returned to the recipient according to agreed standards and regulations, it is again in the public domain.

Water resources cross boundaries within countries and between countries. There are an estimated 261 river basins globally that cross international boundaries. These international river basins cover about 45 per cent of the earth's surface (Wolf/Natharius/Danielsson/Ward/Pender 1999). Managing and developing these transboundary water resources is in itself a public good (Jägerskog/Granit/Risberg/Yu 2007).

56.2.2 Water and Economic Development

Effective water resources management and development are preconditions of sustainable growth and poverty reduction (e.g. Grey/Sadoff 2007; UN Water 2009; Winpenny 2003). Growing demand for public and private goods and services is increasing the pressure and competition for water and natural resources at the regional and local levels (UN Water 2009). Water is a fundamental input for many businesses and services creating important employment opportunities (Granit/Berntell 2008; Merret 2008; UNEP FI 2007; Winpenny 2003). During the past 100 years the world's population has tripled but the use of water has increased six fold (GWP 2008).

How to best allocate water for different purposes to optimize the generation of both public and private goods and services is debated in water policy, customary and modern law at the national and international level (see e.g. Hooper 2006; EU 2000; McCaffrey 2001; Newson 2004; Salman/Bradlow 2006; Tropp 2007; Turton/Hattingh/Gillian/Roux/Claassen/Strydom 2007). The debate centres on the issue of how to prioritize water use in a given context, whether to use market or state controlled mechanisms to optimize water allocation and use, and how to share benefits accrued from water management and development in the society (GWP 2000, 2009).

In developing regions, underinvestment at the national level in water management institutions, capacity building and water infrastructure has led to mismanagement of water resources and competition among user groups (UN Water 2009; World Bank 2003b). This in turn blocks the development potential in several key sectors and has a negative impact in meeting poverty alleviation objectives (Grey/Sadoff 2007). Broad-based water service interventions in water supply and energy utilities, water and sanitation and irrigation services benefit everyone including the poor and play a major role in reaching some of the *Millennium Development Goals* (MDG, see UN Water 2009; Winpenny 2003). Many countries and regions are off track towards meeting the water supply and sanitation target of the MDG (WHO 2004). This policy target (number three) states that by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation should be halved.[2] Following current trends, the targets for water supply would be met by 2040 and for sanitation not until 2076 (WHO 2004). It is argued that US$1 invested in improved water supply and sanitation yields gains of US$4–US$12, depending on the type of intervention (SIWI 2004). Without means to capture rainfall in the landscape or in artificial storage, a high degree of rainfall variability will turn into high output volatility and increased risk coverage against water shocks to the economy from the devastating impacts of floods and droughts (Grey/Sadoff 2007).

The World Bank (2003b) asserts in its Water Resources Strategy that countries must take action on several fronts to build sustainable societies. This includes increasing their capacity to manage water resources and provide security against rainfall variability, floods, and droughts. This entails broad based interventions, including major infrastructure projects such as dams and inter-basin transfers, which provide local, national and regional benefits (Grey/Sadoff 2007). Chenoweth (2008) states that it is effective human organization that is critical in ensuring sufficient water availability for domestic needs and for facilitating economic development. Extreme water scarce states that also lack petroleum assets such as Malta, the Maldives and Israel, can achieve good social and economic development even though plentiful water resources is more beneficial to societal development (Chenoweth 2008). From a management and development perspective, a combination of weak institutional frameworks and lack of hydrological and meteorological observation systems are obstacles for effective water resources planning and development at the regional, national and local level (CAPNET 2008; GWP 2009).

While industrialized countries have invested significantly in major water management capacity and water infrastructure, many developing countries have not. In hydropower development, for example, industrialized countries use most available hydroelectric potential as a source of renewable energy. Many developing countries, on the other hand, harness only a small fraction of available hydropower potential. In Africa only 7 per cent of the technical and economic hydropower po-

2 See at: <http://www.un.org/millenniumgoals/environ.shtml> (13 March, 2009).

tential is exploited compared to 22 per cent in Asia, 69 per cent in North America and 75 per cent in Europe.[3]

In the case of Mozambique, the World Bank (2007b) claims that high variations in rainfall, combined with limited storage facilities and underdeveloped flood control infrastructure are the main factors contributing to the high variability in the river flows. This variability results in water shortages in a number of basins during dry seasons and a high risk of water related shocks to the economy and the society. Mozambique's economic performance is significantly affected by the frequency of floods and droughts. Analysis suggests that the GDP growth in Mozambique is cut by 5.6 per cent, on average, when a major water shock to the society from drought or floods occur (World Bank 2007b). Similarly, in Tanzania the World Bank (2006c) notes that the 2003 GDP growth rate of 5.6 per cent was less than the projected rate of 6.5 per cent. It is argued that this is largely because of the impact that drought had on the agriculture, manufacturing, livestock and energy sectors (World Bank 2006c).

Grey and Sadoff (2007) introduce the concept of water security which summarizes the development challenges in the water resources sector in developing regions. Water security is defined as the "availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies." Water security can be enhanced if the capacity to harness the productive potential of water and limit its destructive impact is increased.[4] This means adjusting the structure of the economy of a country to move it out of a water dependent low-equilibrium poverty trap through significant investment in the sector (Grey/Sadoff 2007).

The *Nile Basin Initiative* (NBI) is an example of how developing countries that share a river basin can explore development options and work cooperatively towards greater water security (box 56.1). The country partners in the NBI jointly identify necessary investments in institution building, human capacity, infrastructure and the environment and explore options to sharing benefits derived from the utilization of the Nile Basin water resources. It is also an example of how countries can work in a collaborative framework without having a formal agreement of water allocation in place that is recognized by all riparian countries.

56.2.3 Environmental Trade-offs From Water Management and Development

In industrialized regions and in countries in economic transition the external effects of poor water management and development are evident. The Baltic Sea Basin (box 56.2) clearly illustrates this situation. While point-source pollution from industry and urban areas has been largely addressed, diffuse pollution from land-based anthropogenic activities, such as from agriculture production, road and air transport, and energy production has not yet been managed (Lääne/Kraav/Titova 2005).

Dead zones in the coastal oceans and seas have spread exponentially since the 1960's and provide evidence of the long-term environmental stress caused by the intensive use of water for different purposes (Diaz/Rosenberg 2008). The formation of dead zones has been exacerbated by the increase in primary production and consequent worldwide coastal euthrophication fuelled by riverine runoff of fertilizers and the burning of fossil fuels. Diaz and Rosenberg (2008) report that dead zones have been found in more than 400 marine systems affecting a total area of more than 245,000 square kilometres and are generally located in areas with major population centres and watersheds that deliver large quantities of nutrients. The increased use of industrially produced nitrogen fertilizer that began in the late 1940's is also highly likely to have lead to the spread of dead zones (Diaz/Rosenberg 2008). The *Swedish Environmental and Protection Agency* (SEPA 2006) concludes that nitrogen input to the Baltic Sea has increased fourfold and phosphorus input eight times since the mid 19th-century. This has resulted in massive algae blooms of Cyanobacteria and other toxin producers resulting in dead zones in bottom waters in deep basins (Diaz/Rosenberg 2008).

3 See: International Hydropower Association; at: <http://www.hydropower.org/downloads/F4%20Hydropower%20Making%20a%20Significant%20Contribution%20Worldwide.pdf> (13 March 2009).

4 See the chapters on water security in the previous volume of Hexagon Series by Oswald Spring/Brauch (2009); Allan (2009); Shiva (2009); Affeltranger (2009); Aydin/Ereker (2009); Hayek (2009); Selby (2009); Jageskog (2009); Adly/Ahmed (2009); Kameri-Mbote/Kindiki (2009); Ashton/Turton (2009); Kipping (2009, 2009a); Borghese (2009); Lindemann (2009); Rakel (2009); Wunderer (2009); Martius/Froebrich/Nuppenau (2009); Tignino (2009).

Box 56.1: The Nile Basin Initiative (NBI): Management and development efforts in a transboundary basin. **Sources:** See at: <http://www.nilebasin.org/> (23 March, 2009).

The Nile river basin encompasses an area of about 3 million square kilometres. Ten countries, with a total estimated population of 300 million people share the Nile river basin: Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The population in the basin countries is expected to reach 600 million by 2025 (Adly/Ahmed 2009; Kameri-Mbote/Kindiki 2009).

Human security is strongly linked to poverty reduction. In the Great Lakes region in East Africa at the head waters of the White Nile, poverty is fuelling civil strife at the local and sub-regional scale (Falkenmark/Folke/Granit/Jägerskog/Mathews/Molden/Rajagopal/Scanlon/Schulze/Sendama 2002). The rationale for improved water resources management is to contribute to sustainable economic growth and poverty alleviation. The total potential annual direct gross economic benefits of Nile water utilization in irrigation and hydroelectric power generation are estimated to be on the order of US$7–11 billion (Whittington/Wu/Sadoff 2004).

The Nile riparian countries took a major step to establish the NBI in 1999, an initiative that includes all Nile countries and provides an agreed basin-wide framework to fight poverty and promote socio-economic development in the region. The NBI follows a set of institutional arrangements supported by international organizations and technical cooperative frameworks on hydrometeorology and environmental protection since 1960 (McCaffrey 2001). The initiative is guided by a shared vision "to achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources."

The Nile riparian countries seek to realize their shared vision through a strategic action programme, comprising basin-wide projects and joint investment projects at the sub-basin level. This programme seeks to exchange experience, build capacity and trust and create an enabling environment for investments (Whittington 2004). Seven basin-wide projects address issues that are common for all the riparians. This includes: transboundary environmental concerns, regional power trade, agricultural production, water resources planning and management, communication, applied training, socio-economic development and benefit-sharing (World Bank 2008e).

To unlock the development benefits, the riparian countries are exploring investment opportunities in multipurpose water management and development by collaborating in two Subsidiary Action Programmes. The two programmes are the *Eastern Nile Subsidiary Action Programme*, which includes Egypt, Ethiopia, and Sudan and the *Nile Equatorial Lakes Subsidiary Action Programme* (NELSAP), which includes Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania, Uganda, Egypt and Sudan. The two downstream countries, Egypt and Sudan, are directly affected by developments upstream and hence also members of NELSAP (Falkenmark/Folke/Granit/Jägerskog/Mathews/Molden/Rajagopal/Scanlon/Schulze/Sendama 2002). Approaches taken to increase joint investments include pre-investment studies, such as *Strategic/Sectoral Social and Environmental Assessments* (SSEA), and the design of far-reaching multi-purpose programmes in areas such as IWRM, flood management, power generation and interconnection, and irrigation and drainage (King/Noël/Granit 2008).

The NBI is closely linked to other cooperative frameworks including the *East African Community* (EAC). Modelled on the EU, the EAC is *a Regional Economic Community* (REC) that provides a broader framework linking natural resources management with regional economic development. Currently, EAC has five member countries in the upstream part of the Nile Basin (Burundi, Kenya, Rwanda, Tanzania, and Uganda). EAC manages through regional regulations move the member countries into legislative compliance that would be difficult to achieve on a voluntary basis[5].

The NBI provides a forum to explore water security and promotes a cooperative process with the stated objective of bringing tangible benefits to the basin (Song/Whittington 2004). The alternative would be unilateral actions which could lead to tensions and conflicts (Falkenmark/Folke/Granit/Jägerskog/Mathews/Molden/Rajagopal/Scanlon/ Schulze/Sendama 2002). The decision-making process is strong with the Nile Council of Ministers for Water Affairs serving as the highest decision-making body of the NBI. The core cost of this arrangement is supported by the Nile Basin countries through payment of annual dues (World Bank 2008).

5 See at: <http://www.eac.int/> (23 March, 2009).

Box 56.2 below details the situation in the Baltic Sea Region, the impacts of large scale euthrophication and the response by the basin countries and the *European Union* (EU).

Box 56.2: The Baltic Sea - the ecosystem that 'flipped'. **Source:** The author.

The summer of 2005 served as a wake-up call for all citizens around the Baltic Sea. Alarming reports in the local newspapers about toxic algae blooms, dead sea zones caused by anoxic conditions, and the loss of fish species resulted in heated debates about the 'flip' of the Baltic ecosystem.[6] The citizens, believing that the scientists had a clear picture of the reasons for the current state of affairs, were shaken by the fact that the root causes threatening the Baltic ecosystem were not known. An open conflict between different scientific disciplines on the root causes of euthrophication ensued (SEPA 2006).

The political and economic geography of the Baltic drainage basin is complex. Fourteen riparian countries fully or partly lie in the basin: Belarus, Czech Republic, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Slovakia, Sweden, and Ukraine. Nine of these states border the Baltic Sea directly and only Russia is a non EU littoral state.[7]

There are a multitude of complex linkages and feedbacks between the land-based ecosystems of the drainage basin, the sea-based ecosystems and the human economic systems (Lääne/Kraav/Titova 2006; Lundqvist/Granit/Rahm 2007. Subsequent studies have made an attempt to assess these and put an economic value on the cost of euthrophication. The benefits of accomplishing a Baltic Sea undisturbed by excessive inputs of nutrients are calculated to be about 5 billion Euro annually (SEPA 2008).

At the policy level, the UN Conference on the Human Environment in Stockholm (1972) was the first global conference highlighting the linkages between human well-being, the environment and economic growth.[8] The next major regional step in the Baltic Sea Region was the establishment of the *Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea* (HELCOM; Räsänen/Laakkonen 2007). It became the first international management regime on the protection of a regional sea (Joas/Jahn/Kern 2008). In 2007 HELCOM agreed on a *Baltic Sea Action Plan* that sets clear but voluntary ecological objectives to realize the joint vision of a healthy marine environment.[9] However, in spite of the work through HELCOM evidence indicates that this form of traditional cooperation and coordination have been inadequate (Joas/Jahn/Kern 2008).

With the EU enlargement process in 2004 there has been a strong Europeanization process (Joas/Jahn/Kern 2008) offering new management opportunities of the Baltic Sea as a public good. The EU has developed different forms of regulations and laws to link freshwater and oceans management that address the management challenges at each stage from source to sea. The EU Water Framework Directive (EU 2000) addresses freshwater resources and the *Integrated Coastal Zone Management* (ICZM) principles seeks, over the long term, to balance environmental, economic, social, cultural and recreational objectives within the limits set by natural dynamics (European Commission 2000). The Marine Strategy Directive takes the marine environment as the starting point and directs that each Member State shall, in respect of each marine region or sub-region concerned, develop a strategy for its marine waters (EU 2008). The agreed objectives of achieving a good water status should be reached by 2015 for freshwater systems and by 2020 for marine water systems.

In the three pieces of legislation integration of management objectives and coordination of sectors are stressed. The EU has through these and other environmental legislation managed to ensure compliance by the member states in the area of environmental policy which has never occurred before in the history of the Baltic Sea Region (Joas/Jahn/Kern 2008). The water resources management concept is moving towards a more broad based system analysis and improved understanding of the water management continuum[10] on land, at the coastal zone and in the open sea (Granit 2008).

During 2008 and 2009, the EU Commission is developing a Baltic Sea Region Strategy in consultation with the member states and Russia.[11] This is the first regional strategy the EU Commission is developing to address the environment with a focus on making the Baltic Sea Region a prosperous, accessible, attractive, safe and secure place.[12] With the new integrated governance regime provided by the EU there is a good opportunity to tackle the challenge of legal compliance and integrate the environment into mainstream regional economic planning. Existing management regimes such as HELCOM will need to fit into the coming EU Baltic Sea Region Strategy.

6 See, e.g. at: <http://www.dn.se/opinion/kolumner/smutsen-kanner-inga-nationsgranser-1.369162>; <http://www.dn.se/opinion/huvudledare/ga-till-botten-med-ostersjon-1.561935> (24 March 2009).

7 See at: <http://www.helcom.fi/home/en_GB/welcome/> (13 March 2009).

8 See at: <http://www.unesco.org/water/wwap/milestones/index.shtml> (24 March 2009).

9 See at: <http://www.helcom.fi/home/en_GB/welcome/>.

10 Presentation by Stephen Lintner, Senior Technical Advisor, the World Bank: "Environmental Cooperation in the Baltic Sea Region: Sustained Commitment and Partnership" (19 April 2004).

11 See at: <http://www.svd.se/opinion/brannpunkt/artikel_2421685.svd> (23 March 2009).

12 See at: <http://ec.europa.eu/regional_policy/cooperation/baltic/> (23 March 2009).

56.3 Evolution and Critique of IWRM

IWRM has been actively promoted as the preferred approach to manage water for the past 15 years (Dombrowsky 2007; GWP 2000, 2008, 2009) at both the national and transboundary level. The concept of IWRM was first developed during the International Conference on Water and the Environment in Dublin in 1992. The Dublin Statements on Water and Sustainable Development highlight four principles of managing water. These are that water is a finite and vulnerable resource, essential to sustain life; water development and management should be based on a participatory approach; women play a central part in the provision, management and safeguarding of water and; water has an economic value and should be recognized as an economic good.[13] Later that year these principles were reinforced during the *United Nations Conference on the Environment and Development* (UNCED)[14] and detailed in Agenda 21.[15] The subsequent four World Water Forums (ibid) and the annual World Water Week organized by the *Stockholm International Water Institute* (SIWI) since 1991 have reinforced the IWRM concept.

The *Global Water Partnership* (GWP 2008) defines IWRM as "a systematic process for the sustainable development, allocation and monitoring of water resource use in the context of social, economic and environmental objectives." GWP notes that IWRM departs from traditional natural resources management approaches in three ways (GWP 2000, 2008):

1. The multiple goals and objectives are crosscutting and depart from the traditional sectoral approach in natural resources management.
2. The spatial focus is the river basin with multiple water resources instead of single water courses.
3. It incorporates participatory decisionmaking of all stakeholders (inclusion vs. exclusion).

GWP (2000) argues that IWRM is a problem-solving approach to address key water challenges in ways that balance *economic efficiency*, to make scarce water resources go as far as possible; *social equity* in the allocation of water across different social and economic groups; and *environmental sustainability* to protect the water resources base and the ecosystems upon which it depends. The GWP has played an important role promoting IWRM through its action network of water management actors including government agencies, public institutions, private companies, professional organizations, and multilateral development agencies.

There is a growing global trend towards decentralized governance that supports the IWRM principles (Tropp 2007). This provides opportunities for governments to more actively engage citizens, and corporate and public institutions in the decisionmaking process to tap their creative and innovative capacity. As decentralized governance gains ground, the three clusters of actors in the trialogue (government, scientific community, civil society) need to be engaged and involved in management and development actions (Turton/Hattingh/Gillian/Roux/Claassen/Strydom 2007). In spite of the decentralization trends, water decision-makers and managers are not prepared to fully realize the development potentials of these new forms of governance options and impacts (Tropp 2007). This would include facilitating inclusive decision-making processes emphasizing the management of people and processes, diversity of organizations and knowledge sharing (Tropp 2007).

As illustrated in the case on the Baltic Sea Basin, the EU has encoded IWRM into the EU Water Framework Directive (European Union 2000). This directive expands the scope of water protection to all waters at both the national and transboundary level and establishes management and environmental objectives. The EU has effectively been able to promote IWRM amongst countries with different interests and negotiated a new water management regime valid throughout Europe.

The development of water resources and building capacity to achieve it is a long term process and requires long term support (Jägerskog/Granit/Risberg/Yu 2007). This is true in both in-country and in transboundary contexts. Consistent central government support for basin management, stakeholder involvement and water policy reform is one of the most important factors behind successful water development cases (Kemper/Dinar/Blomquist 2005). The authors continue to argue that while the level of economic development of the nation and the basin matters there is no reason to believe that improvements in water resource management are limited to wealthy basins (ibid). On the contrary they demonstrate that notable

13 See at: <http://www.wmo.ch/pages/prog/hwrp/documents/english/icwedece.html> (24 March 2009).

14 Chapter 18 on the protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources.

15 See at: <http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter18.htm> (24 March 2009).

improvements have been realized in a variety of settings, and sometimes very early in the life of basin organizations and stakeholder participation initiatives (ibid).

Despite the wide uptake of IWRM in both developing and industrialized regions its contribution to economic growth and meeting environmental objectives is being questioned. A growing critique asserts that it is amorphous and questions its track record in the actual provision of development outcomes (Biswas 2008). Further, Newson (2004) argues that IWRM has helped to define a new scientific agenda that is hard to comprehend outside the IWRM epistemic community and has had difficulty creating valuable tools for effective management and development of water. The perception for its failure lies mainly in the inappropriateness of basin management institutions and styles (Biswas 2008) that do not have a clear strategy for engagement with the broader economy.

Allan (2003) argues in a similar fashion that the IWRM approach will not serve the needs of water policy-makers unless it escapes the assumption that the river basin is the fundamental management system. Sustainability is about social and economic processes and integration and management are political processes (Allan 2003). To broaden water issues outside the water sector itself, it is critical to treat politics as both part of the problem and the solution (Granit/Berntell 2008). The two case studies on the Nile and the Baltic basins illustrate clearly how governments at both the national and regional level struggle with the politics of demonstrating development and environmental outcomes from IWRM policy.

56.4 Ensuring Water Resources Development and Management Outcomes - Minimizing Negative Trade-offs

Water experts define the physical drainage basin as the geographical framework and natural unit for water management (GWP 2000; Kemper/Dinar/Blomquist 2005). Socio-economic and political systems, however, are not and will likely never be, confined within these geographic boundaries. Many times IWRM policy is owned by a Ministry for Water or by a *River Basin Organization* (RBO) that has little influence on the policies of a Ministry for Planning or Finance, or key water dependent sectors such as energy, agriculture and the environment. Water experts and managers must therefore adapt to this situation and provide recommendations and management strategies that fit the basin as well as the political, administrative and economical context beyond the river basin. This will ensure that benefits from management and development of water resources are recognized and valued within the broader society.

At the transboundary level, the absence of common frameworks for sharing information and exploring common development options can hinder the exploration of broad based collaborative benefits from water development and the comparative advantage of countries' water endowment from being utilized (McCaffrey 2001; Dombrowsky 2007). In regions with weak cooperative frameworks, collaboration around a shared water body can be the starting point for partnerships in several other associated areas, such as energy markets, transport, and trade of agricultural products as illustrated in the Nile Basin case. In countries in economic transition and in industrialized economies, expectations from cooperation may be slightly different and the outcome of cooperation will in some cases be geared more towards meeting environmental quality objectives and aesthetical values as in the case of the Baltic Sea Basin.

Sharing water is a complex and highly political process (Philips/Claassen/Granit/Jägerskog/Kistin/Patrick/Turton 2008). Simple negotiating strategies among countries are based on perceptions of acquired rights, harm from water development and poor management, and territorial sovereignty that do not tackle the broader political and economic gains that could be gained from cooperation (Grey/Sadoff 2002, Song/Whittington 2004). To develop an appropriate water sharing regime entails negotiations among sovereign states. The skills and preparedness for negotiating regimes that benefit all may differ and be an object for tension and dispute (McCaffrey 2001; Dombrowsky 2007). The capacity to undertake effective negotiations at the transboundary level is determined by the institutional capacity at the country level.

For IWRM to be relevant, it needs to support the delivery of management and development outcomes in the broader economy and geographic context. SIWI (2004) argues that the greatest economic benefits of improved water resources management and water supply and sanitation will be felt in those countries with the greatest water challenges. The role of water in development is stressed by Stern (2002) when he notes the importance of building an investment climate that facilitates growth and empowers poor people to participate in that growth. The quality of infra-

structure including water is a prerequisite for growth along with good governance and strong institutions and macroeconomic stability (Stern 2002). Sachs[16] further notes the linkages between water and development aid and claims that international aid resources should target *inter alia* food production and clean water and sanitation.

To promote the exploration of political and economic gains Phillips, Claassen, Granit, Jägerskog, Kistin, Patrick and Turton (2008) introduces the *Transboundary Waters Opportunity* (TWO) Analysis. The TWO is a simple conceptual framework that can be used by stakeholders concerned with the management and development of shared freshwater resources in a country or between countries. The concept assists in analysing potential benefits in a transboundary river basin to optimize economic growth, political stability and regional integration intended to be used by basin state governments, RECs, and financing entities. The concept stresses four key development opportunities and associated benefits: 1) hydropower production and power trading; 2) primary production; 3) urban and industrial development; and 4) environmental and ecosystem services. To realize these opportunities, countries sharing water bodies need to cooperate and jointly explore opportunities and tradeoffs from development. Such an approach can contribute to overall economic growth and resource sustainability.

Practical examples of benefit sharing beyond the river include the interconnection of electricity transmission networks, the development of power pools for energy markets (King/Noël/Granit 2008) and water transfer schemes developed between basins to meet water demand in water scarce areas (Philips/Claassen/Granit/Jägerskog/Kistin/Patrick/Turton 2008). Such practical ways of distributing benefits through market mechanisms benefit citizens beyond the actual watershed and whole regions. The United Nations General Assembly (GA 2009) highlights the role of reliable and stable transit of energy in ensuring sustainable development and points to the importance of international cooperation in developing transportation systems and pipelines to reach regional benefits. In this context, REC frameworks, such as the *Southern Africa Development Community* (SADC) and the *European Union* (EU), are critically important to ensure the integration of markets and free movement of goods, services and labour that can materialize from water management and development. Where a REC exists, as in the case of the Baltic Sea Basin, the management and development of transboundary water resources can be designed so that it meets and supports the strategic objectives of the REC.

The findings by Diaz and Rosenberg (2008) and of SEPA (2006) indicate the strong *linkages between freshwater use and its impacts on coastal and marine ecosystems*. Beyond the creation of dead zones, poor water management can have numerous negative impacts on coastal regions, such as salt water intrusion into freshwater areas and changes in sedimentation patterns (SEPA 2006). Euthrophication is a clear symptom of stress from water quality degradation that is threatening not only the water ecosystem, biodiversity and the water resources themselves but also other ecosystem services providing added value such as recreation, tourism, and spiritual values.[17] To reduce and reverse costly degradation of the marine environment, the impacts of land-based activities along the coast and further inland that impact water resources must be considered and incorporated into water resources management planning (Gonzalo/Clement/Jønch-Clausen 2008). The IWRM concept needs to be broadened and incorporate tools and methods to address issues on management of water from the source to the sea.

56.5 Conclusions

Transboundary water resources management is a public good that contributes to the achievement of private goods and services. Effective water resources management and development are essential to achieve sustainable growth and to meet environmental objectives in all societies and at all levels. This chapter highlights the dual challenge of the need to both develop water resources for economic growth and the need to manage environmental tradeoffs from water resources development at the regional level.

The concept of IWRM has been developed over the past 15 years as the preferred management response to water challenges in the society. This chapter asserts that IWRM is not effectively delivering much needed development outcomes and also does not effectively provide good integrated management tools

16 Jeffrey Sachs: "A new system of development finance", in: *Financial Times*, 27 November 2008; at: <http://blogs.ft.com/wolfforum/2008/11/a-new-system-of-development-finance/>.

17 Special Report: "Troubled Waters", in: *The Economist*, 3 January 2009.

to achieve environmental objectives in regions where water resources have been developed.

It is concluded that the IWRM approach needs to be re-considered in three ways to better meet water management and development challenges at the regional level.

- *First*, it should include the broader political and economical context beyond the river basin. This is to ensure that benefits generated from water management and development are properly valued and become part of the broader economic development planning. RECs provide useful vehicles to ensure a broader integration of IWRM objectives in economic planning.
- *Second*, IWRM should more strongly promote investments in hydraulic infrastructure for multipurpose water use to ensure real development outcomes in developing regions. The promotion of hydropower development and power trading to achieve direct benefits illustrates such opportunities.
- *Third*, IWRM needs to define tools and approaches to better manage the full water cycle along the continuum from freshwater management on land, to coast and sea. The spreading of dead zones in coastal seas, as in the Baltic Sea Basin, illustrates water quality degradation and euthrophication because of development.

57 Coping with Population Growth, Climate Change, Water Scarcity and Growing Food Demand in China in the 21st Century

Zhanyi Gao and Yaqiong Hu

57.1 Introduction

China is a developing country with the largest population in the world. Food security is not only important for the sustainable social and economic development of China, but also for its food security and for stable global food prices. According to the guideline for food and nutrition development by the State Council of the People's Republic of China, the average grain holdings in 2000, 2010 and 2020 should be 400, 415 and 420 kg per capita per year, respectively (General Office of the State Council PRC 2001). In China food security will be achieved when the average grain holdings reach these levels. However, with the rapid social and economic development the people's living standard and their meat consumption are significantly increasing, why more grain will be needed.

China is also a large country in terms of irrigation, which is crucial for agricultural production. In the year 2000, the yield of irrigated paddy was 6900 kg/ha, and the average yield of other irrigated grain crops was 5250 kg/ha while the average yield of rain-fed grain crops was only 2100 kg/ha. This means that the yield of irrigated land can be increased by 1 to 3 times compared with rain-fed land (Shi/Lu 2001). In 2008, the irrigated area in China covered 57.8 million ha, accounting for 47.38 per cent of the total farmland. The irrigated area produced 75 per cent of the total grain production, and more than 90 per cent of cotton and vegetable production (Li 2009).

With the recent economic development more water and land resources are converted from agricultural production to other sectors. Furthermore, extreme drought and flood disasters occur more frequently due to climate change impacts. Thus, agricultural production is facing a challenge. It is a key research area how to cope with population growth, climate change, water scarcity and the growing food demand in China in the 21st century. This research analyses whether available water resources can meet the growing agricultural demand and how an increasing irrigated area and grain production can be realized without a significant increase in water consumption for agriculture. This chapter reviews the major results of related research, planning and practice.

57.2 Population Increase and Grain Demand

The total population and its growth rate are two key factors that affect the demand for cereals in China. Table 57.1 offers the most recent UN data on China's past and projected population size, density and urbanization range from 1950 to 2050. Table 57.3 compares the projections of China's population by the UN Population Division (UN 2001) and China's Population and Development Research Center (2000). The average of both projections is used below.

Based on this near-term population projection (table 57.3) and the average grain holding required by the guideline for food and nutrition development, the Chinese grain demands in target years is listed in table 57.4.

Table 57.5 lists the requirement of domestic grain production and needed grain imports under self-sufficiency rates of 92, 95 and 98 per cent respectively.

57.3 Irrigation Requirement for Grain Production

The total size of grain production depends on the following factors: farmland area, crop index, proportion of land for grain crops and cash crops, irrigated area and its yield, rain-fed area and its yield, etc. Irrigation has played an important role in grain production in China. Figure 57.2 shows that grain production has been increased with the increase of irrigated area in China.

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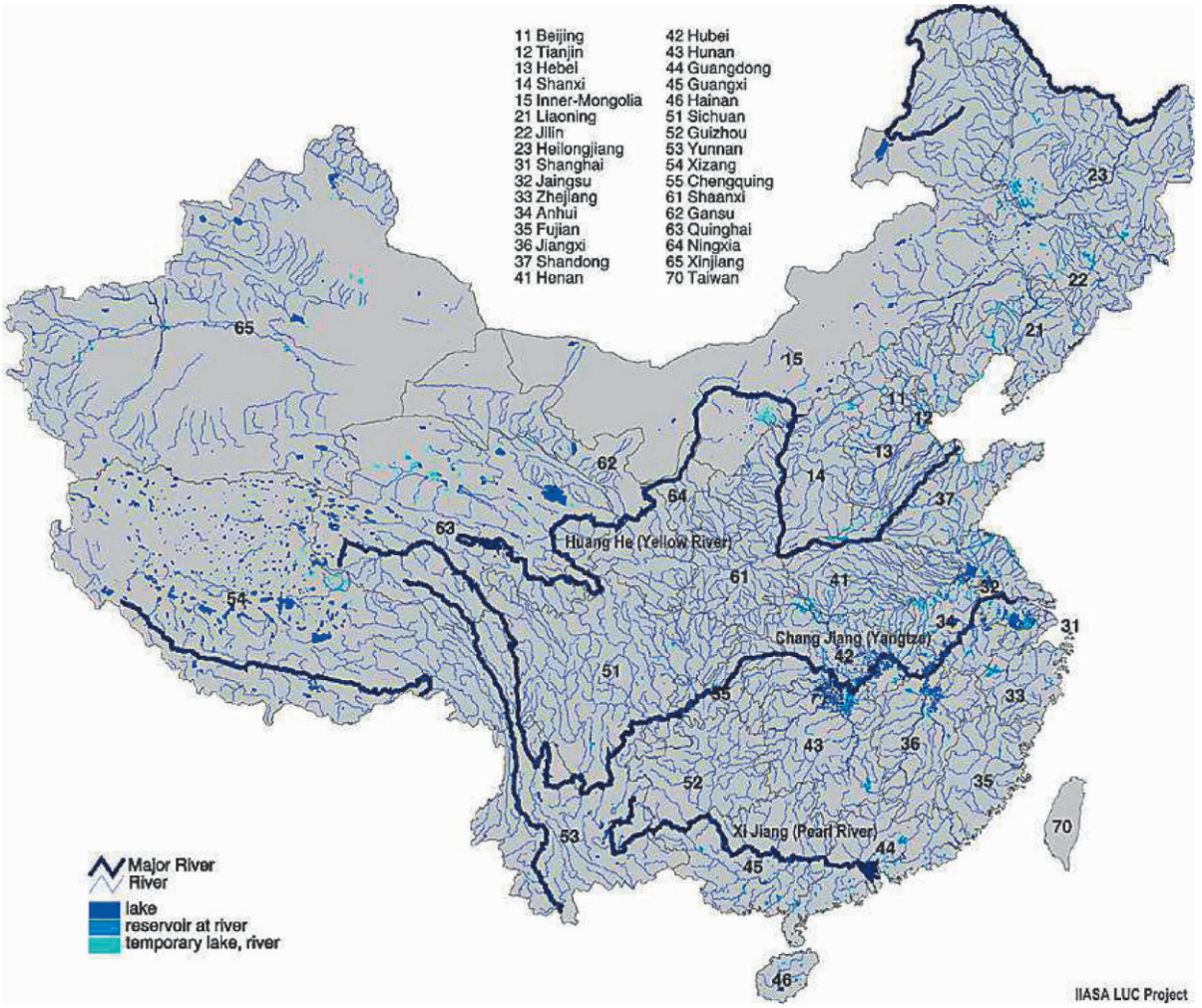
Figure 57.1: Rivers of China. **Source:** © Heilig, G.K. (1999): *ChinaFood. Can China Feed Itself?* (Laxenburg: IIASA, 1999) [CD-ROM Vers. 1.1].



The areas and their yields of both irrigated and rainfed cereals can be estimated by analysing the development trends and considering major determining factors. Based on the above estimates and on the potential water resources the irrigation requirement for an efficient irrigation in agricultural production can also be estimated. A framework for the analysis is provided in figure 57.3 (Gao/Wang 2008).

The year 2000 is used as the base year for the analysis. In the year 2000 the irrigated area was 55 million ha. The grain crop yield has been increased due to the development of irrigation and the improvement of farming practices, seeds, fertilizers, etc. By considering all of these factors, a study was carried out to analyse the requirements for irrigation development for 2010 and 2020 under different self sufficiency rates for cereals (Gao/Wang 2008). The results of the study are provided in tables 57.5 and 57.6.

Therefore, to maintain the grain self sufficiency rate at a level of 95 per cent the irrigated area should reach 58.69 million ha in 2010 and 59.97 million ha in 2020.

57.4 Irrigation Area and Distribution

Influenced by climate conditions of the monsoon, the average annual precipitation in China decreases from 1600 mm in the southeast to less than 200 mm in the northwest (figure 57.5) and 80 per cent of precipitation occurs in four months (June- September).

Further, 80 per cent of the water resources are in the south of China where the land resources represent only 38 per cent of the total. But only 20 per cent of the water resources are in northern China where land resources account for 62 per cent of the Chinese ter-

Table 57.1: Changes of the population size (in thousand), population density and of the urban population in China (1950-2050) for the medium variant. **Source:** UN (2009, 2008); at: <http://esa.un.org/unpp/p2k0data. asp>.

Year	Population Size	Population density	Urban population	Percentage urban
1950	544 951	57	72 119	13.0
1955	598 226	62	86 363	14.2
1960	645 927	67	105 246	16.0
1965	716 270	75	128 093	17.6
1970	815 951	85	144 537	17.4
1975	911 167	95	161 439	17.4
1980	980 929	102	196 220	19.6
1985	1 053 219	110	245 322	23.0
1990	1 142 090	119	314 845	27.4
1995	1 210 969	126	380 553	31.4
2000	1 266 954	132	454 362	35.8
2005	1 312 253	137	530 659	40.4
2010	1 354 146	141	607 230	44.9
2015	1 395 998	145	683 474	49.2
2020	1 431 155	149	756 340	53.2
2025	1 453 140	151	822 209	56.9
2030	1 462 468	152	879 892	60.3
2035	1 462 351	152	928 839	63.7
2040	1 455 055	152	969 337	66.9
2045	1 440 289	150	1 002 121	70.0
2050	1 417 045	148	1 027 294	72.

ritory. These differences in water and land resources highlight the importance of irrigation and drainage for agricultural production. According to the irrigation demand of crops, China may be divided into three irrigation zones, a) an intensive, b) a supplementary and c) a rice paddy irrigation zone (PRC 1998).

a.) The *intensive irrigation zone* includes northwest China and parts of north and northeast China, where annual precipitation is below 400 mm. Here the precipitation and its distribution do not meet crop water requirements, why there is hardly any agricultural production without irrigation.

b.) The *supplementary irrigation zone* covers the plain area of the Yellow River, the Huaihe River and the Haihe River and most parts of northeast China. The annual precipitation in this zone varies

Table 57.2: Achievement in the Agricultural Production of the People's Republic of China from 1950 to 2008. **Sources:** UN (2009, 2008); at: <http://esa.un.org/unpp/p2k0data.asp>; National Bureau of Statistics of China (2001,2008) at: <http://www.stats.gov.cn/tjgb/> and <http://www.cpirc.org.cn/tjsj/tjsj_cy_detail. asp?id=304>.

Year	Grain Production (Million Tons)	Population (Million)	Average Grain Holding (kg/person/year)
1950	132.1	545.0	242.5
1955	183.9	598.2	307.5
1960	143.9	645.9	222.7
1965	194.5	716.3	271.6
1970	240.0	816.0	294.1
1975	284.5	911.2	312.3
1980	320.6	980.9	326.8
1985	379.1	1053.2	360.0
1990	446.2	1142.1	390.7
1995	466.6	1211.0	385.3
2000	462.2	1267.0	364.8
2005	484.0	1312.3	368.8
2008	528.5	1328.0	398.0

Table 57.3: Population Projection in China (unit: billion people) for 2010 and 2020. **Sources:** UN (2001, 2009); China Population and Development Research Center (2000).

Projection (year)	2000	2010	2020
United Nation (UN 2001, 2009)	1.275 (1.266†)	1.366 (1.354†)	1.446 (1.431†)
China, demographic information research centre	1.269	1.377	1.472
Average	1.272	1.372	1.459

Table 57.4: Grain demands at target years. **Source**: Gao and Wang (2008).

Items	Base year	Target year	
	2000	2010	2020
Population (billion)	1.272	1.372	1.459
Average grain demand (kg/person/year)	400	415	420
Total grain demand (million tons	509	569	613

Figure 57.2: Growth of grain production with the increase of the irrigated area in China. **Source:** MWR *Statistic Bulletin on China's Water Activities* (2000-2008).

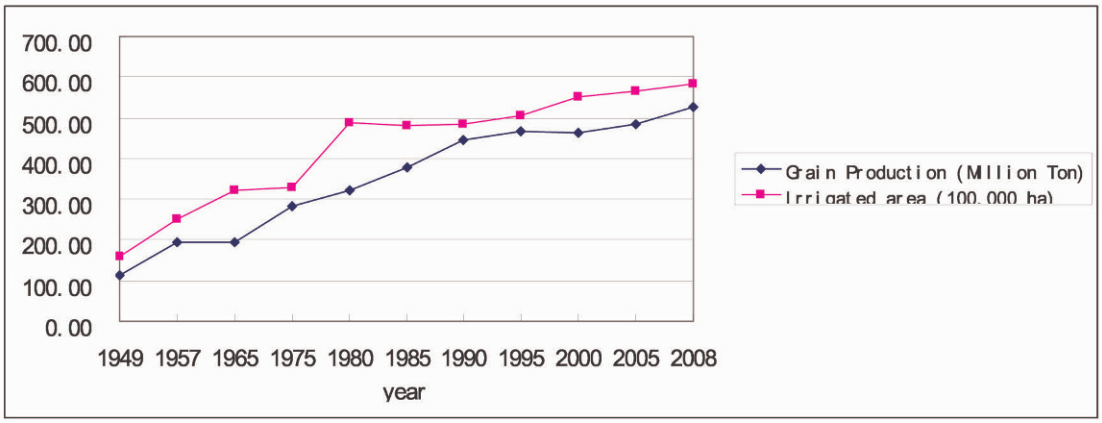


Table 57.5: Required grain under different grain self sufficiency rates. **Source:** Gao and Wang (2008).

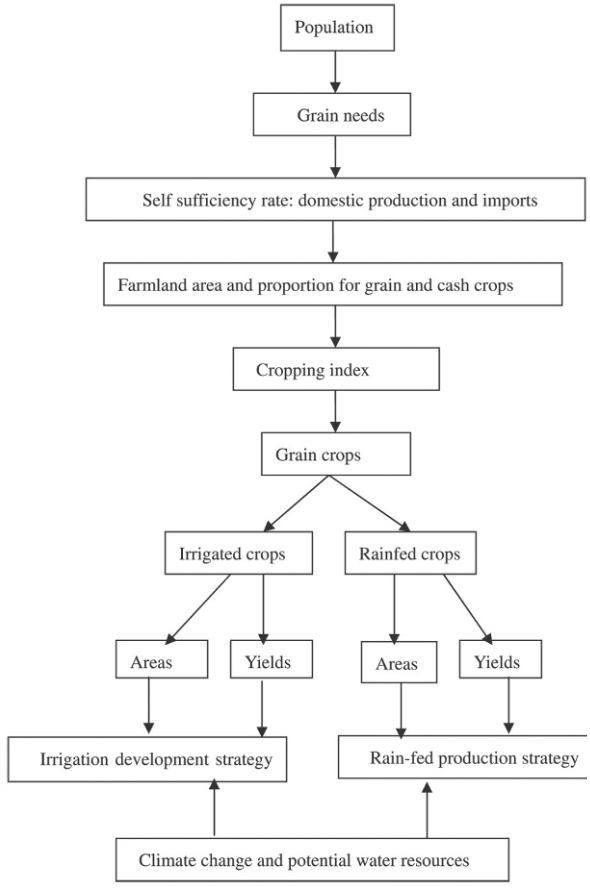
Target year	2010			2020		
Self sufficient rate per cent	92	95	98	92	95	98
Domestic production million tons	524	541	558	564	582	600
Import (million tons	45	29	11	49	31	12
Total (million tons)	569	569	569	613	613	613

from 400 to 1000 mm. Influenced strongly by the monsoon, the precipitation in this zone is distributed extremely uneven. Here crop water requirements change sharply in different years, why drainage is extremely necessary. Therefore, both irrigation and drainage are highly needed for a stable and high yield agricultural production.

c.) The *paddy irrigation zone* covers south and part of southeast and southwest China. The annual precipitation in this zone is more than 1000 mm. Paddy rice is the main crop in this zone and irrigation is needed although precipitation is here very high. Irrigation is unnecessary for other crops during the rainy season, but it is necessary during the drought season. Here drainage and flood protection facilities are the basic condition for stable agricultural production during the rainy season.

Due to the uneven distribution of precipitation in both time and space, irrigation and drainage are the life blood of agricultural production. Up to 2008, approximately 85,400 reservoirs were constructed with a total capacity of 634.5 billion m^3. The current annual total water supply capacity of various projects

Figure 57.3: Framework for grain production and the analysis of the development of irrigation. **Source:** Developed by the authors.



reached 659.1 billion m^3. In 2007 the total volume of water used was 581.9 billion m^3, whereof 12.2 per cent, 24.1 per cent, 61.9 per cent and 1.8 per cent were

Table 57.6: Requirement for the irrigation area in 2010. **Source**: Gao and Wang (2008)

Grain self sufficiency rates per cent	92	93	94	95	96	97	98
Irrigation area (Million ha)	55.39	56.49	57.59	58.69	59.79	60.89	62.00

Table 57.7: Requirement for the irrigation area in 2020. **Source:** Gao and Wang (2008).

Grain self sufficiency rates per cent	92	93	94	95	96	97	98
Irrigation area (Million ha)	56.92	57.99	58.95	59.97	60.98	62.00	63.01

Figure 57.4: Evolution of world grain production (1950-1995). **Sources**: Philippe Rekacewicz, UNEP/GRID-Arendal based on data from the Worldwatch Institute (1996); at: <http://maps.grida.no/go/graphic/evolution_of_the_world_grain_production_comparison_world_europe_china_africa> and at: <http://maps.grida.no/go/graphic/evolution_of_the_world_grain_production_comparision_with_china _and_united_states>.

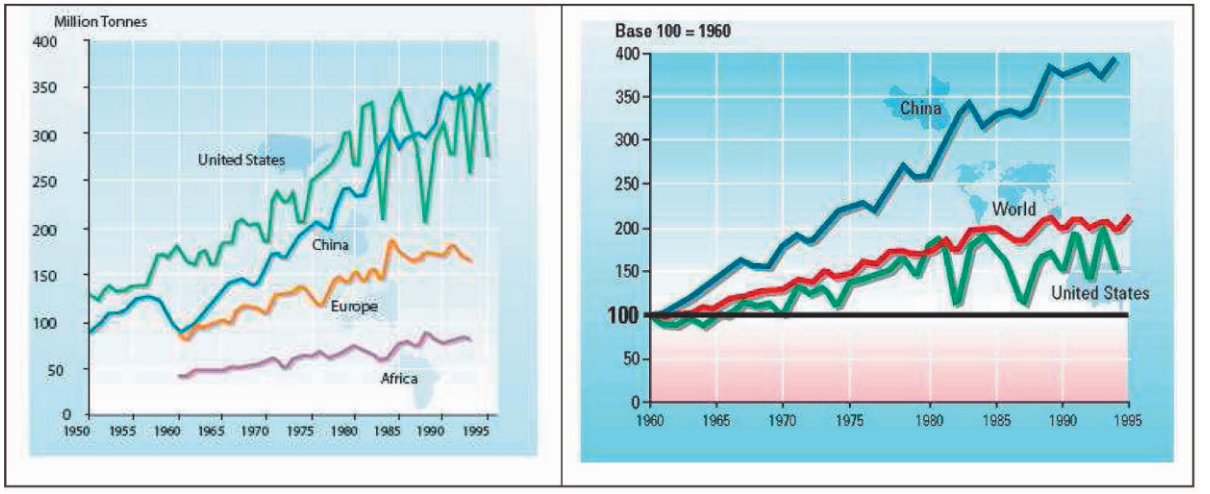
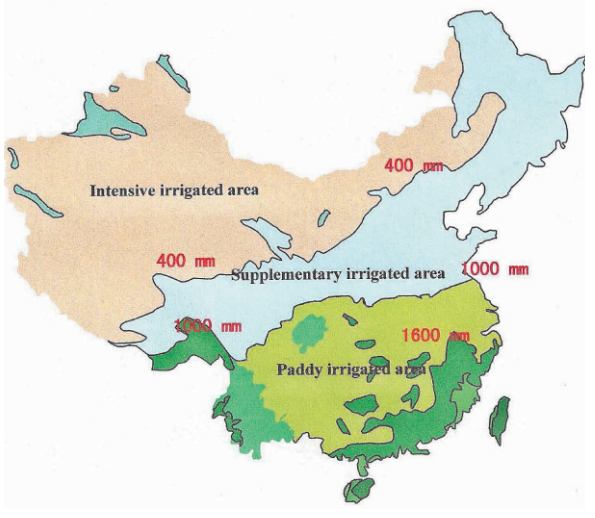


Figure 57.5: Precipitation distribution and irrigation zones. **Sources:** The authors.



used by the households, the industry, the agricultural sectors, and by the ecological system. Up to now, there are 402 large irrigation schemes each with an irrigated area of more than 20,000 ha. For China the construction of small rain water harvesting projects is of utmost importance (PRC 2007).

57.5 Effects of Climate Change on Water Resources

Due to global warming annual average temperature and precipitation varied significantly over several years. Extreme weather events have also increased, and the regional variation of precipitation and river run-off rose significantly. During the past two decades, the annual average temperature has risen, especially for northern China. Since 1985, China has experienced 21 warm winters. Due to climate change the relationship between precipitation and water resources has changed in some river basins. Particularly, in the Yellow River, the Huaihe River, the Haihe River, and the Liaohe River basins, the average surface runoff has declined by 17 per cent of which a six per cent decline occurred during the past 20 years.

Among these four river basins, the Haihe River Basin experienced the largest change with a 41 per cent reduction in surface water resources due to a 10 per cent decline in precipitation.

For the past decade, the climate and hydrological changes and their effects on water resources in China were summarized by Liu (2008):

- In most parts of China, temperature has been rising, except in the southwest region. The temperature increase in the north has been higher than in the south; the areas with the highest temperature increase are in the northeast and in Xinjiang, where temperature has increased by more than 1°C.
- Annual precipitation in south China with latitudes below 30° has significantly increased. However, precipitation in the area north of the Huaihe River decreased, except in the northwestern part of Xinjiang and in the west of the northeast region.
- Water surface areas are shrinking and water levels are falling in the lakes in the northwest of Inner Mongolia and in the central and western part of he Qinghai-Tibet Plateau.
- The runoff in the Huaihe River and in major rivers north of the Huaihe River has declined. The frequency of floods in the main stream of the Yangtze River and its tributary as well as for rivers south of the Yangtze have increased.

Since 1990 both drought-affected areas and drought disaster areas have expanded. The reduction of grain production caused by drought accounted for more than 60 per cent of the total reduction of cereal production caused by various natural disasters. Taking the extreme drought of the year 2000 as an example, the total disaster area caused by drought was 40.53 million ha and the total losses were 60 billion kilogrammes for grain production and 51.1 billion RMB Yuan for cash crops. The total drought-hit grassland area in the north, northeast and northwest of China was 78 million ha, accounting for more than 65 per cent of total usable grassland. In the year 2006, a serious drought hit Sichuan and Chongqing and resulted in 9.75 billion kilogrammes losses in grain and about 310,000 ha of orchards were destroyed. According to preliminary estimates, since 1990 the average annual loss caused by drought is about 1.1 per cent of the Chinese national GDP, this figure can reach up to 2.5 ~3.5 per cent in extreme drought years (Lu/Gao 2008). Drought and flood affected areas in China from 1950 to 2008 are listed in table 57.8.

Table 57.8: Flood and drought affected areas in China. **Source:** PRC (2009).

Year	Flood affected area (1000 ha)	Drought affected area (1000 ha)	Loss of grain production (million t)
1950	6559	2398	1.90
1951	4173	7829	3.69
1952	2794	4236	2.02
1953	7187	8616	5.45
1954	16131	2988	2.34
1955	5247	13433	3.08
1956	14377	3127	2.86
1957	8083	17205	6.22
1958	4279	22361	5.13
1959	4813	33807	10.81
1960	10155	38125	11.28
1961	8910	37847	13.23
1962	9810	20808	8.94
1963	14071	16865	9.67
1964	14933	4219	4.38
1965	5587	13631	6.47
1966	2508	20015	11.22
1967	2599	6764	3.18
1968	2670	13294	9.39
1969	5443	7624	4.73
1970	3129	5723	4.15
1971	3989	25049	5.81
1972	4083	30699	13.67
1973	6235	27202	6.08
1974	6431	25553	4.32
1975	6817	24832	4.23
1976	4197	27492	8.58
1977	9095	29852	11.73
1978	2820	40169	20.05
1979	6775	24646	13.86
1980	9146	26111	14.54
1981	8625	25693	18.55
1982	8361	20697	19.85
1983	12162	16089	10.27
1984	10632	15819	10.66
1985	14197	22989	12.40
1986	9155	31042	25.43

Year	Flood affected area (1000 ha)	Drought affected area (1000 ha)	Loss of grain production (million t)
1987	8686	24920	20.96
1988	11949	32904	31.17
1989	11328	29358	28.36
1990	11804	18174.67	12.82
1991	24596	24914	11.80
1992	9423.3	32980	20.97
1993	16387.3	21098	11.18
1994	18858.9	30282	23.36
1995	14366.7	23455.33	23.00
1996	20388.1	20150.67	9.80
1997	13134.8	33514	47.60
1998	22291.8	14237.33	12.70
1999	9605.2	30153.33	33.30
2000	9045.01	40540.67	59.96
2001	7137.78	38480	54.80
2002	12384.21	22207.33	31.30
2003	20365.7	24852	30.80
2004	7781.9	17255.33	23.10
2005	14967.48	16028	19.30
2006	10521.86	20738	41.65
2007	12548.92	29386	37.36
2008	8867.81	12136.8	16.06
Average	**9705.39**	**21569.74**	**15.79**

57.6 Measures for Coping with Climate Change

57.6.1 Establishing a Legal Framework

In China the laws and regulations for coping with climate change effects include: a) the water law (box 57.1), b) the law on agriculture (box 57.2), c) the law on the popularization of agricultural technologies, d) the regulation for the management of irrigation schemes, e) the regulation for the calculation, collection and management of water fees, and f) the regulation for the management of subsidies for small irrigation and water and soil conservation projects.

The Law on the 'popularization of agricultural technology' encouraged the extension of techniques of irrigation and water conservation, soil improvement and water and soil conservation; techniques of water supply and energy utilization in rural areas and agricultural environmental protection; techniques of agricultural meteorology, and techniques of agricultural management and administration (PRC July 1993).

57.6.2 Implementing Integrated Water Resource Management

The *integrated water resources management* (IWRM) at the basin level has become a new model for water resources management. In China irrigation is the largest water user and consumes more than 60 per cent of the water resources of each basin. There is a significant difference in irrigation efficiency and water productivity among the irrigation districts located at the upper, middle and lower parts of river basins because of the variation of natural, economic and social conditions. Usually, the irrigation efficiency and water productivity of the irrigation districts downstream is higher than those of the upstream irrigation districts. However, compared with those downstream the upstream irrigation districts usually receive more water with better quality. Thus, it is necessary to optimize the allocation of water resources at the basin level in order to increase the general water use efficiency and productivity in the whole basin.

57.6.3 Enhancing Infrastructure for Irrigation and Drainage

During the past five decades, China has made tremendous achievements in water conservation. Currently, there are 57.8 million ha of irrigated area, accounting for 47.38 per cent of the total farmland of 122 million ha. However, most of the existing irrigation schemes were built before the 1970's with low design standards and mismatching facilities. After more than 30 years of operation, serious aging problems have emerged, which resulted in low efficiency and reliability. Since 1998, the rehabilitation and modernization of large-scale irrigation schemes has been carried out with the objective to upgrade 402 large irrigation schemes by the year 2020. The main purpose of the rehabilitation and modernization of large irrigation schemes is to increase its water efficiency and productivity. The rehabilitation of more than 260 large-scale pumping stations for irrigation and drainage is scheduled to be completed until 2012 to 2014 within. The reinforcement of 6240 large, medium and small-sized reservoirs will be completed by 2010. In the mean time, the amelioration of low-yield farmland will be implemented in large scale (Chen 2009).

Box 57.1: Modifications of the Chinese water law. **Source**: PRC (1 October 2002).

China's modified 'water law' entered into force on 1 October 2002, highlighting the following aspects:

- Article 3: Water resources shall be owned by the state. The State Council shall exercise ownership of water resources on behalf of the state. Water in the ponds of rural collective economic organizations and in the reservoirs constructed and managed by rural collective economic organizations shall be used by those organizations.
- Article 4: The development, utilization, preservation, and protection of water resources and the prevention and control of water disasters shall be carried out through comprehensive planning, with all factors taken into consideration. The planning shall seek both a temporary solution and a permanent cure, with emphasis on multipurpose use and achieving maximum benefits to take advantage of the multiple functions of water resources and harmonize water use in production and the environment.
- Article 5: The governments at and above the county level shall strengthen the construction of infrastructures for water conservation that shall be included in plans for national economic and social development.
- Article 6: The state shall encourage entities and individuals to develop and utilize water resources according to law, and to protect their legal rights and interests. The entities and individuals developing and utilizing water resources shall bear an obligation to protect water resources according to law.
- Article 7: The state shall apply the systems of water licensing and paid use of water resources according to law, excepting collective economic organizations and their members' use of the water in the ponds and reservoirs owned by those organizations. The department of the water administration under the State Council shall be responsible for organizing the water license system and its implementation as well as the nationwide paid use of the water resource system.
- Article 8: The state shall require strict economy in the use of water, vigorously promote measures for water saving, spread of new technology and techniques to conserve water, develop the water conservation industry and agriculture and service industry, and establish a water conservation society.
- Article 10: The state shall encourage and support the research, distribution, and application of the advanced technology for the development, utilization, preservation, protection, and management of water resources and the prevention and control of water disasters.
- Article 11: The people's governments shall award the entities and individuals that have made outstanding achievements in the development, utilization, preservation, protection and management of water resources and in the prevention and control of water disasters, etc.
- Article 21: The development and utilization of water resources shall first satisfy the needs of the urban and rural inhabitants in their domestic use of water and give overall consideration to the agricultural, industrial and ecological need for water as well as to the needs of navigation.
- Article 25: The local governments at various levels shall improve the leadership over the work of irrigation, draining saturated fields, and water and soil conservation, thus promoting the development of agricultural production. In areas where brackishness or saturation is likely to take place, the governments shall take actions to control and lower the level of groundwater. In dry and semi-dry areas, the development and utilization of water resources shall take into full consideration the ecological water needs for the environment.
- Article 47: The state shall apply a system that combines the control of the total amount that is to be managed on a quota basis.
- Article 49: The used water shall be measured, and the water shall be used according to the approved plans. Measurements of water use shall be adopted charging progressively fees for the water use above the granted quota.
- Article 50: The governments at various levels shall promote water saving irrigation modes and water saving technology, and shall take necessary measures

Box 57.2: References to irrigation in the law on agriculture. **Source**: PRC (1 March 2003).

In the 'law on agriculture' these articles address irrigation development and management (PRC 1 March 2003)

- Article 17: People's governments at all levels shall take measures to strengthen the agricultural development and the construction of infrastructures for agriculture and the rural areas, such as irrigation and water conservation, protection of the agricultural ecological environment, rural roads, rural energy and electric networks, storage and circulation of agricultural products, fishing ports, grassland enclosures and bases of original and fine breeds and improved strains of animals and plants, improve the conditions for agricultural production, and protect and increase the comprehensive production capacity of agriculture.
- Article 19: Governments at all levels and agricultural production and operation organizations shall strengthen the construction of irrigation and water conservation facilities, establish a sound system for the management of such works, economize on the use of water, develop a water-saving agriculture, con-

trol strictly in accordance with the law the use of irrigation water resources by non-agricultural construction projects and prohibit all organizations and individuals from unlawfully occupying or damaging irrigation and water conservation facilities. The state gives priority to water-deficient regions in supporting the development of a water-saving agriculture.

- Article 20: The state encourages and supports farmers and agricultural production and operation organizations to use advanced, applicable farm machines and it improves the safety control over such machines to raise the level of agricultural mechanization..

The state also supports farmers and agricultural production and operation organizations in purchasing advanced farm machines.

- Article 21: Governments at all levels shall support the development of the meteorological undertakings in the service of agriculture and enhance their abilities for monitoring and forecasting meteorological calamities.
- Article 40: The state, through taxation, pricing, credit and other means, encourages and guides farmers and agricultural production and operation organizations to increase investment in agricultural production and operation and in capital construction such as small irrigation and water conservation projects.
- Article 59: The governments at all levels shall take measures to improve the comprehensive rehabilitation of small river basins, and to prevent and control soil erosion. Units and individuals engaged in the production or construction which may cause soil erosion shall take preventive measures, and shall be responsible for the control of soil erosion caused by production or construction.

57.6.4 Adopting Water-saving Irrigation Practices.

Currently in China the annual water shortage in agricultural irrigation is about 30 billion m^3. Due to social and economic development the demand for water will further increase. To cope with the water shortage and to increase the irrigated area technologies and measures for water saving in irrigation have been introduced and extended with the objective to improve the efficiency and productivity of water use.

The efficiency and productivity of irrigation are improved at two levels, at the farm and the irrigation district level (Gao 2005). The technologies and measures for improving the efficiency and productivity of water use for irrigation differ at both levels because the beneficiaries, the incentives and goals of water saving may be different.

At the farm level small basin, furrow, sprinkler and drip irrigation and land levelling and other measures can be used. For cash crops, micro sprinkler irrigation and drip irrigation can be applied. For field crops, such as wheat and maize the main water saving measures include land levelling, optimal size of basin and furrow, and use of low pressure pipelines. The end users of these water-saving technologies and measures are farmers. They can benefit from water savings by reducing irrigation and labour costs, improving irrigation uniformity, increasing production and labour intensity by adopting water-saving irrigation technologies and measures. Across China on-farm water saving practices were tested in pilot projects in 300 counties and the extension of water saving practices is currently being carried out nationwide.

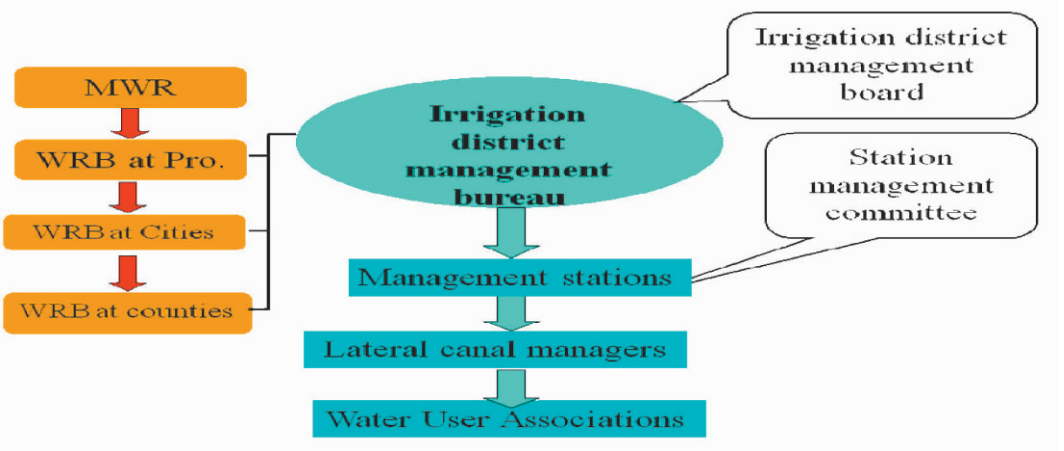
At the irrigation district level, the technologies and measures adopted for increasing water use efficiency include canal lining, application of pipelines and improvement of control structures and facilities for water measuring, automation and other technologies for operating irrigation systems. These technologies have been tested in 30 large irrigation districts. The recycling and reuse of water resources in irrigation districts is also practiced at the irrigation district level. It has been proven that recycling and reusing water at the irrigation district is a cheaper and more effective way to increase the water for irrigation by using efficiency and productivity.

57.6.5 Reforming Irrigation Management Institutions.

In China the administration of the irrigation management is handled by water resource departments at various levels (Gao 2009). The structure of the irrigation management system is shown in figure 57.6.

At the central level, the *Ministry of Water Resources* (MWR) takes the responsibility to work out national irrigation development planning, stipulate and modify related regulations, and supervise the implementation of planning and regulations. The *Water Resources Bureaus* (WRBs) at the province, city and county levels take the responsibility to work out local irrigation development planning and supervise the implementation of planning and regulations and the management of irrigation schemes. To promote sustainable development and to increase the productivity and profitability of irrigation systems, institutional reforms in irrigation and drainage system management

Figure 57.6: Structure of the irrigation management system. **Source:** Li Daixin (2002).



towards a stakeholder-involved management have been introduced.

The major stakeholders include the government, the professional irrigation management agency, *water use associations* (WUAs) and farmers. In China most of large and medium irrigation schemes are jointly managed by professional agencies and farmer's collectives or WUAs. Usually, as a professional agency the irrigation management bureau and its management stations takes the responsibility to operate and maintain the main structures, and the main and branch canals of the irrigation system. The canals below the tertiary canal and small irrigation projects are operated and managed by *Water User Associations* (WUAs) or farmer's collectives. Different roles of the three key stakeholders of the government, of irrigation management agents and of WUAs must be distinguished.

The role of the *government* is to provide leadership, to design national development planning, to stipulate and modify modifying policy and legal arrangements and related regulations, to supervise the implementation of planning and regulations, to stipulating and, to make and modify institutional arrangements, to strengthen capacity building, to making financial arrangements and to asess existing irrigation systems.

The tasks of *irrigation management agents* are to evaluate and benchmark the operation of irrigation systems, to conduct feasibility studies and designs for rehabilitation, to carry out the rehabilitation of the main canals and structures of irrigation systems, to implement institutional reform, to operate and maintain the main structures and canals systems, to bridge the gap between the government and WUAs, to provide technical support to WUAs, to supervise and monitor irrigation systems, to document the operation of irrigation schemes and to test and introduce new technologies and materials.

The *responsibility of WUAs* is to carry out the rehabilitation as well as to operate and maintain on farm canals and structures and to provide irrigation services to individual water users.

57.6.6 Collection of Water Fees

Since 1995, when the first farmer WUA was established in the Zhanghe irrigation district of Hubei province, participation of irrigation management has been adopted in 30 provinces and autonomous regions in China. Currently, there are more than 20,000 such water user associations and cooperative organizations which involve 60 million farmers. The irrigated area managed by water user associations has reached to 6.67 million ha (Pie 2009). It has been proven that participatory irrigation management is an effective measure to increase the water efficiency and productivity of irrigation, especially for China's specific conditions of many small land plots per household. The collection of water fees has been improved since the introduction of WUAs.

57.6.7 Strengthening Protection and Proper Groundwater Use

In China groundwater has played an important role in irrigation, in domestic and industrial water supply, especially in dry years. Groundwater will play an even more important role under climate change. To achieve a sustainable exploitation and use of groundwater, it is important to protect the groundwater through a reasonable exploration and use and adequate recharge measures. The new 'Water Law' high-

lights the integrated surface and groundwater management.

57.6.8 Strengthening the Construction of Small-scale Water Conservation Projects and the Use of Poor Quality Water

To cope with problems of water shortage and climate change, the construction of medium, small and micro-size projects, including rainwater harvesting and utilization projects, have been developed in China, especially in the northwest and southwest. The treatment and application of poor quality water is also practiced in line with local conditions. Currently, there are 4.2 million small water storage ponds and rainwater harvesting wells for supplying drinking water and 7 million small water storage ponds and rainwater harvesting wells for irrigation purposes.

57.6.9 Encouraging International Cooperation

Facing the floods, droughts and water shortages caused by climate change, the research on adaptation strategies and long-term development planning are being carried out with the support of the governments at different levels. Much experience and progress has been gained with integrated water resources management and through the application of advance technologies. China has attached great importance to international cooperation on research to cope with climate change.

57.7 Conclusions

The food demand in China is continually going up due to population growth. Irrigation has played a significant role in agricultural production and food security due to the uneven distribution of precipitation in both time and space. Climate change has and will have a big impact on the supply and demand of water resources, as floods and droughts have occurred more frequently. Extreme droughts and floods caused by climate change have a major impact on agricultural production. Thus, measures must be undertaken to cope with climate change. To maintain food security at a self sufficiency rate of 95 per cent, the irrigation area in China should reach 58.69 million hectares in 2010 and 59.97 million hectares in 2020.

To solve the problem of water shortage and to cope with climate change, measures are undertaken to improve the use of irrigation water by enhancing the efficiency at the farm, irrigation district and river basin levels with a different focus at diverse levels. Related laws and regulations have been passed and modified. Integrated water resource management will be an effective measure to cope with climate change and water shortage.

Most of China's existing irrigation schemes were built before the 1970's, the rehabilitation of these irrigation schemes is an effective measure for coping with climate change and ensure food security. China has launched the rehabilitation and moderation of large irrigation schemes, and this rehabilitation work is scheduled to be completed by 2020. Reform of the irrigation management institutions is an important component of the modernization of these irrigation schemes and has been successfully adopted in China.

Measures have been undertaken to strengthen the protection and reasonable exploitation and utilization of groundwater. Medium and small projects, including rainwater harvesting and utilization projects, have been developed to cope with water shortage and climate change in China.

58 Ensuring Water Security in Rural Areas of Bangladesh under Climate Change and Non-climatic Drivers of Change

Mohammed Rahman Zillur and Kuntala Lahiri-Dutt

58.1 Introduction

This chapter addresses the question of security[1] and sustainability[2] of *water resource management* (WRM) in Bangladesh due to climate change and complex social and political factors including weak governance. It suggests that social networks should play an important role in ensuring security at the micro levels, and the promotion of people-centred water management. Bangladesh, a highly populated country located on the floodplains of the Ganges-Brahmaputra-Meghna Rivers, receives abundant monsoonal rain which is concentrated between June and September. Rapid population growth, economic growth imperatives, changing farming practices and the weak coordination of WRM have increased the gap between the demand and supply of water leading to a water crisis that threatens the stability of the country. It is increasingly being understood that climate change poses a serious challenge for future water resource management in South Asia as a whole and exacerbates existing environmental problems. Babel and Wahid (2008) showed that Bangladesh is highly vulnerable to declining freshwater supplies. Mirza and Ahmad (2003) showed that the melting of the Himalayan glaciers will change the volume and frequency of monsoonal floods due to changed river regimes and affect Bangladesh more severely than other parts of South Asia. Other changes in the country's water resources include large-scale sedimentation, changing water quality, saline intrusion in coastal areas, land-use conversion and degradation of water ecosystems.

Threats to the security of water resources and vulnerabilities,[3] however, are not caused only by climate change; there are a number of non-climatic drivers or human-induced activities involved. For instance, discharging household and industrial sewage and wastewater into canals and rivers without any treatment, illegal encroachment of river course and construction inside river channels, imbalanced use and control of water by upstream users causing a reduction on the volume of flow, are important human-driven factors. These affect water availability in major rivers causing water resource pollution and posing threats for human health throughout the rural areas in Bangladesh.

Sustainable economic development and poverty reduction still remain top priorities for Bangladesh, while the effects of climate change and impacts of non-climatic drivers on its water resources affect human activities and settlements, making farmers in rural areas in particular and poor people in general highly vulnerable. Increased water insecurities have the potential to undermine the nation's development goals, in particular to erode its sustainability.

Although the predictive power of water resources and climate change models has improved significantly, so far little has been done to link climate change to rural social factors, which are crucial in determining

1 Environmental security is an increasing issue in world affairs. Currently there is little coherence around the world on its definition, threats, and policy responsibilities. For the present purpose of this chapter, we use Barnett's definition: environmental security is the proactive minimization of anthropogenic threats to the functional integrity of the biosphere and thus to its interdependent human component (Barnett 2001).

2 For the purposes of this chapter, we follow the definition of sustainability or sustainable development by the World Commission on Environment and Development (1987), defining sustainability as "forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs."

3 The best, pro-poor, definition of vulnerabiulity has been proposed by Wisner, Blaikie, Cannon and Davis (1994: 16): "By vulnerability, we mean the characteristics of a person or a group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard."

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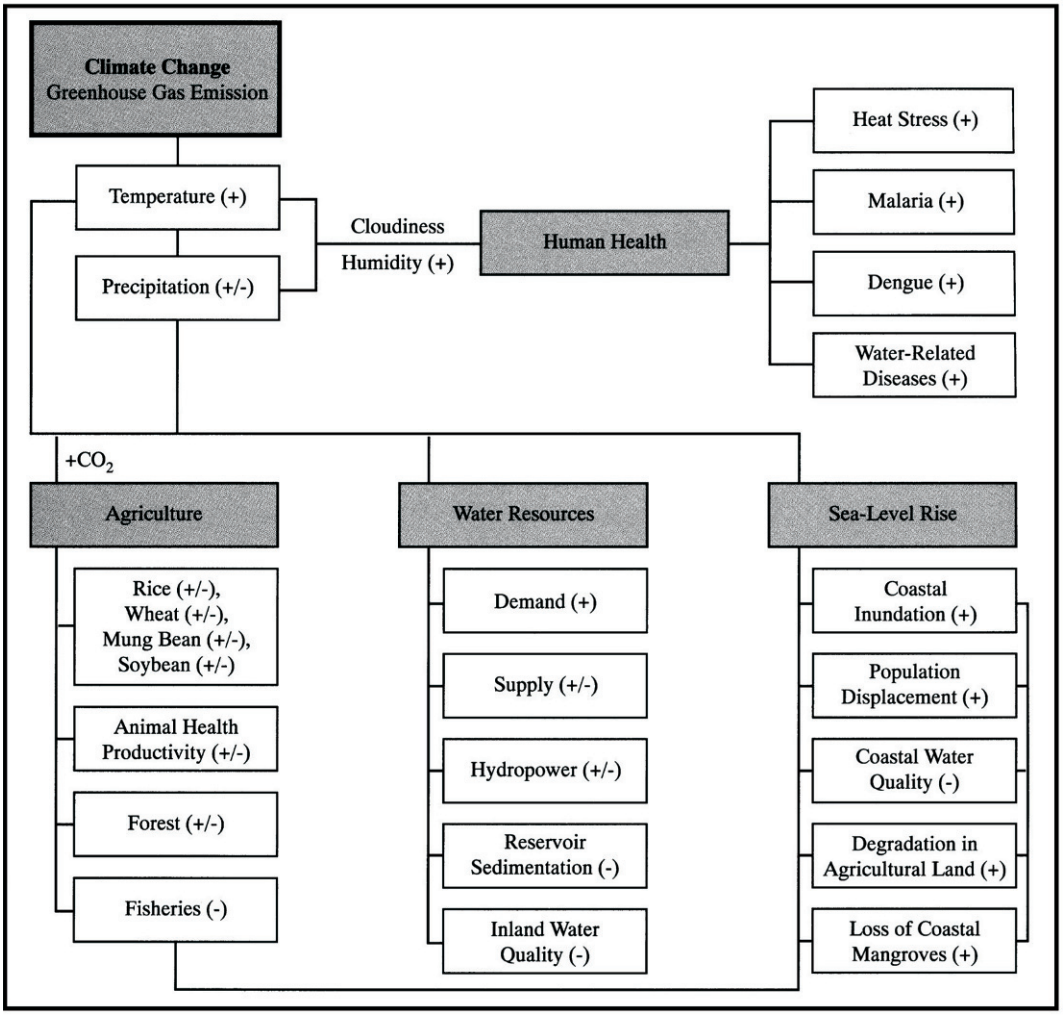
Figure 58.1: Possible Climate Change Related Impacts in Tropical Asia. **Source:** IPCC (1998: 392). Reprinted with permission of the IPCC.



water resources management practices in Bangladesh. In linking both, this chapter assumes that the study applies to WRM and security issues by enhancing our knowledge of sustainability under changing climatic and non-climatic conditions. Given its weak governance structures this chapter may have some policy relevance for Bangladesh and could be used by other countries whose water resources are also severely affected.

58.2 Background

Local to global water resources, environment and ecosystem are being heavily influenced by both climate change and non-climatic drivers such as human activities. In the following sections we shall discuss how climate change (*climatic drivers*) and human activities (*non-climatic drivers*) impact on water resource and increase the vulnerabilities of the environment, of human beings and society in Bangladesh.

58.2.1 Climatic Drivers: Impacts and Vulnerabilities

Alam and Murray (2005: 3) observed that climate change would impose significant stress on resources throughout Asia, but "water resources, coastal ecosystems and human settlements" are amongst those that are "thought to be highly vulnerable to climate change." The *fourth assessment report* (AR4) of the *Intergovernmental Panel on Climate Change* (IPCC 2007a) indicates that one of the most important challenges for Bangladesh's potential for sustainable development is the impact of climate change on its wa-

Figure 58.2: Flood types in Bangladesh. **Source:** Ahmad, Warrick, Ericksen and Mirza (1996: 13). Permission was granted.

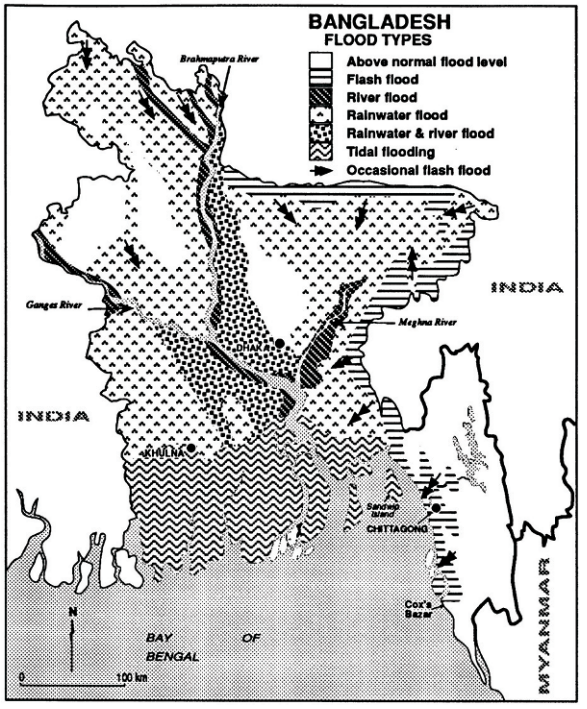
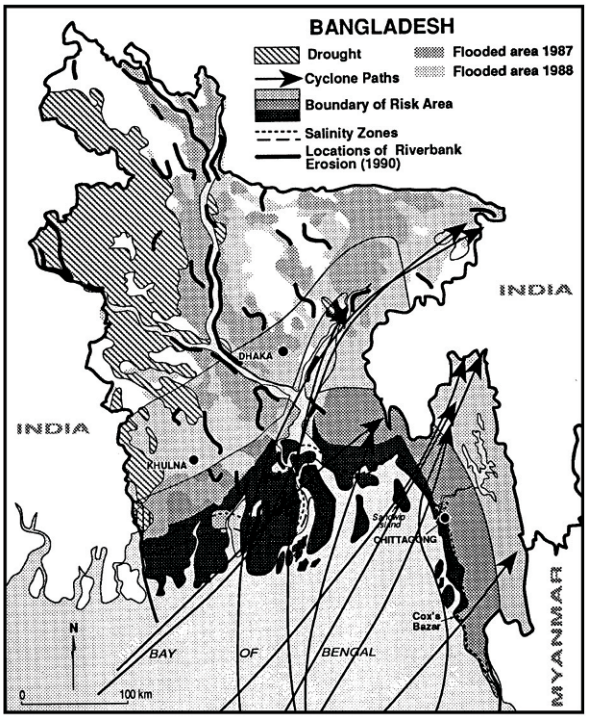


Figure 58.3: Five main types of climate-related natural events for Bangladesh. **Source:** Ericksen, Ahmad and Chowdhury (1996: 264). Permission was granted.



ter resources. Hydro-geological, human health and socio-economic factors in Bangladesh are highly vulnerable to the severe impacts of climate change. In coastal zones, for example, there would be a combined effect of climate change, sea level rise, subsidence and changes of upstream river discharge, cyclone and coastal embankments. Bangladesh's dynamic coastal morphological processes would experience change in the tidal and seasonal variations as well as experience increased frequency and intensity of extreme events (World Bank 2000). According to Ahmed (2006), a number of factors are contributing to the increase of these vulnerabilities, such as the geographical location of the country, the low elevation of the land and the deltaic and tidal landscape, concentrated and heavy monsoon rains within a short period, high population density and a high dependence on agriculture that is dependent on monsoonal water supplies. The key impacts of climate change on water resources in Bangladesh and the increased vulnerabilities raise the question(s): who or what is vulnerable to climate change and how and why they are vulnerable? We discuss these questions this next section.

In short, the key climate change impacts in Bangladesh are:

- increases of rainfall leading to an unusual flow of abundant water between June and September and very limited water flows from November to May;
- increases of water temperature and evapotranspiration rates lead to a decline in water quality in most parts of country;
- increased temperatures in the Himalayan glaciers lead to water shortages in Bangladesh;
- acceleration of the ice discharges from Greenland and Antarctic ice sheets contribute to a rise in sea-level, posing threats to costal areas in Bangladesh.
- which impact on aquatic ecosystems raising concerns on water-related biodiversity.

58.2.1.1 Important Vulnerabilities

People living in rural and costal areas in Bangladesh are more vulnerable to the impacts of climate change on water resources. Urban livelihoods and national economic activities directly and indirectly rely on the production (agriculture, fishing, cattle) in rural areas. Thus, the climate change impacts on water resources increase the vulnerabilities not only in rural areas, but also of urban livelihoods and the economic development of the country. For instance, if less rice is pro-

Table 58.1: Socio-economic impacts of sea-level rise. **Source:** IPCC (1996a: 306). Reprinted with permission of the IPCC.

	Climate-Related Events				
Impact categories	Coastal Erosion	Flooding/ Inundation	Saltwater Intrusion	Sedimentation Changes	Storminess
Human Settlements	✓	✓			✓
Agriculture		✓	✓		✓
Freshwater Supply, Quality		✓	✓		
Fisheries	✓	✓	✓	✓	✓
Financial Services	✓	✓			✓
Human Health		✓			✓

duced, the government must spend public resources for imports. Below, we discuss how and why people in rural and costal areas and national economic development are vulnerable to the impacts of climate change.

Water quality: According to Longfield and Macklin (1999), climate change increases the vulnerabilities of many geomorphic processes in water infrastructures, such as slope stability, soil moisture, erosion and sediment transportation. The usual infrastructures of most rivers, canals and agricultural lands in Bangladesh are becoming endangered by the unusual water flows. This further increases the vulnerabilities from floods, droughts and water quality in most parts of Bangladesh, posing threats to human health and ecosystems. Heavy rainfall and floods bring additional suspended solids and increase the turbidity in lakes, ponds, reservoirs and introduce pollutants (pesticides, organic matter, heavy metals) and promote algal blooms and increase bacteria content. Moreover, Schindler (2001) argues that volatile and non-volatile compounds such as ammonia, mercury, dioxins and pesticides will spread with surface water bodies to the atmosphere, putting rural people's living conditions at risk.

Key human vulnerabilities are for:

- *rural people*, especially farmers (using contaminated water for irrigation), children and poor men and women who are directly affected by water quality (from lack of pure water for drinking and other household purposes);
- *urban people* who are indirectly vulnerable, because many sick people in rural areas move to urban areas and spread diseases. Food supply in urban areas could decline and urban livelihoods could thus also be affected.

Coastal areas: Ericson, Vˆrˆsmarty, Dingman, Ward and Meybeck (2006) have noted that the Ganges, Brahmaputra and Meghna rivers are highly sensitive to sea-level rise, where the largest segment consists of deltaic plains. This unique physical property of the region presents great risks to coastal water resources and for the population, particularly for the poorer communities (Woodroffe/Nicholls/Saito/Chen/Goodbred 2006). Allison, Khan, Goodbred and Kuehl (2003) argue that salinization of surface water in the coastal regions in the south of Bangladesh increases through seawater (saltwater) incursion into surface or freshwater sources, costal aquifers and costal river systems and that is attributed by a rising sea level in the Bay of Bengal.

Key human vulnerabilities: Coastal farmers will lose agricultural lands and its productivity due to sea level rise and saltwater intrusion.

Agricultural productivity: Agriculture and agri-food production sectors in Bangladesh are most vulnerable due to conditions such as heavy rains, flood conditions, weak quality of water and severe drought. Faisal and Parveen (2004) point out that rice and wheat productions are more vulnerable than other crops because of their requirement of water for cultivation. They argue that about 8 per cent of rice and 32 per cent of wheat production will drop in Bangladesh by 2050 due to climate change and its implication on water sector. From past experiences, almost every year, all floods had submerged huge agricultural cultivated lands and damaged large amount of crops. On the contrary, during the summer season, rural farmers face challenges to cultivate rice and wheat crops due to severe drought in the northern part of Bangladesh.

Key human vulnerabilities:

- Because the rural people will not have the means to access the commercial market to buy products

Table 58.2: Synthesized results of case studies on Bangladesh and Egypt on 1-m sea-level rise in 1990 US$. **Source:** IPCC (1996a: 308).

	People Affected		Capital Value at Loss		Land at Loss		Wetland at loss	Adaptation/ Protection Loss	
Country/Source	People (1000s)	% total	Million US$	% GNP	Km^2	% total	Km^2	Million US$	% GNP
Bangladesh (Huq 1995; Bangladesh Government 1993)	71,000	60	-	-	25,000	17.5	5,800	>1000	>0.06
Egypt (Delft Hydraulics 1992)	4,700	9	59,000	204	5,800	1.0	-	13,100	0.45
India (Pachauri 1994)	7,100	1	-	-	5,800	0.4	-	-	-
Netherlands (Peerbolte 1991)	10,000	67	186,000	69	2,165	6.9	642	12,300	ß.05

Table 58.3: Potential land loss and population exposed in Asian countries to sea-level rise. **Sources:** IPCC (2001a: 569).

Country	Sea-level rise	Potential land loss		Population exposed	
	cm	km^2	%	millions	%
Bangladesh	45	15,668	10.9	5.5	5.0
	100	**29,846**	**20.7**	**14.8**	**13.5**
India	100	5,763	0.4	7.1	0.8
Indonesia	60	34,000	1.9	2.0	1.1
Japan	50	1,412	0.4	2.9	2.3
Malaysia	100	7,000	2.1	>0.05	>0.3
Pakistan	20	1,700	0.2	n.a.	n.a.
Vietnam	100	40,000	12.1	17.1	23.1

that they could produce, less agricultural productivity will pose direct threats to their livelihoods.
- Urban people are indirectly vulnerable because food supply in urban areas will decline and urban livelihoods would be affected.
- National economic development is directly vulnerable because of its agro-based economy.

Water related biodiversity: The impacts of climate change on inland aquatic ecosystems in Bangladesh are quite large. Water-related biodiversity across the country remain highly vulnerable because of the effects of rise in water temperature that lowers water quality; alter mixing patterns of water compounds of lakes, ponds and rivers. Production of planktonic communities and their food web, species composition will change with higher water temperature. As a result fish yields in many lakes, ponds and rivers in Bangladesh have declined and many other species are threatened with extinction (MA 2005). On the other hand, coastal vegetated wetlands and water-based species also face this risk due to saline intrusion and erosion through extreme events such as seal level rise, tornados and cyclones in coastal areas.

Key human vulnerabilities: Less fish production poses threats to rural people in terms of lack of protein with their intake. Less fish in rivers and canals means rural people can not access the commercial market to buy fishes.

Risk of human health: Human beings are directly and indirectly vulnerable to climate change through changes in the poor quality of water. Floods, considered to be one of the most frequent natural weather disasters in the country, have large impacts on the water quality[4] and on health ranging from injuries to deaths (Ahern/Kovats/Wilkinson/Few/Matthies 2005). In addition, floods, storms, cyclones and tornados destroy many infrastructures including the sanitation sys-

4 See EM-DAT: The OFDA/CRED International Disaster Database; at: <http://www.em-dat.net> (10 April 2009).

tems of the rural poor. They also contaminate water supplies with faecal bacteria, with dangerous chemicals, pesticides, metals and hazardous waste. All these affect human health through diseases such as vector-borne (e.g. malaria) and water-borne (e.g. cholera). One indirect result of poor public health is that the productive efficiency of rural agricultural activities and non-farm economic activities are affected by the shortage of labour and waste of man days.

Livelihood vulnerabilities in the Charlands: The river systems in the Bengal delta, are in the final stages of formation. They bring large amounts of silt from upstream parts in the Himalayas which give rise to riverine islands within the river beds and channels that are locally known as the *char*lands. People living in *char*lands are among the poorest and the most vulnerable to sudden floods. Baqee (1998: 1–2) has shown that the large number of *choura*s, the inhabitants of the chars, constitute "some of the most desperate people in the country," who live in a most uncertain and fragile environment. Thus, *chars* have been at the epicentre of resource management and of policy debates in Bangladesh because of the importance of the riparian zones to the country's life and economy and the large number of people living and using these lands (Chowdhury 2000). Lahiri-Dutt and Samanta (2006) noted that people who live in *char*lands and who are coping with perceived insecurities, due to certain livelihood benefits as well as lack of alternative opportunities, and social capital play an important role in mobilizing community support and enhancing resilience to cope with sudden disasters. The impacts of climate change on water resources, in particular the seasonal floods, riverbank erosion and shifting river channels, are expected to make these large numbers of *choura*s physically, socially and economically more vulnerable and displace many of them, forcing them to become environmental migrants unless people-oriented water management practices are promoted.

Socio-economic vulnerabilities due to climate change can occur in different forms in Bangladesh; for instance, damages can occur in an inequitable manner leading to even permanent displacement of the rural poor due to floods, droughts (or perceived droughts, such as the lack of water in Padma River), tornados and cyclones. Rural and coastal communities in Bangladesh are mostly victims of these changes because of their limited resources, opportunities and protection. Traditional livelihoods of local people are threatened by their lacking ability to irrigate crops due to water shortage or their lacking resources to buy other products due to the crop damages from natural hazards. Affected people are mentally stressed losing crops, property, infrastructures and livestock. But certain segments of the population, especially children, the elderly, daily paid workers (working for other farmers) and marginalized groups are even more vulnerable Further, diseases emanating from the poor quality of water make some local people socially vulnerable because they do not get proper treatment due to a lack of money. As a result, social stability will be affected because most rural people will lose their income, become unemployed and live with high mental stress. The education of children and of the young from affected families will be interrupted and they will be socially vulnerable due to lower economic productivity. Finally, the national economic development is directly affected by these changes.

58.2.2 Human-induced Drivers, Impacts and Vulnerabilities

Water resources in Bangladesh are not only threatened by the impacts of climate change, but also by non-climatic drivers or human-induced activities, such as:

- Household sewage and wastewater are discharged untreated into canals and rivers causing water pollution.
- Due to a lack of tight regulations and effective monitoring systems water sources are at risk from industrial effluents discharged into rivers. Textiles, tanneries, pulp and paper mills, fertilizer, chemical industry and refineries are the most harmful industries for the water sector in Bangladesh. According to Cegis (2003) these industries also discharge hazardous chemicals, both organic and inorganic, without treatment.
- Imbalanced use and control of water by upstream users (e.g. India) are affecting water availability in major rivers in Bangladesh (e.g. in the Padma River).

58.2.2.1 Important Vulnerabilities from Non-climatic Drivers

The quality of water is depleting due to industrial effluents, household sewage and wastewater discharged into rivers. As a result, fishes and other aquatic species are becoming vulnerable to water pollution. Direct or indirect effects of these pollutions are also contributing to people's health and livelihoods. Loss of biodiversity, reduction of fisheries (a major source of pro-

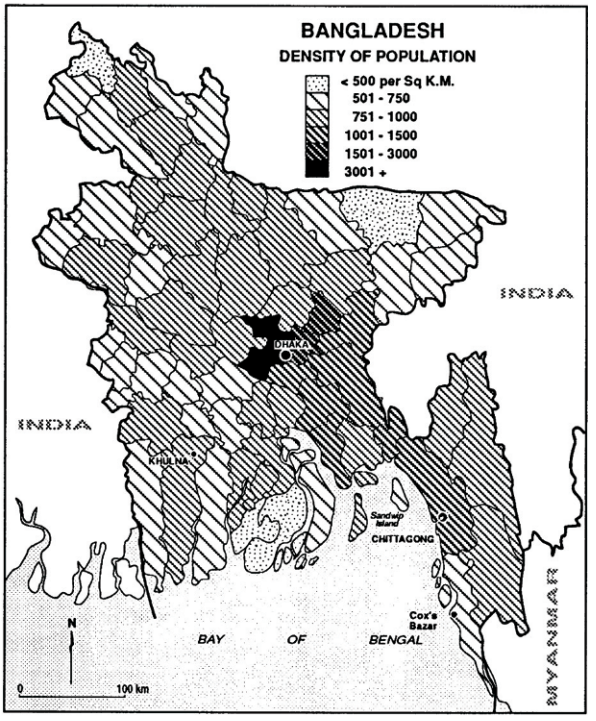


Figure 58.4: Urbanization in Bangladesh. **Source:** Ericksen, Ahmad and Chowdhury (1996: 239). Permission was granted.

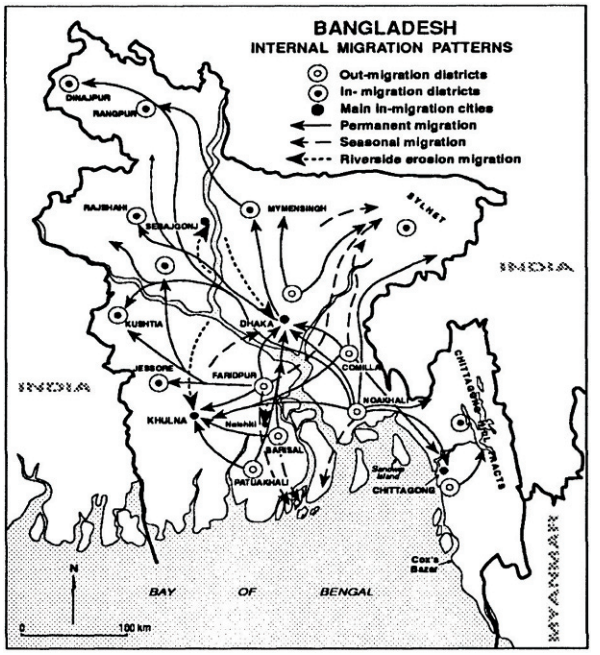


Figure 58.5: Migration in Bangladesh. **Source:** Ericksen, Ahmad and Chowdhury (1996: 245). Permission was granted.

tein for the people) and reduction of agricultural production near river banks also increase the vulnerability of local poor farmers for sustenance.

The water flow of small rivers, canals and lakes distributing the waters from or depending on the Ganges becomes vulnerable due to the diversion and unbalance use of water resource by upstream users in India. The construction of the Farakka barrage over the Indian part of the distributaries of the Ganges River has undoubtedly worsened the water availability during the winter months in Bangladesh. Moreover, the chronic reduction over the recent years in the flows of rivers falling into the Bay of Bengal has unduly created misunderstanding between the upper and lower riparian countries in this part of South Asia. The physical effects have also led to further socio-economic vulnerabilities in the rural areas of the Ganges-Padma basin in Bangladesh. Finally, due to increasing industrialization and urbanization, agricultural lands are shrinking in all over the region, and it is feared that reduced availability of farming land is making the poor more vulnerable. This was apparent from the recent outburst of public anger across the border in West Bengal in India over the acquisition of cultivable land for industrial use, leading to widespread public perception of a looming decline in food security.

58.2.2.2 Weak Governance

According to UNESCAP (2007), most developing societies are facing enormous challenges due to inefficiency and poor accountability which are symptoms of weak governance. Pande, Tropp, Sharma and Khatiwada (2006), in their report on human development and good governance on Nepal, argue that ignoring the interest and priorities of the people in the execution of plans by the government reflects weak governance. This challenges principles of human dignity (inclusiveness, liberty, equality and cooperation) and at the end societies become vulnerable to weak policies. Weak governance is a key non-climatic driver with adverse impacts on WRM. Although climate change impacts are also related to governance issues, the direct impacts of weak governance on the sustainability of water resources in Bangladesh are obvious.

For the WRM in Bangladesh, the influence of weak regulations, lack of cooperation and monitoring systems are acknowledged when major industries (textiles, tanneries, pulp and paper mills, fertilizer, chemical industrial and refineries) ignore their environmen-

Figure 58.6: The central or national (top-down) control system and influences on the local level of government. **Source:** Zillur (2007).

tal consequences that affect the people's livelihood by polluting water resources through industrial effluents. An example of weak governance is the well-known common occurrence of encroachment and illegal constructions on rivers.

The security of water resources in Bangladesh is not only threatened by industrial pollution, but also from the narrowing-down of the water system by illegal encroachment of river channels and river banks for building activities. A recent report in the *Daily Ittefaq* of 16 June 2009 suggests that the Buriganga River in Dhaka will no longer be considered a legitimate river with a regular flow if the construction activities around it are not immediately stopped. Such a dramatically reduced water flow does not only undermine environmental sustainability but also threatens the security of the water resources. One may question the legitimacy of such constructions on common property resources or on public lands, but more importantly, the excessive demands for land are threatening the natural river flows with long-term consequences for human well-being. One may argue that the lack of accountability, transparency and responsiveness of the public authorities are responsible for the failure of the protection of water systems in Bangladesh.

The influence of the national government on local governments is another aspect of weak governance and of poor WRM. Although there is a great demand from civil society organizations, from non-governmental organizations (NGOs) and academics for a decentralization of governance, little progress towards a real decentralization of administration and political power has so far taken place. A reduced control of the central government over local authorities would lead to a loss of power to interfere in local matters.[5]

Unfortunately, the lack of accountability encourages many central administrators to use their authority for personal benefits (figure 58.6). This systematic top-down control is a reflection of weak governance and the process directly and indirectly impacts negatively on the country's water resources. However, there are certain aspects contributing to this prevailing weak governance and affecting the paradigm of WRM (figure 58.7).

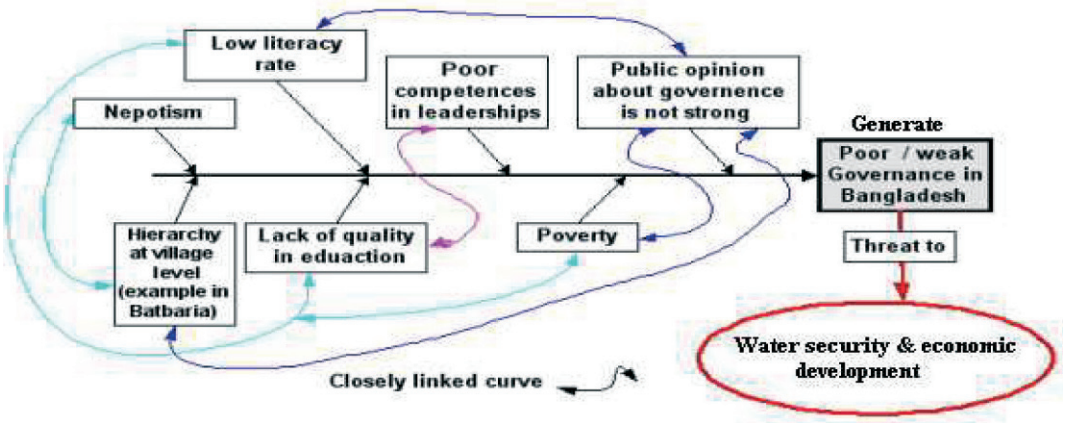
Figure 58.7 illustrates the close linkages among these factors and how these factors are contributing to the risk of water resources due to the formulation of weak governance. For instance, to put pressure on the authorities for certain legal issues, a strong public opinion is necessary. However, it is difficult to consider these public issues given the low literacy rate (ca. 41 per cent) and as many people live below poverty line.

The sensitive politics of transboundary water sharing is another aspect of water security for the rural areas of Bangladesh. Different policies on the water use in international river basins by one country, e.g. by India, Nepal and China affect the water availability in Bangladesh. The Dublin principles[6] emphasize the importance of upstream and downstream users of water as:

5 S. Kazi and K Alam, 2006: "Empowering Local Government in Bangladesh"; at: <http://nation.ittefaq. com/artman/publish/article_29731.shtm> (30 June 200?).

6 Four principles for IWRM were developed in Dublin (1992) by a conference on water and environment
Principle No. 1: Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment;
- *Principle No. 2*: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels;
- *Principle No. 3*: Women play a central part in the provision, management and safeguarding of water;
- *Principle No. 4*; Water has an economic value in all its competing uses and should be recognized as an economic good (<www.gwpforum.org>).

Figure 58.7: Interlinked factors behind weak governance posing threats for water security in Bangladesh. **Sources:** Zillur (2007).



> Upstream users must recognize the legitimate demands of downstream users to share the available water resources and sustain usability. Excessive consumptive use or pollution of water by upstream users may deprive the downstream users of their legitimate use of the shared resource (Jonch-Clausen 2000: 15).

Bangladesh has complained about declining water flows during the dry season (November to May) due to the construction of Farakka Barrage on the Ganges by India. India has started to build barrages upstream to use the waters of two other large rivers, the Brahmaputra and Meghna. These rivers comprise the main sources of water for many small rivers and canals in Bangladesh and such constructions may impede their natural flows with dire consequences for the downstream ecology (Rahman 2005). The first and second Dublin Principle on *Integrated Water Resource Management* (IWRM) emphasize that a "holistic management approach"[7] and effective participation by all countries – Bangladesh, India and Nepal – are required for an efficient management of transboundary rivers. The geopolitics of the region is undoubtedly dominated by India and water issues continue to provoke strong tensions (Hill 2008). The impacts of reduced flows are far-reaching downstream. Samarakoon (2004) has shown that besides the environmental effects, some social and economic challenges in Bangladesh can sometimes be traced to decreased water flows in the Padma River, particularly during the dry season when other canals and rivers also become vulnerable to reduced flows.

58.2.2.3 Crisis of Water Availability or Governance

Experts have referred to weak governance as the main problem in South Asia. For Moench, Dikshit, Rathore and Srinivas (2003: 3–4) governance is the "core water challenge in South Asia." The fundamental challenge posed by the water crisis in South Asia is not about the capacity of key stakeholders (governments, NGOs or communities) to select technical solutions or planning mechanisms. Since water challenges heavily depend on the 'constitutional foundations' to which all decisions are linked, the authors argue for a deeper analysis of such foundations and if necessary the rethinking of these constitutions. Major questions exist as to who does the integration of water resources planning, whose interests are reflected in the integration process and how this process is governed to ensure that the interests of all stakeholders are equitably reflected, how disputes are resolved, and above all, which issues must be addressed through integrated approaches (Lahiri-Dutt 2008: xxxvii). Similar opinions are voiced by completely different schools of thought. For example, whilst Shiva (2002: 1) argued that "the water crisis is the most pervasive, most severe, and most invisible dimension of the ecological devastation of the earth" and she stressed that the wa-

7 According to the EU, a holistic approach of water resources management that is combined, 'environmentally-sound water management; food security especially for the poor; private sector involvement; reduction of subsidies; decentralization of decision-making to the lowest appropriate administrative level; user participation in services; institutional reform and regulatory frameworks; and cost recovery and pricing' (EU 1999). The definition has been taken from the paper of "Wetlands: water, life, and culture", 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971), Valencia, Spain, 18–26 November 2002.

Figure 58.8: Water crisis and poor governance relationship. **Source:** Zillur (2007).

ter crisis is mostly a human-created crisis or water *management* crisis instead of a natural crisis.[8] From a more technocentric perspective, Biswas[9] (2006) argued similarly that the South Asian region faces "a crisis of bad water management." The *Asian Development Bank* (ADB) also argued that "the concept of governance is concerned directly with the management of the development process" (ADB 2005).[10]

Recently Turton, Hattingh, Roux, Claassen, Maree and Strydom (2007) have described strong governance as depending on a 'trialogue' between the state or governments, the civil society and the scientific or technocratic experts. Their hypothesis is that the trialogue model, consisting of six essential elements, effectively reveals the degree of successful governance. It denotes the balance between the three elements because governance requires the existence of effective science, government and society processes. Governance also requires effective interfaces between each of the three processes, namely society and science, government and society, and society and science. Thus, irrespective of the philosophical perspective of the experts, rethinking its *management* seems to be the direction towards future water security for not only the South Asian region, but also for Bangladesh. Thus, the crisis of water management may also be defined as the crisis of governance by several equations (figure 58.8).

These equations stress the significant relationship of non-climatic conditions for water security with regard to governance.

58.3 Prospect of Social Networks to Form Local Good Governance: Better Water Resources Management

Although it is difficult to draw a clear-cut boundary line between 'good' and bad' governance of water, following UNESCAP, eight major characteristics are outlined: 1) participation, 2) transparency, 3) consensus oriented, 4) responsiveness, 5) equity and inclusiveness, 6) effectiveness and efficiency, 7) the rule of law and 8) accountability of what is commonly seen as good governance (UNESCAP, 2007). Coming from another perspective, Bohle (2009) considered these factors as the key to sustainable livelihoods security.

With regard to social networks, our thesis is that they are invaluable in mobilizing good water resource management in Bangladesh under a scenario of change driven by both climate and non-climatic factors. Despite a large state bureaucracy on water, non-state actors continue to operate and manage water in the informal sphere based on traditional social institutions. The following section briefly outlines social institutions, social capital and social network theories to explore how they generate good governance from the local to the national level for the security of water resources in Bangladesh.

58.3.1 Social Institutions

The term 'institution' includes social activities, values, norms, social structures and cultural systems (White/Mohr 2008). It may also be used for 'social institutions', which represent several interlocking social networks. The theory of social institutions examines cultural networks (shared stories, shared narratives, systems of value) and relational structures (linking meanings, values, and stories together), which are significant to organize social life that is directly or indirectly related to the development of local governance and WRM in Bangladesh. Social institutions theory also analyses different linkages that occur across various orders of social phenomena (Varvasovszky/

8 Shiva, Vandana, 2006: "World without Water", in: *Channel 4* [*True Vision Productions* broadcast, UK], *29* April.

9 Asit K. Biswas is the founder of the Third World Centre for Water Management and of the *International Journal of Water Resources Development*. He received the 2006 Stockholm Water Prize.

10 "Governance" simply means, "the process of decision-making and the process by which decisions are implemented (or not implemented)" (UNESCAP 2007: 1).

Brugha 2000). Such analyses are highly applicable to rural areas in Bangladesh, where a duality of styles and institutions exists, often somewhat separating the formal and informal spheres. Both styles represent different sets of values that correlate with the principles of social institutions. In Bangladesh the actors in WRM operate through social institutions through their values based on their behaviour.

58.3.2 Social Capital

Social capital is about values and social relationships that facilitate human beings to act collectively. The concept of social capital is not about "what you know, it's who you know" (Woolcock/Narayan, 2000: 225). This statement recognizes the benefit of social relations. For instant, individuals who form interactions and networks with others, mostly increase their chance of benefit. Lin (2001) argues that 'information and influence' are some of core reasons to study social capital in social networks. Sharing information with others through social ties thus enhances the outcomes of organizations or the activities of individuals. By using the theory of social capital, it will be possible to explain the investment in social ties that increases the level of information and would then influence the actors, the key players in decision-making or holding strategic positions who can influence developing good governance to improve WRM in Bangladesh.

58.3.3 Social Network

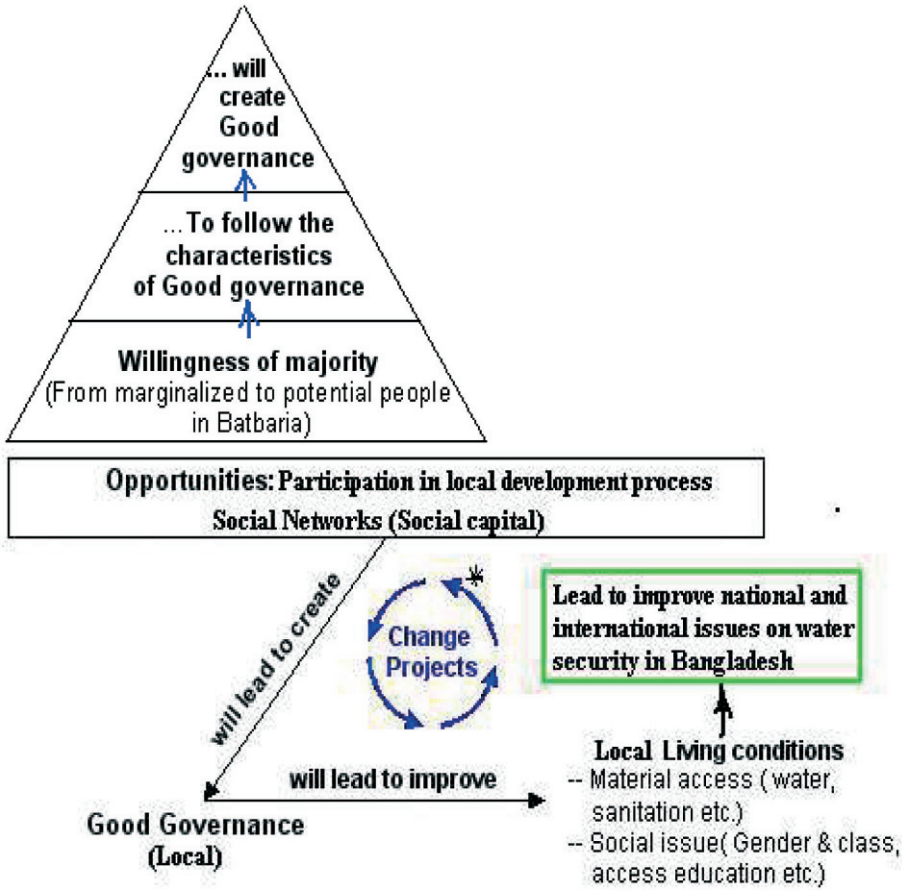
Social network analysts argue that the social environment is based on the relationships among interacting units. According to Wasserman and Faust (1994) social network analysis looks critically at the characteristics of social units and understands how these ties influence properties of the social structural environment. In Bangladesh, a significant part of the analysis is influenced by social relationships. By using social network analysis, key concepts (such as actor, rational tie, dyad, triad, subgroup, and group) of the theory are used to explain how WRM is influenced by social prestige, groups or clique, social cohesion, social position, social role and mutuality in the local areas in Bangladesh. Selection to use the social network to represent the relational tie, where actors are linked by social ties with each other and it establishes a linkage between two actors or a pair or three actors or groups of actors. At the local level in Bangladesh, a group is recognized as a collection of all actors where relationships are considered.

58.3.4 Coping with the 1998 Floods by Social Networking

As an example of how the social elements play a crucial role during a great crisis the case of the 1998 flood in Bangladesh is discussed below. Heavy monsoonal rain, lack of sufficient culverts and insufficient drainage contributed to an intensive flood where about 39 out of the 64 districts were flooded, breaking all hydrological records (Nasreen 1999). The flood waters devastated agricultural crops and disrupted farming activities for several months, and destroyed the sources of fisheries and farm livestock (Ahmed 1999). Millions of people lost their homes and took shelters on higher grounds, such as the river embankments. Not only were their houses destroyed, roads and other communication infrastructure were also damaged. Flood refugees took shelter in nearby schools and colleges around the villages, and it was extremely difficult to send food and other relief aid immediately to all remote locations. However, there was a low number of fatalities; villagers managed to survive based on mutual support in flood-affected communities. Many civil society organizations mobilized their strengths and brought assistance to those in need. Ordinary citizens helped each other, large amounts of clothes, *khicuri* (cooked rice and lentil) and drinking water were provided to them by local unaffected people. Students from colleges and schools collected food, money and medicines from *bazars*. Imams, priests and gurus of mosques, churches and temples collected food, clothes as gifts to flood affected people. Even those who were affected by the flood tried to extend their help to others to transport their goods and cattle to higher locations. Mobilization of the civil society helped to avert a major post-flood disaster. This case of a disaster response illustrates the use of social theories in the communities in Bangladesh.

Looking back at the social mobilization, a noted Bangladeshi thinker, Sobhan (1999: 41) prescribed: "Efforts by the government to keep track of such emerging problems would be greatly facilitated by drawing upon the efforts of civil society that is already in the field fully involved with the relief process." The collection of best practices, examples of difficulties, storing of this information in an easily accessible form, and easy communication of such information can play an important role in averting human tragedies in a post-flood situation. Bangladesh is a flood-prone land, where climatic and non-climatic drivers add to these flood risks. Unless social institutions are

Figure 58.9: Participatory approach facilitates creating good governance. **Source:** Zillur (2007).



strengthened at the local level and social capital is mobilized, it will remain impossible to grant security to ordinary citizens.

58.3.5 Theories of Social Capital and Social Networks as Inputs for Good Governance

Participation by all is the first step to create an environment of good governance. Social capital and balanced social networks facilitate the willingness of all people, including the poor and the marginalized, to participate (core of good governance), and it opens potentials for development, by using more local knowledge collectively and increasing the chance of *consensus-oriented* activities in the communities. Strong social networks and ties will develop transparency to participants since people will be more interested to keep progress in the society. Automatically, it creates local public accountability.

Therefore, social networks and approaches based on social capital enhance local participation and promote inclusiveness, transparency and accountability, which are the fundamental characteristics of good governance. Figure 58.9 shows the input of social networks (social capital) to generate a willingness to participate in community activities. This leads to the formation of good local governance. When there is good governance, there is a good management. This will then contribute to improve local people's living conditions thereby encouraging top authorities and politicians to adopt and implement good approaches and efficient policies for water security in the country.

58.3.6 Social Networks for Creating Good Governance

Based on the above discussion, increased motivations of local actors and water users holds the potential to trigger bottom-up changes in WRM in Bangladesh with regard to changes by climate-driven and non-climatic factors. Local practices of good governance may influence local elites, who have good connection with higher authorities responsible for decision-mak-

ing in the formal sphere. Since political leaders are well-connected in local areas, there are possibilities that they may be influenced to adopt local principles of good governance on a national and international scale. Such changes in governance may cross national boundaries to address complex transboundary water issues that are essen-tial for securing water resources for Bangladesh. In other words, good WRM practices arising from the local context can spread to governance of the global level.

Flood mitigation, after all is not a so-called simple matter of controlling a natural hazard. Floods are indeed a natural occurrence, but they are also "socially produced" through the interaction of the physical incident and social vulnerabilities (Lebel/Nikitina/Manuta 2006: 3). Consequently there is a need to go beyond the purely technical solutions to mitigating the risks of increased flood or other water insecurities that are envisaged for the future. The technical measures, as noted by Dixit (2003: 166) only intensify flood and related problems and largely ignore the mitigation potential during the period of normalcy between two extreme events. Shen has also consistently emphasized the importance of perception as the key factor for developing a mitigation plan to reduce flood risks, and has suggested that instead of risk externalization, the interests of vulnerable social groups needs be considered and an integrated flood mitigation approach needs to be adopted. As suggested by Yohe and Strzepek (2007), for reducing the risks of climate change impacts on the waters of South Asian countries, mitigation and adaptation strategies will need to go hand in hand, and for this purpose, a greater understanding of the social institutions will be absolutely vital to improve the governance of water.

58.4 Conclusions

This chapter has addressed a diverse range of issues related to the security and sustainability of WRM in Bangladesh in the context of the looming threat of climate change and the complex social and political factors including weak governance in the country. It has suggested that social networks could play an important role in ensuring security at the micro-levels, and the promotion of people-centred water management, particularly for the densely populated country, Bangladesh. Whilst the increasing gap between demand and supply of water has led to a deepening water crisis in the country, climate change has posed a serious challenge for future water resource management. On the one hand there will be further reductions to freshwater supplies, on the other the melting of the Himalayan glaciers will change the volume and frequency of monsoonal floods and change the river regimes in Bangladesh.

The chapter ends with a question for further research: what are the determinants of social networks for the sustainability of WRM in rural areas of Bangladesh? This question will address the existing research gap by incorporating social networks to explore what parts of social networks are important, why they are important, and how they influence the development of sustainable WRM strategies in Bangladesh.

59 Applying Bottom-up Participatory Strategies and Traditional Methods of Water Harvesting in the Thar Desert, Rajasthan

Kanupriya Harish and Mathews Mullackal

59.1 Introduction

With the increasing evidence on climate change policy-makers and researchers are searching for ways to cope up with its impacts and consequences. Adaptation is particularly important for developing countries as impacts of climate change will deeply affect the geographical locations of developing countries (Walker/King 2008: 60–63). They are most vulnerable due to their limited economic capacity as: "the people who will be exposed to the worst of the impacts are the ones least able to cope with the associated risks" (Smit quoted in Adger/Huq/Brown/Hulme 2003: 180). The management of water resources will be most troublesome due to the unpredictability of the climate (Walker/King 2008: 55), thereby seriously affecting not only the availability of drinking water but also other sectors such as agriculture, sanitation and health. The vulnerability of the water sector is much worse for most developing countries as their policy frameworks are "less mature, with weaker institutions, and less capable of providing for adaptation to climate change" (Levina 2006: 6).

Nevertheless, important lessons can be learnt from the experiences of water harvesting in the Thar Desert, where the climate has been already harsh and unpredictable. From this experience a bottom-up participatory approach could be a realistic way forward in developing adaptive strategies to climate change. The chapter traces the water crisis in the Thar Desert (59.2), the scope of the bottom-up participatory approach in natural resource management (59.3), traditional wisdom in the region (59.4) and a success story of coping with adverse and changing climate in the region (59.5).

59.2 Thar Desert and Water Crisis

The Thar Desert in Western Rajasthan, with a population density of around 100 persons per square kilometre compared with three to ten in other deserts, is the most densely populated arid zone in the world (Dhir 2003: 1). The Thar, the world's seventh largest desert, is a hot season rainfall region, situated in the north-west of India. The aridity in the region is considered as relatively new in geological scale and a cause for the end of the Riparian and Harappa-Kalibangan civilization (Jaiswal 1977). The Palaeobotanical evidence indicates an increasing trend in aridity due to geological and climatic changes in the region since the Miocene times. The desertification was exacerbated by the demise of a well-knit river system with the diversion and disappearance of three classical rivers: the Yamuna, the Saraswati and the Ghaggar (Jaiswal 1977).

About 10 per cent of the Thar Desert eco-region is composed of sand dunes, and the other 90 per cent of craggy rock forms, compacted salt-lake bottoms, and interdunal and fixed dune areas. The weather is extreme with temperatures varying from almost-freezing in the winter to more than 50 °C during the summer. All rainfall is associated with the short July-September southwest monsoon that brings a mere 100-500 mm of precipitation, while the average rainfall in the region is only 200 mm (Khan 1998: 167). Also the ground water in most of the region is saline and unsuitable for drinking. Although these factors make this region inhospitable, the population of human settlement in the region has only been increasing (figures 59.1 to 59.6).

The history of the current and uniquely high human settlement in this region dates back to over 2000 years. Historians believe that the influx to this rather inhospitable but physically secure tract started soon after Alexander's invasion in 327 BC. Thereafter the population continued only to increase. By the

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Figure 59.1: A *dhani*, a traditional mud house in the Thar desert, Rajasthan. **Sources:** Photo by Kanupriya Harish.

Figure 59.2: People and landscape in the Thar desert, Rajasthan. Women restoring her courtyard with clay. **Sources:** Photo by Kanupriya Harish.

Figure 59.3: People and landscape in the Thar desert, Rajasthan. **Sources:** Photos by Kanupriya Harish.

Figure 59.4: People and landscape in the Thar desert, Rajasthan. **Sources:** Photos by Kanupriya Harish.

beginning of the second millennium the entire region was not only well settled, but also politically organized (Dhir 2003). Since the census of 1921, the population growth was even higher than for the rest of India (figure 59.7). Development of infrastructure and transportation facilities, which facilitated easy access to the previously less explored region, could have contributed to this recent trend.

However, recent years saw increasing challenges for human settlements in the region, with an increasing number of drought years. The fragile desert ecosystem is currently subjected to increasing human and livestock pressure, non-sustainable use of natural resources and neglect of traditional wisdom. To make things worse, droughts have become a recurring phenomenon; on an average the region witnesses six drought years in a decade (Mohnot 2003: 3). Though it seems natural in this region, Indira Khurana argues: "it is truly a human made or rather a government made disaster" (Khurana 2003: 138).

These increasing incidents of droughts are the result of two major shifts of water management that happened in the last century. Firstly, responsibility of water management was taken by the State from individuals and communities. Secondly, modern technologies promoting large exploitation of natural resources such as dams and deep tube wells replaced traditional and simple rain water harvesting methods (Khurana 2003). This change has resulted in mismanagement of water resources and also in unsustainable water use

Figure 59.5: People and landscape in the Thar desert, Rajasthan. **Sources:** Photos by Kanupriya Harish.

Figure 59.6: People and landscape in the Thar desert, Rajasthan. **Sources:** Photos by Kanupriya Harish.

Figure 59.7: Growth of human population (base year: 1900 as 100). **Source**: Dhir (2003: 2).

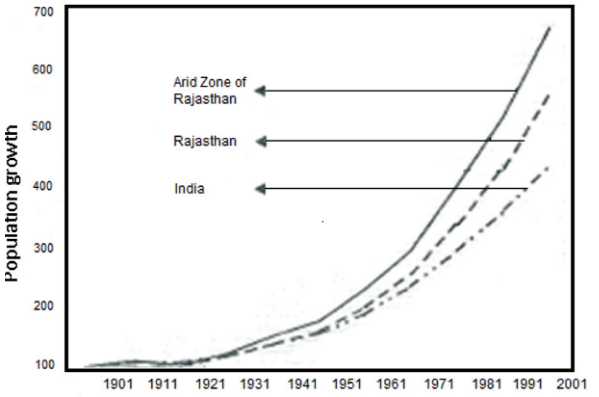

Figure 59.8: The Great Indian Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

behaviour, as the "Statement of Shared Concern" (Agarwal/Narain/Khurana 2001: 448) concluded, that was adopted by the participants of a national conference (New Delhi, 3–5 October 1998) of the Centre for Science and Environment, a leading think tank on environmental issues in India, on potential of water harvesting.

The modern paradigm has resulted in a mismanagement of both groundwater sources and river water, and also in water use behaviour, which does not reflect concerns for the growing scarcity of water. Subsidized water services by the state has further encouraged this behaviour and put limited water sources under stress (Agarwal/Narain/Khurana 2001: 449).

Although the people in this area have developed a variety of coping mechanisms for centuries, it is increasingly observed that the resilience of the community, particularly of the poor, to adverse climatic conditions has considerably declined. The causes include population growth along with a change in land use and a decline in altruistic attitudes (Scott 2008: 9). The already stressed water sector in this region is predicted only to get worse with looming impacts of climate change. Although there were uncertainties about human-induced climate change

Figure 59.9: The Great Indian Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.10: A small open water harvesting tank called *tankli*, covered with thorns.

Figure 59.11: Droughts in the Thar in Rajasthan, a recurring phenomenon. **Source**: Photo by Kanupriya Harish.

Figure 59.12: Droughts in the Thar in Rajasthan. Water distressed communities collect every drop of water from water holes. **Source**: Photo by Kanupriya Harish.

until this decade, now there is a wide consensus and it is predicted that the average surface temperature would increase at least by 2 °C in this century (IPCC 2007c).

The first national communication of India to the *United Nations Framework Convention on Climate Change* (UNFCCC) reveals that Rajasthan is one of the most vulnerable states in India, due to a weak social capital and various impacts of climate change. Particularly, the Luni river, the west flowing river of Kutch and Saurastra that benefits 60 per cent of the area of Rajasthan is likely to experience acute physical water scarcity (GOI 2004: 78). Also the rain-fed agriculture in this area, a major livelihood source, would be adversely affected by climate variability which has been impacting on the lives of millions of poor people.

These challenges necessitate an adaptive governance to manage water resources in the region. According to the IPCC, vulnerability is not only a function of sensitivity or exposure, but also of adaptive capacity. It is increasingly realized that adaptation must not start from scratch. A bottom-up participatory approach that acknowledges various coping mechanisms developed through traditional iterative learning process

would be a realistic way forward. It helps people to adapt to present climate variability based on past experiences and to develop strategies for responding to future climate variability.

59.3 Bottom-up Participatory Approach

Most development programmes in the past have adopted a top-down approach or an external expert approach, in which an external agency puts itself outside the local system and makes decisions about the system. The participatory or bottom-up approach that incorporates the participation and ownership of local people, has emerged against the top-down approach. This radical idea envisages an empowerment of the disadvantaged section of humankind to fight against oppression and to claim denied choices (Gujith/Cornwall 1995: 3).

Nowadays, participatory methods have become a dominant paradigm in development and are considered as the backbone of bottom-up development. The participatory approach is often considered as being superior to the conventional approach in development, and has gained an increasing thrust particularly in the natural resource management discourse. Since the government ownership and management of natural resources has resulted in their overexploitation, in the name of development, the participatory management has indeed increasingly become relevant (Mishra/Bajpai 2001: 9). Also it is ever more realized that natural resource management cannot be effective without involving the local communities, whose livelihood is directly dependent on it.

There are many outcomes of the participation in development or natural resource management. The foremost outcome of a real participatory approach is to create a self energized community that is sufficiently capable to analyse their own situation, both the gaps and their potential, and to strategize and plan a course of action for their integrated development. It means that participatory development not only brings positive changes in development indicators but also in the social structure in terms of an enhanced social capital, self-reliance, social equity and lower dependence on the government.

Therefore, a participatory development worker should have appropriate facilitation skills, while respecting the capabilities of the community and their traditional wisdom. Apart from the above key outcomes, there are at least three objectives or immediate outcomes for the participatory approach (Biswas 2000: 167).

- Firstly, what has been realized for a long time, it generates a wealth of quality information about a local region and community. Indeed, the whole idea of a participatory approach evolved from experiments of anthropologists when they rapidly collected information from rural communities. Later techniques, like a *participatory rural appraisal* (PRA), have become unavoidable in development initiatives. Despite a faster methodology of data collection, it is often emphasized that data collected through a participatory approach is more trustworthy than other methodologies (Biswas 2000). It has a unique advantage to get information about sensitive and surprising realities that are not accessible with traditional methods (Chambers 2003: 40).
- Secondly, the participation increases the involvement of communities, as people get psychologically attached to the decision taken through a participatory approach. When people are involved in a decision, they tend to take ownership of the decision and there is a motivating force for them to ensure that the activity undertaken succeeds.
- Thirdly, participation results in enhanced knowledge generation, as participation of many people result in a culmination of complimentary knowledge leading to a better understanding of an issue (Biswas 2000: 168). Moreover, participation of indigenous people would reflect time tested traditional wisdom in development interventions. Furthermore, such a process will improve the knowledge of local people as well as of the external facilitator, and it would be more widely accessible when properly documented.

Participation of communities in the development process, however, remains a much contested notion. The term participation itself is very dynamic, and lacks a universal definition. There are broadly two different notions of participation, those that relate to the means and ends of a development process (Singh/Murari 2001: 14).

- The first school of thought views participation as 'means' of a development process. In other words, participation of local communities is a strategic component to attain the objectives of a project, as participation ensures smooth and effective implementation of the project.
- Conversely, the second notion, which sees participation as an 'end' of a development process, envi-

Figure 59.13: Mobilization of communities through village meetings and interactions. Jal Sabha (village water user association) interacting with JBF Trust functionaries. **Source:** Photo by Kanupriya Harish.

Figure 59.14: Mobilization of communities through village meetings and interactions. During a monitoring meeting impact of interventions being evaluated. **Source:** Photo by Kanupriya Harish.

Figure 59.15: Mobilization of communities through village meetings and interactions. Discussions for formation of a Jal Sabha (village water user association) **Source:** Photo by Kanupriya Harish.

> sions developing and strengthening capacities of communities whereby common people access and control resources which would improve their living conditions (Singh/Murari 2001: 14).

Clearly the second notion, as it is a process that unfolds over time, is more sustainable and long term in nature than the first one which lasts only during the implementation of a project. This is particularly relevant since underdevelopment is increasingly recognized as a result of non-participation and lack of 'voice' of local communities in managing and controlling the natural resources. Therefore, the authors believe that the participation of the community in the development process should be emancipatory, leading to community ownership and sustainable control of natural resources. Apart from the above notion there are broadly three different interpretations of participation (Oakley 1991: 8).

- Firstly, the dominant interpretation of participation views it as implying a 'community contribution' in development projects. The contribution, either cash or kind, would ensure ownership of communities in the development initiative. However, such a participation can be merely perfunctory and need not necessarily ensure control of local communities on natural resources.
- Secondly, 'participation as organization' is a widely adopted interpretation of participation. There are many village level or watershed level community organizations in India, formed by NGOs or government projects. These community-based institutions are widely seen as fundamental instruments of participation and essential for a bottom-up development. These institutions could enhance social networking and social capital and make positive interventions for development which would reflect traditional and collective wisdom. Nevertheless, these institutions could bring undesirable changes or reconstruct disparities, if the communities were not empowered and or all the sections in the community were not included.
- Thirdly, participation is interpreted as empowering local communities. In practice, empowerment of communities is a prerequisite for realizing the

Figure 59.16: Traditional water harvesting systems supported by Jal Bhagirathi Foundation in the Thar desert, in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.17: A typical community *tanka* with artificial catchment. **Source:** Photo by Kanupriya Harish.

Figure 59.18: School *tanka* harvesting water from the school building in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.19: A *talab* or village pond in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

above two interpretations of participation in letter and spirit. The term empowerment of communities has mainly two dimensions: enhancing the capacities and skills of communities and transferring the power of decision-making to communities.

A careful analysis of these different interpretations would reveal that all interpretations have their own merit, while none of them is comprehensive in encapsulating the objectives of participation mentioned earlier. Also, it is not possible to treat the above as either discrete or inseparable categories. However, an all-encompassing approach can definitely bring positive changes in the development of a region. Such an approach will include all the three above alternatives: community contribution, community organization and community empowerment. This approach would ensure community ownership, informed decisions, collective action, and best use of traditional wisdom.

59.4 Traditional Wisdom in the Thar Desert

The traditional water management in the Thar desert was embedded in a holistic and ecologically prudent matrix of *Agor* (catchment area), *Gauchar* (pastureland), and *Oran* (sacred groves-biodiversity repository) – the AGO (Mohnot 2003: 3; JBF 2009:

Figure 59.20: A village *talab* with a water channel in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.21: A woman filling water from a *talab* in the Thar desert, in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.22: A camel drinking water from a *talab* in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.23: Water channel bring water from the catchment area to the *talab/nadi* in the Thar desert in Rajasthan . **Source:** Photo by Kanupriya Harish.

16). The *Agor* was well maintained and protected to feed and sustain village water bodies such as *talabs* (village ponds) and *nadis* (grassland ponds), situated in common pastureland (*gauchar*) were maintained as a support system for the livestock economy. On the other hand the *orans*, often associated with a water body, was and remains the most effective approach to protect biodiversity and improve retention and quality of water. *Orans* are the oldest natural resource depositories in the region. Some of the region's *orans* are 150–500 years old, while a few might even be 800 years old (Mohnot 2003: 9). These crucial community resources existed in most villages and were traditionally managed by the village community. Bringing spiritual values and worship, AGO remains the most effective way in conserving natural resources in villages.

The AGO matrix, however, has deteriorated due to the transfer of common property resources to centralized governance. The large population growth, of humans as well as livestock, also resulted in a mismanagement of AGO. These changes have resulted in severe ecological degradation and increasing desertification leading to a scarcity of water. Consequently the resilience of the community, particularly of the poor, to adverse climatic conditions has declined considerably (JBF 2009: 16). Although the government has attempted to promote centralized and huge water supply schemes, few of them have been sustainable in ensuring adequate water supply for the desert communities. Nowadays, there is an increased awareness about the importance of preserving traditional wis-

Figure 59.24: *Nadi,* a pond situated in grasslands in the Thar desert, in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.25: Women taking water from a seepage well called *beri* situated in a *talab; orans* as catchment in the background in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

Figure 59.26: Seepage well called *beri* near a sand dune in the Thar desert in Rajasthan. **Source:** Photo by Kanupriya Harish.

dom in addressing drinking water scarcity in the region.

Though the rainfall in this region is meagre (average 200 mm per year), harvesting rainfall is the effective way to address water scarcity. In fact, by collecting only rainwater, water security can be achieved in the region. Even with the lowest rainfall of 100 mm per year, one square kilometre in the region receives 100 million litres of water, which is equivalent to 1 million litres per capita per year. If one percentage of this rain was captured and stored for the use of humans, each person would get 10,000 litres per year or 27 litres per day, which is more than sufficient considering the demand in the region. However, the challenge remains in harvesting and storing one per cent of the rainfall. Even though one per cent efficiency in rain water harvesting appears an easily achievable task, it requires collective initiatives and appropriate technologies, since the rainfall in the region is erratic with varying intensity.

Recognizing the fact that rainfall in the region is meagre and unreliable, indigenous people, had learnt how to harvest rain effectively. The water harvesting systems such as *tankas, nadis* and *talabs* in the region deserve special mention. *Tankas or kunds* (figure 59.16 and 59.17) are underground cisterns, constructed for collecting and storing runoff water from natural or artificial catchments, or from a roof top (Singh/Sharma 2003: 143). This is the essential source of drinking water in many villages in the region. With capacities ranging from 10,000 litres to 600,000 litres, these are efficient ways of collecting and storing rain water (Khan 1998: 168). *Nadis* or *Talabs* are ponds, dug at natural depression in land to collect water from catchment areas which could be *agor, gauchar* and or *oran*. The runoff from the catchment area is tapped through water channels and directed to the ponds. With a storage capacity ranging from 15,000 m^3 to 250,000 m^3, the *nadis* and *talabs* are convenient but suboptimal water harvesting structures in the Thar Desert (Athavale 2003: 96). The traditional ponds are suboptimal because of seepage and evaporation loss. The water availability in *nadis* and *talabs* ranges from 2 months to 12 months depending on its size as well as the size of the catchment area.

Box 59.1: Jal Bhagirathi Foundation. **Source:** JBF.

The *Jal Bhagirathi Foundation* (JBF) was established as a Trust in India on 15 January 2002. The organization serves to regenerate community leadership and institutional support to strike a balance between environmental capacities and people's needs, especially in the access of drinking water. By positioning its work and learning at a wider level for further replication, it contributes towards the ongoing debate on pro poor policies.

Working in the Marwar region of the Thar desert the Foundation has been focusing on improving the water security of poor communities through renovating and creating traditional water harvesting and storage structures, and building community institutions for their management. This focus underscores a strategic approach for adaptation to climate change by providing an enabling environment for people to increase resilience to their hostile and varying climate. JBF is driven by its strategic vision of "Water security sustained by responsive governance and inclusive growth leading to sustainable development."

The Foundation is headed by HH Maharaja Gaj Singh of Marwar, and Shri Rajendra Singh (winner of Magsaysay Award and popularly known as the 'Water Gandhi'). With the leadership of great visionaries and the proactive involvement of highly qualified professional staff, JBF is probably the only NGO in India that works with internationally recognized management standards, and has been awarded an ISO 9001-2000 certification. JBF has a strong partnership with the UNDP and Italian Development Cooperation, and has also been supported by the Wells for India, the Prince's Charity and UNICEF.

59.5 Coping with a Harsh and Changing Environment

This section reviews the activities of the *Jal Bhagirathi Foundation* (JBF), a leading NGO in the region (box 59.1), to support communities in coping with the harsh and changing environment by adopting a bottom-up participatory approach. The JBF has been working in a project area spread over 2,500 km^2 in the districts of Jodhpur, Pali and Barmer in the Marwar region, situated in the western part of Rajasthan in the Thar desert (figure 59.27).

The term 'Marwar' is derived from the Sanskrit word of 'Maruwat', which means 'Land of Death', referring to the harsh environment. Since the Foundation's mission is to create an enabling environment in which desert communities can access adequate drinking water, it envisions participation of communities leading to community ownership and sustainable control of water resources by them. The JBF pursues bottom-up participatory strategies for strengthening the capacity of desert communities to manage their scarce water resources through adaptive strategies built on traditional best practices of water harvesting. The participatory approach followed by the JBF is encompassing all three interpretations introduced above: a) community organizations, b) community contribution and c) community empowerment.

The Foundation emphasizes strengthening *community organizations* to effectively manage natural resources, especially water. A four-tiered system of community institutions from the village level called the *Jal Sabha* (village water user association) to the regional level called the *Jal Sansad*, ensures active participation of the actual beneficiary community, including women and marginalized sections of the society, from the formulation of the project to the actual implementation.

- The *Jal Sabha* or the Water Users' Association is a village level forum where people from all habitations in a village congregate, discuss problems, seek solutions and assert priorities. This institution at the base level of the tier is considered critical for the participation and community ownership and develops micro-plans as well as specific proposals for water and natural resource development in the village. It is also responsible for the execution of micro projects and mobilization of community resources.
- The *Jal Samiti* or the Water Development Group is a block level forum and comprises of members of *Jal Sabha* and key community leaders from the area. They meet on a periodic basis to review the proposals received from *Jal Sabhas*. They interact with village representatives and help them to collectively assess the prevailing situation, voice their concerns, develop strategies to counter problems, and advocate and build equitable systems for managing and disbursing financial resources within the block.
- The *Jal Parishad* or the Water Forum has been set up at division level with members consisting of people's representatives as well as experts from reputed resource institutions and members nominated by the JBF. The *Parishad* meets every month to review projects and sanction new ones. It also plays a very active role in assisting the JBF for

Figure 59.27: Project Area of Jal Bhagirathi Foundation in Rajasthan State, India. **Source:** © JBF 2009.

developing future strategies and providing a road map for strengthening community action.

- Lastly, the *Jal Sansad* or the Stakeholders Forum has been constituted for the entire Marwar region and it is represented by all stakeholders, i.e. key community leaders, government representatives, staff of the JBF, renowned development practitioners from the NGO sector and volunteers. The Sansad reviews the annual progress made by JBF and finalizes the next year's work plan. It is a common platform where all stakeholders of the JBF projects meet and interact to finalize its annual strategic planning document.

The four tier institutional arrangement promotes 'participation as organization' and a strong sense of ownership of development projects from the planning phase among community members. It also entrusts the community with decision-making power.

In the process of developing micro projects by *Jal Sabhas*, the need for a *community contribution* has been well established as a norm and practice. In all cases at least 30 per cent of the contribution of the total cost of a micro project is raised by the Jal Sabhas. In the case of *Jal Sabhas* with the upper caste communities the contribution is 50 per cent, which highlights the policy of positive discrimination for the backward communities to ensure inclusive growth. In

Box 59.2: *Rodwa Khurd*: Achieving water security in the desert. **Source**: JBF.

The village Rodwa Khurd comprises of 275 households. It is situated at a distance of 50 kms from Jodhpur in the Barmer District of Rajasthan State. The main occupation of the villagers is agriculture and animal husbandry that is mainly dependent on the monsoon rains.

The village was facing acute scarcity of drinking water because the groundwater in the area is saline and unsuitable for drinking. The '*talab*' (pond) in this village is called the '*gawai talab*' (meaning the *talab* of the village) was the only source of drinking water. However, due to improper maintenance, it was silted and could hold water only for three to four months forcing residents to buy water from long distances for the remaining eight months. Although there is a government *Ground Level Reservoir* (GLR), a *Reinforced cement concrete* (RCC) storage tank connected to the government distribution system, it has erratic supply (once or twice a month) and the water supplied from a nearby well is unsuitable for drinking due to salinity. Women in the village had to go long distances walking under the scorching sun to fetch water, spending most of the day time.

Given the above situation of severe shortage of drinking water, the villagers decided to increase the capacity of the *talab* to harvest rainwater. They knew, the rain provided them with enough water for most of the year, if only they were able to retain it.

Facilitated by JBF, they organized themselves into a '*Jal Sabha*' (Water User's Association). With an NOC (no objection certificate) of gram *panchayat* (local government), they made a micro project to enhance the capacity of the *talab* by 8,500 m^3. The Jal Sabha members collected money from the villagers collecting 30 per cent of the total cost and deposited it in the *Jal Kosh* (Development Fund). The project was completed at a total cost of 153,043 Indian Rupees in 2007, with 70 per cent of the cost given by JBF as a grant.

Following the completion of the excavation and the increased capacity of the talab to retain water, the village now has water security for 12 months; the *talab* retains water for the whole year and they store water in *tankas* (underground concrete tank) closer to habitations, reducing the drudgery of women.

Most importantly, this community institution could establish norms for managing the scarce water resource efficiently. Now, people in the village have to pay a fixed contribution every month for cleaning and maintaining the *talab*. For this, Jal Sabha maintains a token system and deposits the collected money in a bank account for ensuring transparency and accountability. This fund (*Jal Kosh*) also ensures sustainability of the project. Moreover, the *Jal Sabha* meets regularly, monitors and controls the use of water from the *talab*, ensuring that it is distributed equitably. For drought years and in years of low rainfall, the Jal Sabha employs stricter norms of usage, to avoid wastage of water and conserve it for a long time, thus adapting to the adverse climate.

both cases the contribution is made as a collective effort with the participation of every individual in the village depending on their capacities. The people's contribution is called *Jal Kosh* (development fund) and deposited in a bank account ensuring better transparency and accountability. Furthermore, it raises resources through a nominal water tariff charged for water transported from the village pond to the tanks of the community or of individuals for ensuring the maintenance of the structures, thereby ensuring sustainability of the project. This strategy of the participatory approach has resulted in a high sense of ownership of the community over its harvesting structures. Also, costs have been brought down by at least 140 per cent for the average household because water catchment and storage capacities eliminate the need to purchase water during most of the year, and in periods of low rainfall.

The institutional arrangement and community contribution is complimented with *community empowerment* programmes to support village level institutions to adopt a pragmatic approach towards development of common property resources, and proper management of ecological resources. Regular field level trainings as well as organized training programmes are conducted to equip community representatives, village volunteers and facilitators in microplanning, community mobilization, technical aspects of water harvesting structures, and project planning and management. Additionally, exposure visits to successful community based projects are organized both within and outside the state. These programmes empower community institutions, particularly the *Jal Sabha* at the base level, to make informed decisions themselves on various development initiatives. To further advance capacity development programmes and networking the JBF has established a Water Resource Centre in Bijolai, in Jodhpur (box 59.2).

Thus, the JBF is involved in creating an enabling environment for communities to develop adaptive strategies and to initiate location specific interventions. With the participation from the community, the JBF acts as a catalyst and facilitator for the construction and restoration of traditional water harvesting systems such as

Box 59.3: Water Resource Centre. **Source**: JBF.

Jal Bhagirathi Foundation has established a 'Water Resource Centre', as an institution that is a conclave to exchange ideas and experiences by civil society groups as well as knowledge centres from all over India and abroad. Refurbishing the historic Bijolai Palace in Jodhpur and recreating the traditional ambience of this heritage property, the Centre has a world class facility for conferences, training and accommodation. It is the organizational entity concerned with capacity development, knowledge generation and information dissemination activities of the Foundation.

The 'Water Resource Centre' is also facilitating knowledge networking and policy advocacy. It has partnerships with national and international resource centres, technical agencies, and knowledge networks; it thus serves as a channel for the flow of knowledge and experience. It is envisioned as a centre for knowledge, best practices, useful data and information related to water quality and availability. Furthermore, it would facilitate dialogues on water-related debates and policies, based on knowledge generated from field experiences and action oriented research with partnerships of think tanks and other knowledge centres. Thus, it will also contribute to innovation in natural resource development and social engineering.

Additionally, it acts as a venue for national and regional conferences, conventions, workshops and symposiums to support the objectives of the Foundation. This is also the venue for networking to create public awareness and optimize social cohesion among communities by providing a platform for continued interaction. Thus, this institution disseminates 'best practices' in community management and control of natural resources and strengthens existing civil society networks to promote community participation in adaptive strategies to climate change and environmental regeneration. Effectively, the Centre promotes an active and enlightened rural community by training and capacitating rural volunteer groups by accomplished social workers to mobilize communities in water resource management.

Furthermore, it is becoming a favourable location for researchers and students who are studying various issues relating to water and rural development including community-based development, social capital, civil society, water resource management, adaptation to climate change, rain water harvesting, water quality and so on. With direct access to the rather isolated desert communities and experiences in working with them to address the water crises, the Foundation has an unmatched potential for undertaking collaborative and multi disciplinary research projects.

- *talab* – a village pond used for drinking water by human and livestock,
- *nadi* – a pond situated in grasslands,
- *nahar* – or water channels situated in catchment areas for directing runoff to ponds,
- *beri* – shallow wells for collecting rain water from subsurface soil. Usually located near to sand dunes or close to ponds, from which water seeps into the well.
- *tankas* - rainwater harvesting tanks.

The aim is to enable people to adapt to climate variability and to provide drought relief to a region extremely distressed with repeated droughts and also focus on community-driven solutions for long-term drought proofing of the project area**.** Thus emphasis is laid on a 'bottom-up approach' as against the 'top-down' approach aiming at a revival and improvement of traditional water harvesting practices.

Over the past six years the JBF has supported the construction of 300 village water harvesting structures in nearly 200 villages. Through these structures, nearly 180,000 people or 2.7 per cent of the population in the project area have benefited directly in terms of improved water availability and access. Additionally, an evaluation study commissioned by UNDP reveals that water availability in a year has now been extended to 6–8 months from an average of two months, despite the increasing climatic variability. This includes a number of villages with water availability around the year. Most importantly, the distance to the water sources has been considerably reduced, which reduces the drudgery of women who spent nearly half of the day in fetching water.

The process is found successful in strengthening decentralized governance particularly at the local level supporting the national policy of inclusive development. All the projects of *Jal Sabha* get approval from the panchayat (local governing body) before submitting it to *Jal Parishad* and there is active representation of panchayat members in *Jal Sabhas*. There are some cases where Jal Sabha influences decision making of the local government relating to development projects in their villages. Thus a convergence of the political and volunteer groups has taken place that are together involved in developing and managing traditional water harvesting micro projects.

Through its participatory methodology, JBF has ensured that the *Jal Sabhas* render equal opportunities for all the sections in the community, which enables inclusive governance at the village level. Representation of women and marginalized sections in Jal Sabhas, particularly in leading positions, ensures that

voice of the disadvantaged is heard in community decision making in addition to equitable access of natural resources. Particularly, JBF's inclusive policy of community contribution ensures that all the community members, irrespective of caste and class, contribute to a micro project. This provides ownership of the project to everyone in the village.

Most significantly, these simple structures of community governance are found as effective means to cope with the changing climate. In the year 2009, which is a drought year, there is only little production from agriculture, but a large number of project villages have drinking water security. This has become possible with effective use of traditional technologies as well as adaptive norms established by the *Jal Sabhas* for efficient use of the limited water resources. The adaptive norms developed with the social capital ensure the control of water usage, restrain waste of water and promote conserving water for distressed months, resulting in a successful coping mechanism.

Consequently, a 'Community Led Water Management System' has evolved in the project area. The village level water harvesting structures such as *talabs* and *nadis* tap runoff from the catchment (AGO) through feeder channels. Though these structures are normally located at the outskirts of the village, water is being transported to *tankas* in the vicinity of the households. It helps to reduce the drudgery of women in fetching water from far away located water harvesting structures and also to reduce the evaporation and seepage losses which are greater for surface water harvesting bodies. Some of the villages in the project area of JBF have become self-reliant in terms of drinking water by adopting this water management system and successfully established replicable and sustainable models of community-led traditional water management for the region. Furthermore, Jal Sabhas have started to give emphasis on the protection and sustainable management of agors, gauchars and orans (they act as catchments for ponds) that are repositories of biodiversity and the source of multiple products such as water, grass, fodder, fuel-wood, timber, and non-timber tree products. Management of these resources is also fundamental to ecosystem stability and contributes to adaptation in the context of climate change.*J*

59.6 Conclusion

From this case study of the Thar Desert, the most densely populated desert in the world, it could be seen that a bottom-up participatory approach is a realistic way forward to develop adaptation strategies in the context of climate change. The region is characterized by low and erratic rainfall, less nutritious sandy soil, deep and often saline ground water, sparse vegetation, and strong sun and winds. Rainfall in the area is very low, with an average of 200 mm per annum. Droughts of varying intensities are a recurring phenomenon in the region. The already stressed water sector is also a victim to climate change; the region has been identified as one of the most vulnerable states in India. A bottom-up participatory approach is being followed by a leading NGO in the region named Jal Bhagirathi Foundation, which has been supporting the desert communities in developing strategies to cope with adverse and changing climatic conditions. It helps people to adapt to present climate variability based on traditional wisdom and then to develop strategies to initiate responses to future climate variability. The process involves facilitating social capital through creating community organizations, promoting community contribution and empowering communities. This approach is based on the realization that adaptation need not be started from scratch. A bottom-up participatory approach that acknowledges various coping mechanisms developed through traditional iterative learning process and that envisions control of natural resources by local people would be effective in developing appropriate adaptation strategies, not only in the Thar Desert but also in a wider context. The examples set by JBF, can be enhanced further and replicated to other villages through local governments, leading to a convergence of voluntary and political spheres.

This participatory bottom-up approach, unlike the conventional external expert approach, enables communities to enhance their coping capacities resulting in adaptive local governance. Since it is rooted in the tradition and local knowledge, the approach is easily understandable and internalized by the communities. This approach, which surrogates the conventional external expert approach, would also have large potential in other sectors like energy, agriculture and health, leading to a more integrated and meaningful adaptation to climate change.

60 Coping with Water Scarcity in the Sahel: Assessing Groundwater Resources in the Western Sahel

Abdelkader Dodo, Mohamedou Ould Baba Sy and Jihed Ghannem

60.1 Introduction[1, 2]

The *Iullemeden Aquifer System* (IAS), shared by Mali, Niger and Nigeria, consists of a number of sedimentary deposits containing two large aquifers: the *Continental intercalaire* (Ci)[3] superseded by the *Continental Terminal* (CT).[4]

It covers a total area of approximately 500,000 km² and constitutes the main sustainable source of water for most communities in the region. The Iullemeden Aquifer System's water resources are considerable but slightly renewable. These water resources are subject to an exponential rise in abstractions – which went from 50 million m^3 in 1970 to 180 million m^3 in 2004 – spurred by a growing water demand linked to population growth (6 million inhabitants in 1970; 15 million in 2000; and a projected 30 million in 2025). This has resulted in an overexploitation since 1995. Studies have revealed that the Niger River receives an estimated 125 million m^3 annually from the Iullemeden Aquifer System. The rational and informed management of the water resources of the Iullemeden Aquifer System appears to be a must.

The analysis of annual rainfall reveals a clear trend starting from the year 1969–1970 (figure 60.1). Three trends can be observed in the basin: a 'wet' period before 1970, a 'dry' period from 1970 to 1993 and the beginning of a 'wet' period from 1994 to date (Anonymous 2003; Hubert/Carbonnel 1987; Hubert/Carbonnel/Chaouche 1989; Traoré/Abdou 2005).

Rainfall data collected in Guinea (Diallo/Diallo 2004), at the Koulikoro and Diré stations in Mali (Diarra/Cissé 2004) and the Niamey station in Niger (Soumana/Barhouni 2004) reveal a rainfall deficit starting from the year 1969–1970 and estimated at 20 to 30 per cent below the levels of the wet period.
This rainfall deficit has caused isohyets[5] to migrate southwards by approximately 100 km, thus reflecting rising aridity (figure 60.2). It has had a significant

1 This chapter draws on several studies in which the authors were involved at OSS (2007, 2007a, 2008). A summary in English is at: <http://www.oss-online.org/pdf/synth-sai_En.pdf>. The material is used here with the permission of the director of OSS. This paper has been produced under the supervision of Mr. Youba Sokona, the OSS Executive Secretary. This paper is the result of an important endeavour undertaken by the *Sahara and Sahel Observatory* (OSS) in partnership with Mali, Niger and Nigeria on the *Iullemeden Aquifer System* (IAS) since 2004 in the framework of the regional project "Managing Hydrogeological Risks in the Iullemeden Aquifer System (IAS)". The authors wish to thank the anonymous reviewers for their suggestions and critical comments.

2 Keywords: Shared aquifers, Continental intercalaire, Continental Terminal, database, Geographic Information System, Mathematical model, transboundary risks, joint management, arid and semi-arid regions, West Africa.

3 The Continental intercalaire indicates a thick series (> 1000 m) of detrital formations of secondary age (Jurassic – Cretaceous) with alternations of sands, sandstones, clays, coherent gravels and conglomerates which accumulated before the marine transgression of the Upper Cretaceous. The Continental intercalaire is the greatest multi-layer aquifer system in the Iullemeden basin. It is unconfined at the edge and confined in the centre of the basin. Detrital is a geological term used to describe particles of rock derived from pre-existing rock through processes of weathering and erosion.

4 The *Continental Terminal* (CT) is a multi-layer aquifers system contained in a heterogeneous continental series of tertiary age of the Iullemeden basin. Its sediments are presented by the alternations of sand and clays, and by sandstone with coherent gravel intercalation. The series is characterized by the many ones and fast lateral and vertical variations of the facies. (Facies refers to a body of rock or sediment with specified characteristics.) These two main principal aquifers of IAS (Ci and CT) are separated by an *aquitard* mainly made up of the Palaeocene and Eocene formations and which locally includes (in Mali) part of the Upper Cretaceous.

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Figure 60.1: Analysis of annual rainfall trends in Mali. **Source:** OSS.

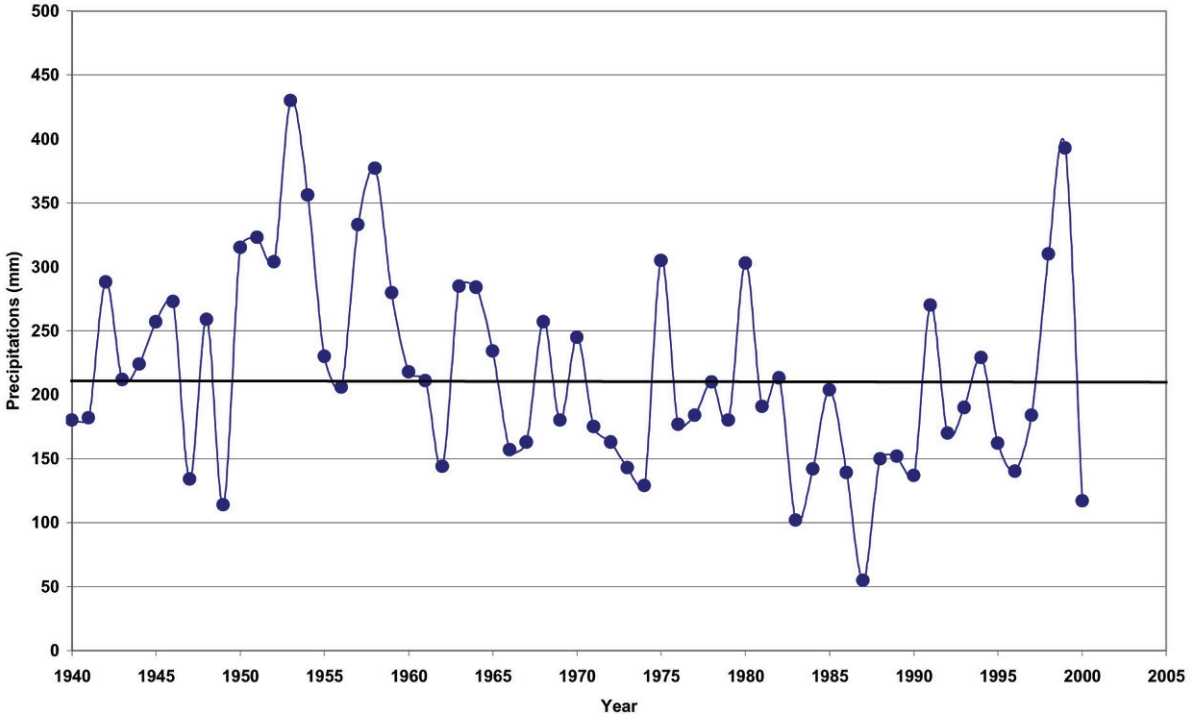
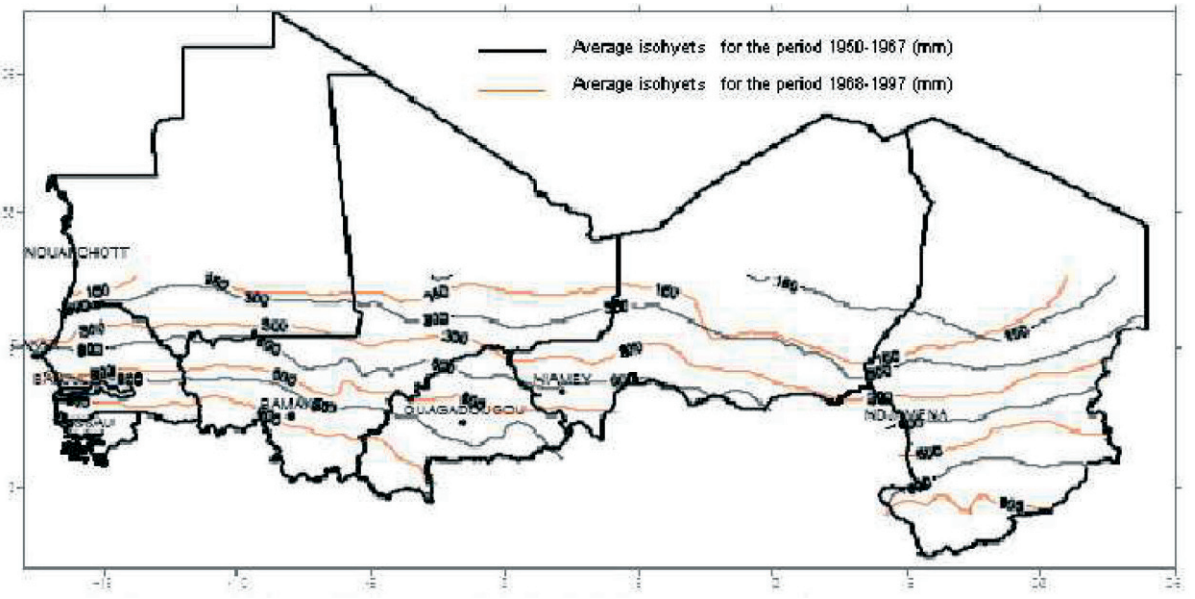


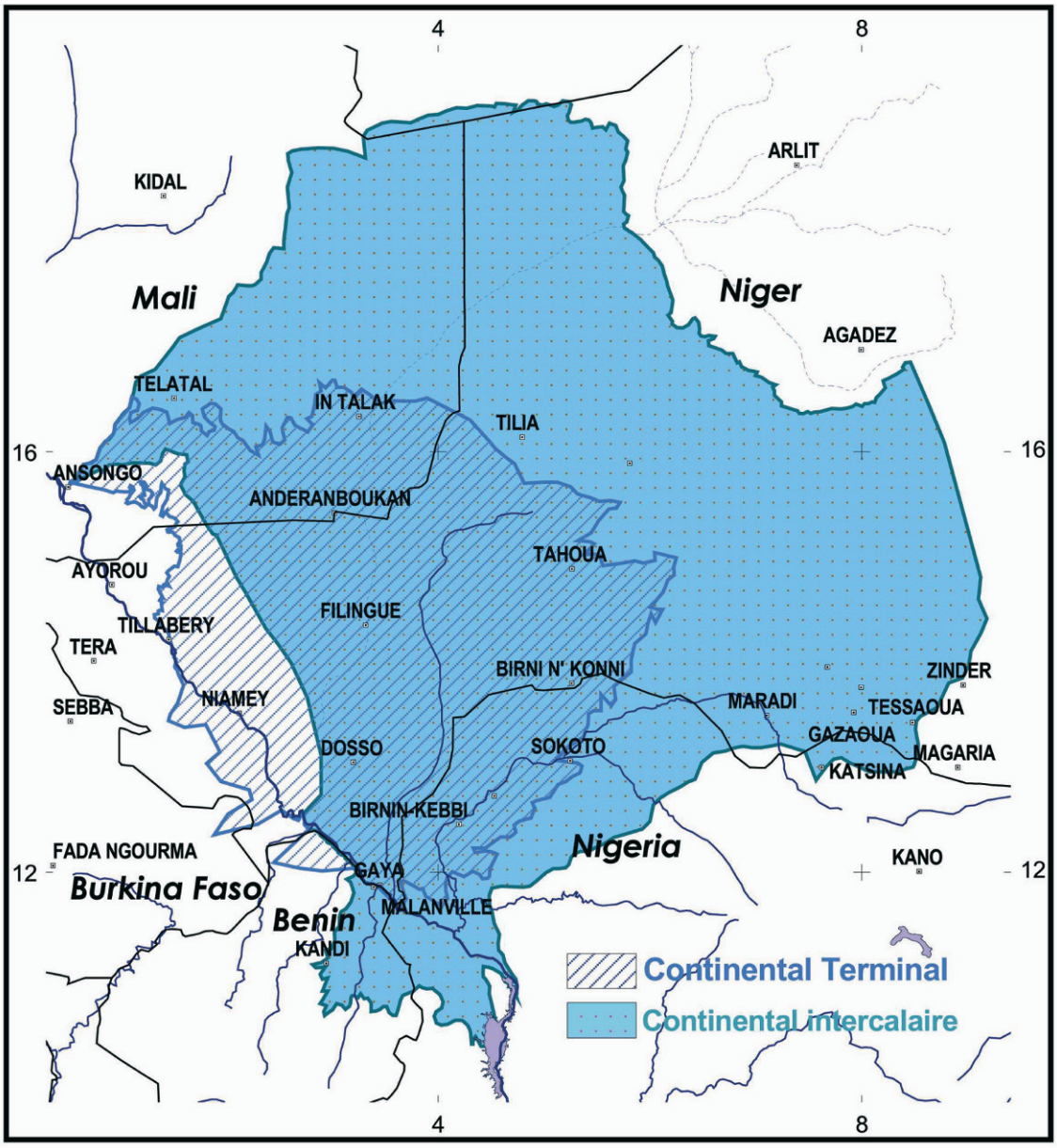
Figure 60.2: Isohyets glide between the two periods before (red lines) and after (dark lines) 1968. **Sources:** Centre Regional AGRHYMET (Niamey, Niger).



impact on the Niger River regimes. As a matter of fact, the runoff diminished by approximately 20 to 50 per cent with a sharp decline in the flow that has caused the runoff to stop at the Douna station in Mali in 1983, in 1984 and in 1987, and in Niamey in 1985 – an occurrence in which the Niger River's bed literally dried up.

5 Isohyets: A line drawn through geographical points recording equal amounts of precipitation during a specific period.

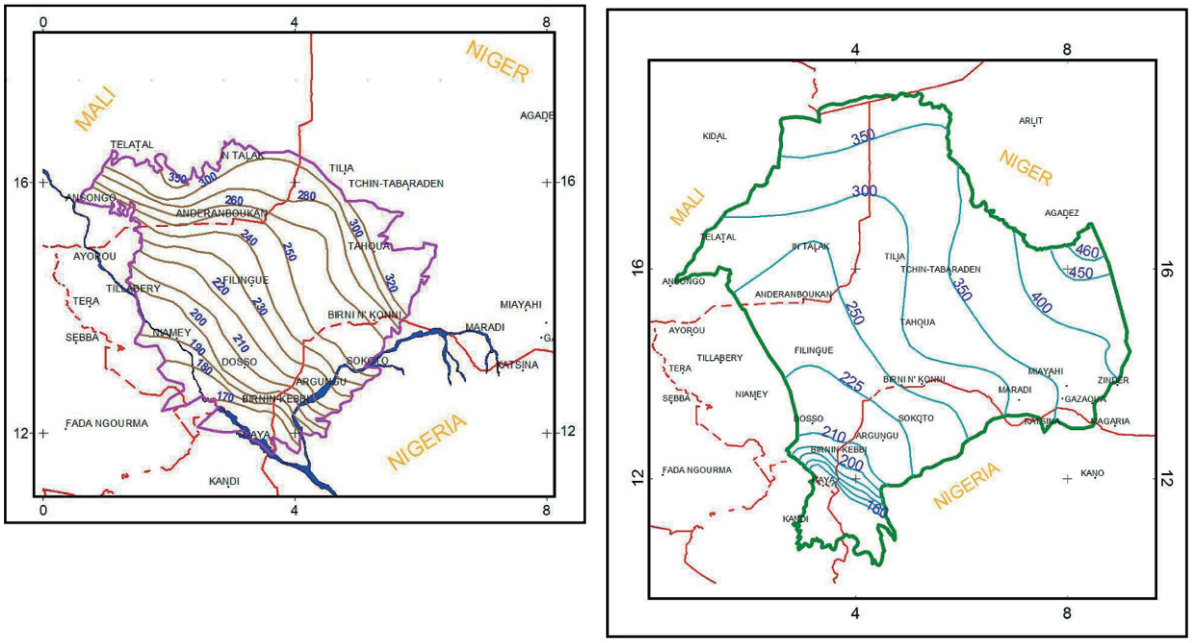
Figure 60.3: Limits of the main aquifers of the Iullemeden Aquifer System. **Source:** OSS.



The decline in rainfall has led to the intensification of abstractions from the water tables of both the *Continental intercalaire* (Ci) and the *Continental Terminal* (CT) (Greigert 1978; Margat 1982; Bonnier/Jackou/Karbo 1991; Dodo 1992) under the pressure of rising water demand. These resources constitute the main source of sustainable water supply for the communities in a region which has witnessed significant population growth during that period. The quality of the groundwater is degrading due to pollution of various origins (Diarra/Cissé 2004; Soumana/Barhouni 2004; Hanidu/Ude 2004). Resorting to increasingly deeper water with high levels of fluoride (between 9 to 12 mg/l in the border zone of Niger and Nigeria) causes various water-related diseases such as dental and skeletal fluorosis (more than 600 children were irreversibly disfigured) (OSS 2007).

In light of this situation, the comprehensive and joint assessment of the water resources of the Iullemeden Aquifer System has become crucial. This assessment has been undertaken with a database, a *Geographic Information System* (GIS) and a mathematical model.

Figure 60.4: Piezometric map of the CT and the CI in 1970. **Sources:** OSS.



60.2 Hydrogeological Setting

The *Iullemeden Aquifer System* (IAS) is located in West Africa. It is shared by Mali, Niger and Nigeria and consists of a number of sedimentary deposits containing two large aquifers, namely the *Continental intercalaire* (Ci) which is superseded by the *Continental Terminal* (CT). The IAS covers a total area of approximately 500,000 km², and is crossed by the Niger River – the third longest river in Africa with 4200 km (figure 60.3).

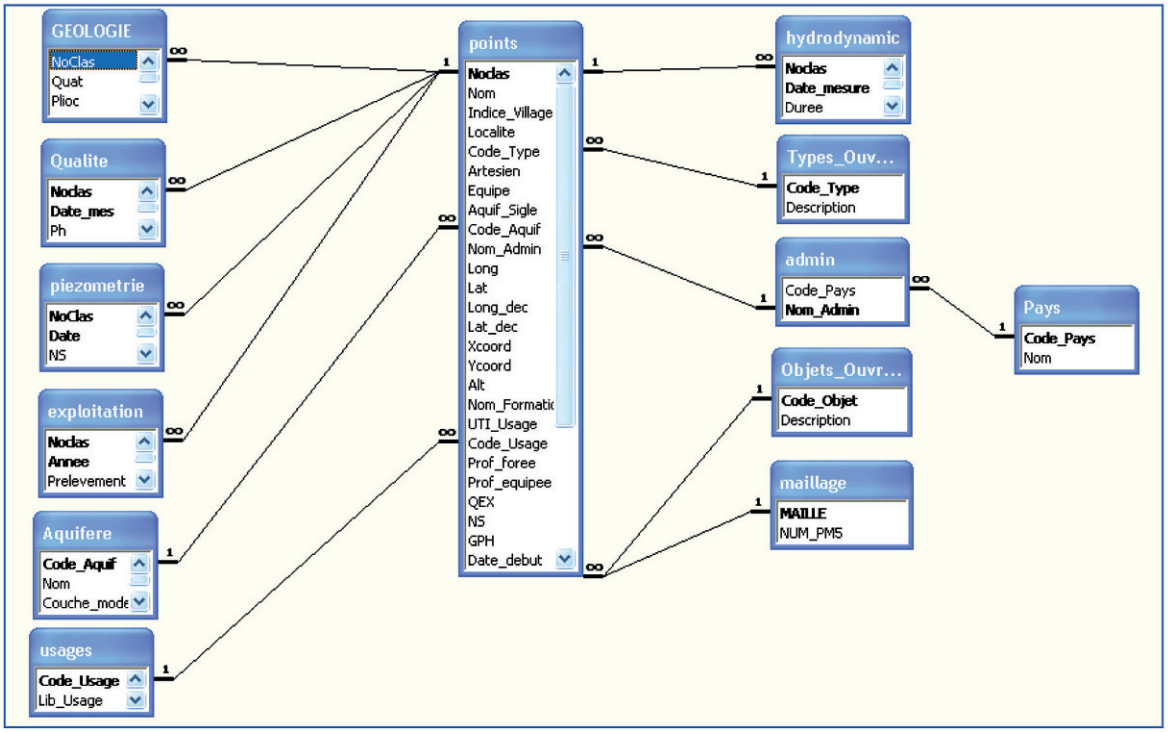
The *Continental Terminal* (CT) includes the tertiary aquifers (CT_1, CT_2 and CT_3) and the shallow aquifers located in quaternary alluvial deposits (Boeckh 1965; Greigert 1978; Margat 1982; Dodo 1992). The *Continental intercalaire* (Ci) is the largest cretaceous aquifer in the Iullemeden basin given its extent and the thickness of its layers (more than 1000 meters at certain locations). It also includes the top level of the lower cretaceous (The Continental Hamadien) (Greigert 1978; Margat 1982; Dodo 1992). The Continental Terminal and the Continental intercalaire have average transmissivity ranging from 10^{-4} to 10^{-2} m²/s.

These two components are separated by an aquitard consisting of Palaeocene and Eocene formations which include – in Mali, for example – thick, mainly marine, upper cretaceous sediments. It stimulates leakage between the Ci and the CT with a mean vertical permeability value of 2.5 x 10^{-10} m/s (ETH 1999).

The piezometric maps of these aquifers were drawn up for the year 1970 – considered as the baseline defining the state of equilibrium of the aquifer system untouched by abstractions (OSS 2007). The piezometric map of the Continental Terminal (figure 60.4a) shows the CT water table's main drainage axes as being oriented North-West South-East and North-East South-West. Recharge zones are located on the North-Eastern (in Niger) and North-Western periphery (in Mali, the Taoudeni basin). They also include the Southern part with the contributions of Goulbi de Maradi – or River Rima. Groundwater resources flow mainly from the North-West towards the South. The discharge zones are mainly the Niger River and the Goulbi de Maradi – which is one of the Niger River's tributaries (OSS 2007).

The piezometric map of the Continental intercalaire (figure 60.4b) shows that the main recharge zones are the Hoggar Mountains to the North, and Goulbi de Maradi to the South. Groundwater resources flow mainly from the North, the North-West and North-East to the South. The Niger River constitutes the main discharge of the Ci water table (OSS 2007).

Figure 60.5: Structure of the IAS relational database. **Source:** OSS.



60.3 The Database and Geographic Information System

The IAS database is administered by Microsoft ACCESS (2000). The software allows the use and management of the database in the three countries (Mali, Niger and Nigeria), and provides an interface with the *Geographic Information System* (GIS). The 2000 edition of this software allows a smooth migration to the SQL-Server as envisaged by the countries (OSS 2003, 2007, 2007a, 2008).[6] The common database of the Iullemeden Aquifer System (IAS) contains data collected in the three countries. The data cover the climatic, hydrological, geological and hydrogeological aspects. The hydrogeological data concern approximately 17,200 water points – 740 in Mali (4 per cent), 16,170 in Niger (94 per cent) and 300 in Nigeria (2 per cent). These data were collected, formatted, organized and stored in a relational database (figure 60.5) shared by the three countries. This, in turn, makes it easier to use these data effectively.

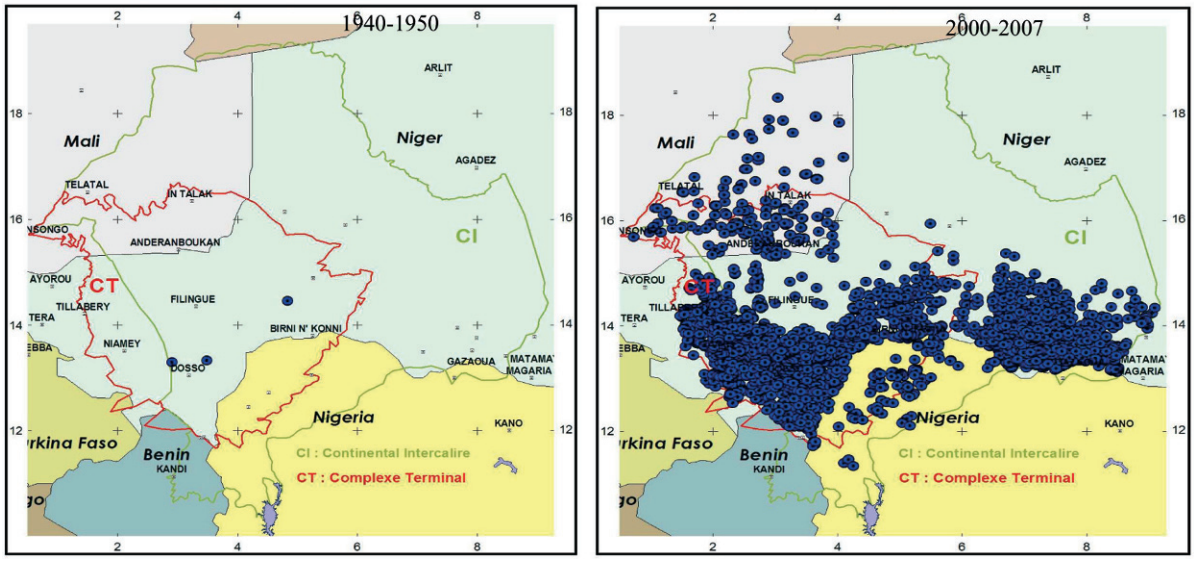
The database's structure shows the central role of the 'points' column which is related, on the one hand, to the identification tables (country, hydrodynamic parameters,, type-'ouvrage', admin, object 'ouvrage', 'maillage', ...)[7], and, on the other hand, to the variables tables (geology, quality, piezometry[8], exploitation, aquifers, uses,...). The relations between the central 'points' column and the other can be univoque (1 to 1) or multiple (one to ****). The processing and formatting of information is performed by tolls such as 'Rockworks' and 'Photoshop' for geological data, and 'Arcview' and 'Mapinfo' for hydrogeological data.

6 The Microsoft SQL Server is the high-performance relational database engine by Microsoft for its Windows Servers and development tools. It is an excellent back-end database for web server applications and software, and is highly recommended for active web sites.

7 Ouvrage = Water point (borehole, well dug well, spring). Admin= administrative unit. Maillage= Model grid: division of the region into equal square cells.

8 Piezometry is the use of a water point for quantitative monitoring (fluctuation of the water level) of an aquifer. It allows to obtain regularly continuous serial data.

Figure 60.6: Evolution of water points since 1940 to date. **Sources:** OSS.



60.4 The Geographic Information System (GIS)

The ARCVIEW software has been selected for its user-friendliness, performance, perfect compatibility with ACCESS and its common use for studies in the water sector. Its powerful scripting language allows the development of the customized modules required to link the GIS with the mathematical model. Thus, a database-GIS-Model interface has been developed in order to produce thematic maps which enable the processing and allow a better visualization of the information. This has in turn provided valuable decision-support tools (figure 60.6). These include maps describing decade-long trends in the number of water points, piezometric maps, transmissivity[9] maps, and geological and hydrogeological correlations. It is therefore possible to see a clear rise in the number of water points across the IAS Basin over the last 40 years, particularly during the transition from the decades from 1960 to 1970 to that from 1980 to 1990. The latter had been declared by the United Nations General Assembly as the "International Decade for Drinking Water and Sanitation." During that period, countries had committed themselves to improve the standards and the quality of drinking water supply and sanitation, notably through developing water points.

60.5 The Mathematical Model of the IAS

The hydrodynamic model of the IAS has been built by using version 5 of the processing modflow (PM5) software package (Chiang/Kinzelbach 1998) based on the modflow code improved by the US Geological Survey (McDonald/Harbaugh 1988) which allows the modelling of water transfers within a multilayered aquifer system through the finite difference method.

Through the database-GIS-model interface, the data required for the calibration and operation of the model were imported directly from the database. Similarly, the results yielded by the model are exported to the database with no risks of alteration or distortion. In addition, the links between the database and the GIS allow the utilization of both the data and the modelling results for various outputs and graphic or cartographic illustrations. The model has yielded initial results on the dynamics of groundwater runoff, the assessment of the state of utilization of the groundwater resources, and the drawdown trends in the two aquifers.

9 The transmissivity of an aquifer is a measure of how much water can be transmitted horizontally, such as to a pumping well.

60.5.1 The Water Balance of the Iullemeden Aquifer System

The water balance of the *Iullemeden Aquifer System* (IAS) has been established in 1970 – with that year serving as a baseline (table 60.1). The main source of aquifer recharge comes from the direct infiltration of rain water estimated at 3.8 m^3/s, which constitutes 78 per cent of the global recharge estimated at 5 m^3/s, and 150 million m^3/year.

Table 60.1: Water balance of the Iullemeden Aquifer System in steady state (1970). **Source:** OSS.

Continental Terminal			
In (m^3/s)		Out (m^3/s)	
Direct infiltration from rainfall	3.29	Niger River	2.50
Leakance Ci[a]	0.013	Dallols	0.45
		Rima River	0.35
Total In	3.30	Total Out	3.30
Continental intercalaire			
In (m^3/s)		Out (m^3/s	
Direct infiltration from rainfall	0.55	Niger River	1.60
Recharge from Northern Boundary	0.29	Leakance CT	0.013
Rima River	0.77		
Total In	1.61	Total Out	1.61

a) Leackance refers in groundwater to the flow of water from or into an aquifer through an underlying or overlying semi-pervious layer.

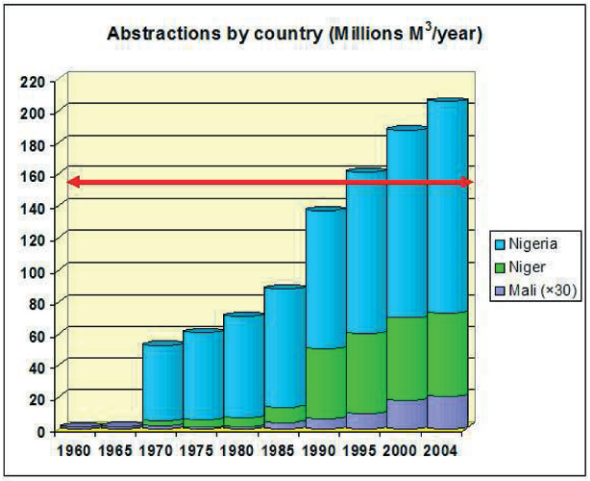
60.5.2 Groundwater Support for the Niger River

The model has revealed and quantified the support provided by groundwater to the flow of the Niger River and vice versa. The Niger River receives approximately 46 million m^3/year from the Continental intercalaire and 79 millions m^3/year from the Continental Terminal – with a total of 125 million m^3 per year. The Goulbi de Maradi, a tributary of the Niger River, contributes approximately 20 million m^3/year to the Continental intercalaire and receives about 12 million m^3/year from the Continental Terminal prior to its confluence with the Niger River.

60.5.3 Overexploitation of the Aquifers

The overexploitation threshold was exceeded in 1995. Starting from that year, abstractions estimated at 152 million m^3/year have outstripped recharge (the red line) estimated in 1970 at 150 million m^3/year (figure 60.7).

Figure 60.7: The overexploitation treshold was exceeded in 1995. **Source:** OSS.

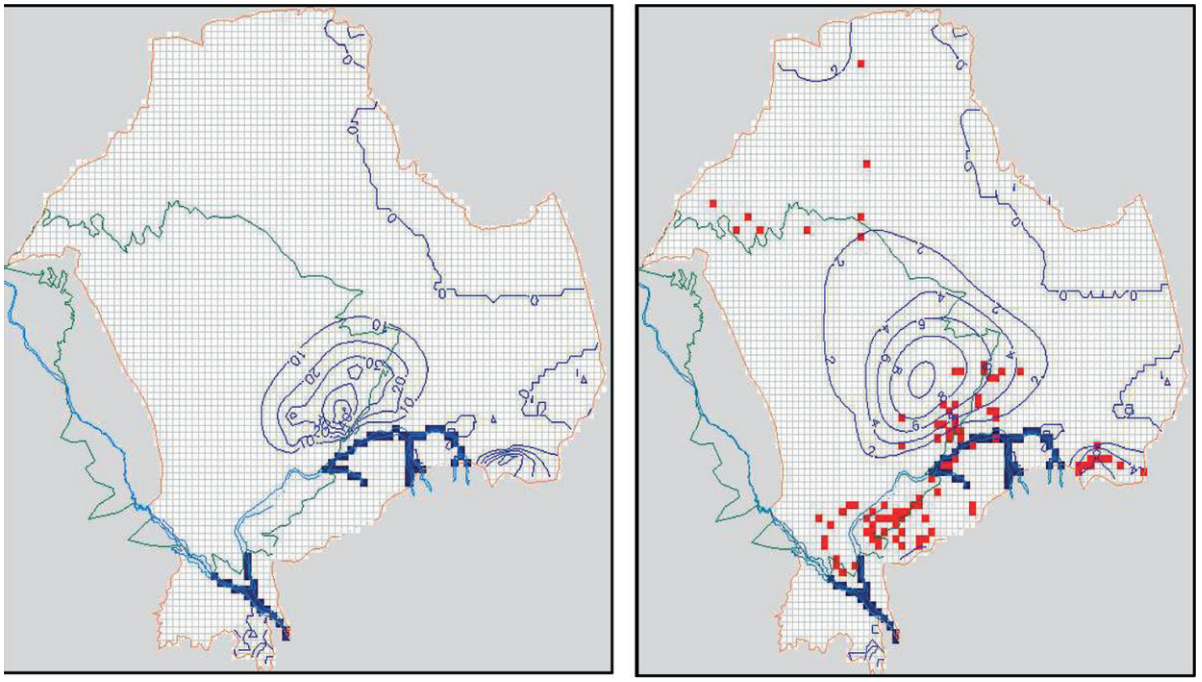


60.5.4 Exploratory Simulations

The hydrodynamic model of the IAS has allowed several simulations and forecasts to be performed. The system behaviour was simulated for the 1970–2004 period (figure 60.8a) and for the 2004–2025 period on the basis of the 'null hypothesis' (figure 60.8b). This hypothesis consists in maintaining abstractions at their 2004 levels and simulating their impact on the resources by 2025.

In the Continental intercalaire, for example, the most acute drawdowns in 2004 occurred in the eastern part of the basin around the Nigerien locality of Birni N'Konni with a maximum of 62 metres (figure 60.8a). The model's forecasts for 2025 show an additional ten-metre drawdown in the Ci (figure 60.8b). The risk zones are characterized by important drawdowns caused by an ever rising utilization. Being hardly renewable, the water resources of the Continental intercalaire (Dodo 1992) are subject to the threat of mining-style exploitation.

Figure 60.8: Drawdown in the Ci (a) in 2004 and additional drawdown in the Ci (b) by 2025. **Sources:** OSS.



60.6 Conclusion

The water resources of the Iullemeden Aquifer System are exposed to rising abstractions under unfavourable conditions caused, notably, by the impacts of climate change and natural variability. The main results and outputs obtained from the shared database, the Geographic Information System and the mathematical model provide Mali, Niger and Nigeria with an opportunity to acquire, for the first time, a kit of common decision-support tools. The support provided by groundwater to the runoff of the Niger River constitutes an alternative, particularly in periods of dramatic decline of the river's flow. While the Continental Terminal benefits from an annual recharge through direct infiltration of rainwater and contribution from the Niger River, the Continental intercalaire is almost totally confined. Its water resources are hardly renewable and exposed to a mining-style exploitation pattern.

61 Global Threats, Global Changes and Connected Communities in the Global Agrofood System

John Grin and Esther Marijnen

61.1 Introduction

61.1.1 Global Challenges

Maybe the most disturbing feature of the global influences discussed in this and previous volumes in this book series is that their impacts are not evenly distributed over the globe. For instance, as Úrsula Oswald Spring (chap. 62) points out below, while the benefits of using genetically modified organisms (GMOs) are likely to bestow especially on northern countries, their more problematic aspects are likely to be exacerbated by, and add to, the negative conditions prevailing in the South. As her analysis makes clear, only in an economically more equitable world economy and a more sustainable global agrofood system, GMOs may provide solutions to some of the more pressing challenges facing global food production. But how realistic is it to expect such global changes in food production?

Sreeja Nair's chapter 64 on adaptive management and co-management strategies as responses to climate change in India leaves us with similar questions. For instance, even for a large country like India, with a significant research and development capacity, it will not be easy to develop the type of scientific knowledge that is tailored to being integrated with local knowledge into appropriate technologies which match local conditions. Research and development are an essentially transnational undertaking, and around the globe they have hitherto been dominated by a modernist approach, which implies precisely the reverse. As Jim Scott has so eloquently put it, modernization processes, and the types of knowledge that have co-evolved with it (Grin 2010a) have brought about a "logic of homogenization and virtual elimination of local knowledge" and, with an Aristotelean notion, mtis – the craft to take contextual conditions into account (Scott 1998: 302; 309–341). Individual countries which, as Nair and Cecilia Conde (chap. 65) propose, wish to promote the converse kind of innovation, are facing the challenge that the required knowledge basis is globally underdeveloped, and that without further change this type of innovation will be economically disadvantaged. How to bring about, globally, a new type of development – one that like the currently dominant type of development benefits from the (implicit) alignment of innovation systems, governance arrangements and markets around the globe, but with a very different normative orientation?

61.1.2 Global Challenges Seen from Modernization Theory

This chapter seeks to help develop a conceptual basis for developing strategies to promote the process of global change required to deal with contemporary global problems. It does so, by drawing upon insights from Ulrich Beck, whose work on (global) risk society and reflexive modernization suggests fruitful ways of appreciating the complex relations between previous development patterns, current problems, and the conditions for future global changes implied in the brief discussion above. In the next section, we will briefly introduce some of his insights. To be sure, we are aware of the criticisms his work has evoked, and we share the complaint of frequently definitional and conceptual ambiguities. However, in the scope of this chapter we limit ourselves to discussing and elaborating some of his notions in a way which we ourselves feel helps us here, leaving aside the debates on his work. More specifically, we will mobilize his insights so as to appreciate, with some depth, the relations between earlier, global development processes, contemporary problems, and the conditions needed to resolve these by promoting a different sort of development.

At the core of our use of Beck's work are three insights. The first is his understanding of what he calls 'risk society'. This notion refers to the fact that many

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contemporary problems are rooted in the negative externalities that have come with past development processes (Beck 1992). Thus 'risk' in 'risk society' should be seen here as a broad, somewhat metaphorical designation comprising societal and physical risks (i.e. potential negative effects) as well as negative side effects that have already become manifest. They may, as Beck puts it, be seen as the dark side of the 'simple modernization' processes of 'first modernity', tailored to realizing progress on basis of knowledge to promote mankind's capacity to control nature and society. It is in the context of simple modernization that many of the uses of GMOs, discussed by Oswald Spring, have been conceived are producing their negative impacts on southern countries. The institutions of modern nation states that have co-evolved with simple modernization processes, have developed blind spots for risks and side effects (constituting 'unawareness', Beck 1999: 109–132) and lack capacities for designing and pursuing strategies which are able to deal with them effectively.

The second insight we wish to emphasize is that, now that concerns about risks have become increasingly widespread ("the politicization of side effects", Beck 1997), they start to feed back into the very processes and associate institutions that have generated them. A re-orientation of modernization is therefore necessary towards the vision of a "radicalized modernity" or "second modernity" (Beck 1997): the vision that we may and must eventually realize the "demand of the Enlightenment" through a process of reflexive modernization – modernization driven by the desire to pre-empt side effects. The modes of food production argued for by Oswald Spring, and the strategies for meeting climate changes proposed by Conde and Nair, may serve as examples of the type of development hinted at here.

More specifically, reflexive modernization implies growing awareness in industrial enterprises, governmental organizations, and knowledge institutes – awareness of the risks associated with simple modernization processes, and awareness of the incapacity of these actors and their institutionalized relations to maintain societal trust in the face of these risks, and to come up with novel solutions (Beck 1992, 1999: 72–90). The consensus underlying the institutional realms of state, society, market, and science and their mutual alignment becomes disputed (Beck 1999: 100). Firms no longer can hide behind the backs of governmental regulations or 'objective reports' when responding to criticism on the environmental effects of their production processes, or their being engaged in child labour. Other than ideal typical, Weberian bureaucracies, current governmental bodies can no longer presume legitimacy of their decisions solely on the basis of the input legitimacy (Scharpf 1997a) of democratic procedures or of expert judgement. And experts have lost self-evident public trust (Giddens 1991). *Vis-à-vis* an increasingly aware civil society, they can no longer rely on the earlier consensus on simple modernization.[1] Our remarks above on the difficulties implied in Nair's recommendations may be understood as acknowledgements of this unawareness and incapacity.

Novel modes of social, economic, and technological development need to be developed, and trust and legitimacy need to be actively produced in the process. As a consequence, "[r]eflexive modernization becomes discursive modernization" and requires novel institutional loci in order to reach novel understandings and create novel connections between the institutional realms in-between which they are located (Beck 1999: 101). These processes Beck calls sub-politics: politics which is being informed by an increasingly knowledgeable civil society. *Subpolitics* does not rely on 'standard' expertise, but mobilizes a plurality of experts as well as sources of more informal or local knowledge in order to design modes of development driven by the desire to pre-empt risk. *Subpolitics* thus may be seen as a communicative rationality according to Habermas, but incorporating a reflexivity that also feeds back into the Latourian dominance of institutionalized discourses as well as incumbent institutions.

Finally, we will draw on a set of interconnected insights that fare under the designation of *global* risk society. Risks produced at one place may be felt at a variety of locations around the globe – though often unequally distributed (Beck 2007; Oswald Spring, chap. 62). Also, mass media and the internet have helped to produce a transnational civil society which may nurture solidarity and share concerns around the globe (Kaldor 2003). Against that background, Beck (1999: 37–40, 2005: 103 ff.) argues, in a Deweyan way, that risks may produce new, global publics that engage in subpolitics that may affect national and transnational policy-making organizations as well as (transnational) firms.

The publics that thus come together may be very different in nature. Some, especially on the African continent, have experienced the dark side of Euro-

1 For a more precise discussion of these transformations, see Grin (2010a: 237–248).

pean first modernity, colonization. Amongst such publics, there may be differing views on what sort of modernization can avoid a new round of European (western) imperialism. In other countries, especially in Asia, critique may be driven by the desire for a modernity with room for national identities and cultural heritage, for modernization without the problematic outcomes of western modernization. Others, especially in Europe, may be primarily driven by concerns on the ecological side effects of early modernization (Beck 2005: 106–110). Thus, Beck argues, the meaning of 'risks' and 'side effects', as well as the strategies to deal with them, are contingent. Thus, as he (Beck 2005: 1010) quotes David Held, global subpolitics arises from "overlapping communities of fate."

61.2 Research Questions and Case Study

Clearly, the idea of reflexive modernization with different communities of fate as key players connects well to the increasing recognition of the need to design strategies from local contexts and in cooperation with the stakeholders involved (chap. by Conde, Nair and Oswald Spring). Yet, one crucial question remains underexplored in Beck's work: how may such different communities actually join forces, across space and in spite of differences in context and prehistory, in order to generate the transformative power needed to re-orient development patterns? This is the central question we set out to answer in this chapter.

To that end, empirically, we will draw on an example from the global agrofood system: the 1992 reforms of the European Union's *Common Agricultural Policy* (EU-CAP) and its implementation in three different EU member states in the late 1990's. The reforms must be contextualized in the then ongoing Uruguay Round of the world trade negotiations as well as internal debates within the EU and its member states on the CAP's financial, social, and ecological aspects. The policy process was influenced both by the politicization of side effects and the global trend towards liberalization, which is often seen (also by Beck 2005) as a competing tendency.

This case therefore brings together a variety of communities of fate: ecologists in Europe, concerned about the ecological effects of modern agriculture; southern countries, who attempted, through the Uruguay Round of the world trade negotiations to combat the EU-CAP for the inequity it implied in global agrofood trade; and European farmers, who faced the disappearance of institutional provisions that were of great importance to modernization of agriculture. On the road towards the reforms, southern countries' strategies and concerns from small farmers and ecologists came together, creating a window of opportunity for, and shaping, the reforms. In the years following the reforms, earlier processes of subpolitics appeared to shape how, and to what extent, the reforms led to real changes in agricultural policies.

Taking a historical example has the advantage that ex-post analysis allows a rich analysis, fitting our primarily conceptual objective in this chapter. Yet, in order to explore the utility of the understanding developed, we will eventually relate our findings to the contemporary examples cited above. Methodologically, we will rely on secondary analysis, employing sources that are based on solid empirical work: literature on the 1992 reforms and their prehistory, as well as a thorough study, by a team of French, German and Portuguese researchers, of their implementation in France, Germany, and Portugal (Bruckmeier/Ehlert 2002) This comparative study is based on document analysis, interviews, and surveys, as well as on the authors' intimate knowledge of the countries they study. For our purposes, the three cases are well chosen. As we will see, there are important differences between France and Germany regarding the preceding subpolitics. And Portugal differs from both in the sense that it had much less been part of earlier agricultural modernization. Thus the reforms hit the ground in Portugal, with many small, relatively traditional farming practices in a very different way than in France and Germany. These three cases enable a comparative argument to discern the way in which earlier, 'simple' modernization as well as subpolitics have shaped the reforms and the degree to which they promoted a 'second modernity'. In particular, we intend to elucidate the global encounter of 'communities of fate' across the continents; the politics and subpolitics to which this gave rise at the global level, the European Commission and its member states; and diverse practices in the primary sector in European countries.

Our central question thus translates into two subquestions:

1. to what extent and how may the CAP reforms of 1992 be understood as resulting during a prolonged encounter in global risk society between overlapping communities of fate; more specifically, which practices of politics and subpolitics contributed in what way to this process?
2. how did these reforms on their turn affect policies as well as agricultural practices in France, Ger-

many and Portugal, and how can we explain the differences between these member states?

61.3 Understanding the 1992 CAP Reforms

The *Common Agricultural Policy* of the European Economic Community extrapolated to the European level the national policies its founding member had created to secure the food self-sufficiency and safety of Europe after two world wars and an economic crisis, and to free labour from the primary sector so as to stimulate industrialization, from which economic growth was expected (Wells 1994).[2] These countries sought to improve productivity and competitive power on the world market through rationalization, relying on the development and rapid diffusion of advanced knowledge and technology. This was accompanied by measures to promote the associate scale enlargement and intensification, especially in terms of physical planning and water management. In order to ensure both a good income for farmers and affordable prices for consumers during post-war reconstruction, there were also price and market policies, in particular product subsidies (Tracy 1989).

Especially the latter policies were, virtually from the EEC's inception, also established at the European level. The CAP comprised two kinds of price subsidies. On the one hand, farmers received product subsidies to ensure low food prices for consumers and a decent income for farmers. This led to a process of increasing food production, which contributed to rapidly increasing surpluses. Simultaneously, as product subsidies kept prices artificially high, European farmers could not compete in the world markets. In order to remedy this, export subsidies were put in place as well (Hennis 2005: 39 ff.).

Together, these structural policies at the national and European level implied strong incentives for productivity increase, intensification, and scale enlargement. Around 1970, this led to outright overproduction, perceived as a moral problem by many citizens, who due to the then recent penetration of television were confronted in an unprecedentedly direct way with the world food problem: graphic images of the effects of famine in the southern hemisphere.

In the 1980's, this system came under increasing pressure from various exogenous trends. Not only did public concerns on overproduction increase; the steady production increase also implied that the volume of the two, mutually reinforcing, subsidy systems grew enormously, leading to a very high share of the CAP in the European budget. The so-called 'stabilizers reform', adopted in 1988, plagued by major disagreements between member states, had not been able to resolve these problems (Ackrill 2000). Without new measures, this share was bound to increase further, also because of the ongoing process of EU expansion with Central and Eastern European countries – a consequence of another exogenous trend, the end of the Cold War. This occurred during the era of the adoption by most member states as well as the EU itself (in the 1992 Maastricht Treaty) of the monetarist paradigm. Finance ministers and 'their' commissioner were pushing on their agrarian colleagues, often with strong political support. In the same trail, liberalization and deregulation were becoming increasingly influential principles (Hennis 2001).

Parallel to these financial-economic trends, concerns on the environmental side effects of modern agriculture were increasing in the wake of the 1987 report *Our Common Future*, drafted by the World Commission on Environment and Development. Concerns especially about water quality and pesticides started to develop, and soon the realization became widespread that these – and others, like over-fertilization – were directly connected to the intensity of production (Hennis 2005: 54). As the 1985 Single European Act had put environmental policy on the EU agenda, this led to EU policies that also started to affect agriculture which thus no longer was the monopoly area of agrarian policy-makers: also consumer and environmental organizations became involved. Maybe most tellingly, already the 1988 reforms had been discussed not in the agricultural council, but in the general council (Hennis 2005: 59).

A second expression of the politicization of side effects concerned the impact of the CAP on world trade negotiations. More than forty southern countries with relatively strong primary sectors, together with Canada and Australia made concerted efforts in the so-called Cairns group, to press for liberalization of the world trade (Higgot/Cooper 1990: 590–593). The shift towards liberalization in the US, helped by lobbies of the country's transnational corporations, led to governmental pledges on far-reaching liberalization of world food trade (Hennis 2005: 47–48). In order to prevent one-sided liberalization, which would damage the American primary sector, the US government started to put pressure on Europe to join the liberalization game (Wells 1994: 2; Higgot/Cooper 1990).

2 This section strongly draws on Grin (2010a: 297–300).

Thus, next to financial concerns, both ecological and world trade effects of intensive agriculture got place on the agenda. It was in this situation that in 1989 Raymond MacSharry became European Commissioner for Agriculture, with the explicit intention to reform the CAP in spite of EU policy-making routines, whereby "the Commission proposes and the Council of Minister disposes" (Petit/De Benedictis/Britton/de Groot/Henrichsmeyer/Lechi 1987: 14). He had an inclination towards sustainable development, and, given his Irish background, was relatively susceptible to the needs of small farmers, whereas the CAP hitherto had privileged larger farming practices. He was not alone in these respects; there was increasing recognition in EU policy-making circles that both overproduction and environmental problems pointed towards less intensive production, and that this would favour the small scale farmers who hitherto had been less privileged by the CAP. Environmental measures came to be seen as a way to protect European farmers now that world trade talks were pressing for less protectionism (Hennis 2005: 59; Latacz-Hohmann/Hodge 2003: 134–137).

MacSharry set up his own team, a small group operating behind closed doors that started to draft a plan, about which even most of his fellow Commissioners were not informed. Thus he managed to produce a plan without being bothered by conventional EU policy arrangements, which included the game of 'commitology', or providing room to powerful lobbies, of which earlier attempts at reform had suffered (Patterson 1997: 151 ff).

Already in February 1991, when a formal green paper was not yet published, a so-called reflection paper was leaked to the press. This plan emphasized the need to retain rural populations, radical price cuts, and direct compensatory aid payments to farmers in certain sectors. Thus benefits "would be switched from the intensive grain and animal product growers in the North to the smaller less-intensive landholders of the Mediterranean and other peripheral areas (including Ireland)" (Patterson 1997: 154). In addition, through subsidizing acres rather than produce, farms were stimulated to have part of their land out of production. All in all, the policy shifted from price support to income support and increasing emphasis on environmental measures (European Commission 1993: 10).

When the reform proposal itself was published in July 1991, the shift from product subsidies to income support was maintained, but compensatory payments had become technically less complex and price cuts less drastic. Thus, many perceived the eventual measures as less drastic than they had feared. Nevertheless, reaching consensus on this proposal would appear far from trivial. Especially France and Germany had always strongly opposed such proposals (Patterson 1997: 136; Ackrill 2000). How, then, did MacSharry manage to succeed?

One important element was that for negotiations on the plan, he created another exceptional policy-making venue, a 'niche' venue within the normal EU structure. He defined a highly closed arena for negotiating it with individual member states. Decision-making within the agricultural council had traditionally taken place in a rather suspenseful dynamic, marked by sharp conflicts on the one hand and a huge measure of solidarity on the other. Different national interests of member states coexisted with a shared conviction that reforms were necessary (Patterson 1997: 149–152). Throughout the process, MacSharry played the card that it would be best to decide on reforms internally rather than having reforms forced onto agriculture from other domains, such as finance or environmental affairs (Patterson 1997: 153–154).

During the final stages of the negotiations of the 1992 reforms, the commission used this tension in combination with its power to define the venue for negotiations to come to an agreement, by having each of the member states articulate their priorities separately, to the Commission. In so doing it monopolized information and turned itself into an "obligatory passage point" for all talks, as well as into the actor who would define the issues of conflict. Eventually, it could thus produce an "accept it or not" attitude because one could claim it was the only workable compromise. Also, ministers were able to speak out freely during these bilateral talks outside the reach of public opinion or special interest organizations. This made it possible for MacSharry to meet the French on, for instance, cereal export subsidies and quota, but not on price cuts (Patterson 1997: 160–161). In combination, this led to a point of departure in which ministers said what they really opposed; they could agree on the issues that would not give them too much trouble at home.

Second, while EU member states' positions in the GATT negotiations had initially been largely influenced by the primary sector's lobbies, both these countries and the rest of the world became increasingly aware of the pressures that the CAP exerted on both world trade relations and the EU budget. Agrofood was the most important file in the Uruguay Round, and without agreement on agrofood trade; no

agreement would be possible on other matters that also pertained to other economic sectors than agriculture. Thus, the GATT introduced also actors from other sectors onto the stage, increasing the pressure on the CAP and reducing the monopoly of farmers' interests on that area. Simultaneously, also main players within the agricultural sector now increasingly recognized that the 1988 stabilizers would not solve the problem (Patterson 1997: 153). They understood that in a globalizing world, also in their domain international cooperation and the influence of global capital had become crucial (Hennis 2001: 833–836).

Against this background, and keeping a firm eye on his tactic of resolving these issues 'internally', MacSharry publicly denied any connection between the CAP reforms and the GATT negotiations until the ministers had formally adopted his plans (Patterson 1997: 153). Yet, it is plausible that he played this card (as well as that of pressure from national and EU financial and environmental policy-makers) behind the closed doors that he himself had put in place (Atkin 1993). Moreover, he used his discretion to include his reforms first of all in the so-called Blair House agreement with the US – an international agreement that had to be submitted to the Council only after the fact (Coleman/Tangermann 1999: 400-401). As implied above, GATT matters will always have been on the minds of national policy-makers.

Third, 'taming' the CAP was also a *sine qua non* for the establishment of the highly desired European Monetary Union (Hennis 2001: 831). Fourth, and more specifically, the German and French governments started to tone down their traditional resistance against changes in the CAP. As regards Germany, unification brought with it a financial crisis, which made the German government reconsider its position on the EU's increasing agricultural expenditures. Unification also changed the nature of the German farming sector, and it mobilized several additional special interest groups. Thus, the political power of actors from the primary sector had significantly declined, and the German government came to consider the interests of a more heterogeneous coalition of interest groups (Patterson 1997: 145). Also, the reunifying Germany was sensitive to good international trade and political relations.

Meanwhile, in France concerns on both budget deficits and environmental damage had steadily increased. In addition, pressure from other policy domains, with a stake in GATT (like intellectual property) more generally, had built up. Finally, it had helped that quotas on cereal – a backbone of the French agricultural sector – were eliminated from the package (Patterson 1997: 157).

The measures adopted reduced the dynamics towards ever increasing CAP budgets as well as the surpluses. To be sure, the wider immediate impacts were limited. As income protection remained in place, and agricultural research and development remained oriented towards productivity increase, the measures did not lead to radical reform of agricultural practice (Hennis 2005: 50). The export subsidies remained in place as well. Yet, the CAP had become more transparent, also to taxpayers (Patterson 1997: 17). In addition, parallel to these reforms (and partly as part thereof) the European Commission launched an agro-environmental policy. This too increased the influence of actors from that domain (Hennis 2005: 65–66). While the measures on changing the subsidy system had been most controversial and drawn most political energy, they were accompanied in EC Regulation 2078/92 by environmental measures aiming at less pollution, less intensive production, more organic farming, and creation of leisure activities in the rural areas. These measures included novel forms of financial support, aimed at activities for:

- promotion of farming practice which reduce the polluting effects of agriculture;
- environmentally favourable extensification of crop;
- sheep and cattle farming;
- environmentally friendly ways of agricultural land use;
- upkeep of abandoned farmland;
- long-term set aside of agricultural land;
- land management for public access and leisure activities; and
- education and training of farmers for environmentally-friendly types of farming (Bruckmeier/Ehlert 2002: 21).
- Overall, the package comprised in Regulation 2078/92[3]– eventually published in June 1992 – was tailored as a response to the negative side-effects of intensive agriculture: overproduction and environmental measures. It encouraged extensification practices. Realizing that this was more of concern in the northern states, the European Commission also included some measures to address some of the concerns of the southern states.

3 Council Regulation (EEC) 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside.

61.4 Impact of CAP Reforms on Member States' Agricultural Policies and Practices

61.4.1 The French Case: Linking Environmental Concerns with Agricultural Practice

61.4.1.1 Agricultural Policy and Practice in France Before 1992

France has a large, versatile agricultural sector covering a wide range of products. From the onset of the CAP, it has been one of Europe's largest food exporters (Bowker 1985: 178). The country has exceptionally widespread grasslands. In France, environmental concerns had penetrated national agriculture policy in the late 1980's (Bignal/Baldock/Tubbs 1996: 7). While the growing sense of urgency amongst the public and politicians about ecological problems had initially focused on industry and urban sources, around 1980 also agriculture became a focus. Until then, this had been unthinkable, given the strong position of the farming community in the nation, the important position of agriculture in the French economy, and the influential farmers' lobby in national politics (Hennis 2005: 99–103). Thus, in the early 1970's the point of departure was that the process of modernization and intensification should not be bothered by environmental concerns; if farmers structurally damaged the environment, they should just pay compensation. The first real environmental measure was the protection of water quality. There was little support for these measures, which had been designed without any serious involvement of farmers. The main exception was the successful, but small-scale attempt of one nature organization to have farmers participate (Billaud/Pinton 2002: 45).

This started to change when the problem of abandoned land became more apparent. As the government wanted farmers to take the role of protectors and owners of the rural landscape, it decided to involve individual farmers in the policy-making process. The relevance of doing so was shared, and practised, by environmental groups as well. Through their active involvement farmers came to share the need for environmental improvement, and to appreciate their role and as well as the opportunity to influence policy-making. This also generated debate within the two main farmers' organizations in France (Hennis 2005: 121).

This successful 'subpolitics' approach to dealing with the issue was partly inspired by the decentralization launched in 1983 by the French government (OECD 1999). Especially in the agricultural domain, regions attained more influence. The consequent local political struggles possible between local authorities, farmers, and occasionally environmental and nature organizations, helped to tune agri-environmental measures to regional circumstances and geographic realities (Billaud/Pinton 2002: 46). This gradually created some support amongst farmers for taking into account the environment in their practices, a mechanism well known from experiences elsewhere (Van de Graaf/Grin 1999).

The first official challenge for the sector emerged from 'Article 19', the first set of environmental measures from the EU. It offered subsidies for efforts for the protection and preservation of natural areas and natural resources in ecologically sensitive zones. The French government responded by sponsoring several experiments. These were launched in 1989, at four different sites which were particularly sensitive ecologically. They were managed by the National Centre for the Development of Farm Structures. These had been jointly designed with regional governments, farmers, and other actors in a particular area. The development programmes in these sites grew rapidly, partly because they quickly attained the additional meaning of providing support for disadvantaged agricultural regions. Shortly they had outsourced the budget (Billaud/Pinton 2002: 48).

These experiments, a novel round of subpolitics, offered interesting perspectives, not only in the eyes of the farmers that had been involved, but also amongst many other French farmers to whom these examples were much more credible and helpful than proposals based on mere scientific evidence (Billaud/Pinton 2002: 49–54). Also, the limits encountered encouraged both environmental and farmers associations to demand better policies from the national government. In 1991, the Ministry of Agriculture introduced the Sustainable Development Plans (*Plans de Développement Durable*, PDD) where they connected modes of production with environmental issues (Billaud/Pinton 2002: 48–49).

As a consequence of these developments, such linking was no longer a taboo in France. Moreover, it had become clear that environmental concerns could be sensibly incorporated in agricultural practice. The project approach adopted in the implementation of Article 19 and the PDDs, with policy design focusing on a particular local context and involving local farmers and environmental groups, appeared to have many of the effects Beck ascribes to such forms of subpoli-

tics. It had proven successful in producing plans that respected local circumstances, and could be accommodated by farmers. Also, it had led offered spaces where farmers could discuss their practices and learn from each other, as well as from environmentalists, on changes therein. In other words, this approach helped farmers to appropriate policy. In the process, trust increased amongst farmers (Billaud/Pinton 2002: 54).

All this cleared the road for the 1992 agri-environmental measures. An additional helpful factor was the fact that French farmers had positively appreciated the CAP for over 30 years. Over the decade, it had had significant influence on national agriculture policy (Billaud/Pinton 2002: 46).

61.4.1.2 Implementing EU Agri-environmental Measures in France

The task to implement EU Regulation 2078/92 was adopted by the Ministry of Agriculture and the Ministry of Environment. This partnership symbolized that the government wanted actors in both domains to cooperate. By 1993, the following measures were announced (Dupraz/Rainelli 2004: 169; Billaud/Pinton 2002: 50):

1. a national programme for the maintenance of extensive livestock systems, mainly through premiums;
2. national plans for sustainable development; and
3. local and regional agri-environmental programmes in line with EU Regulation 2078.

It was clear from the outset that farmers' organizations supported the new link between the environment and agriculture. This significantly contributed to the measures' legitimacy in the French primary sector. However, they criticized the agri-environmental measures for not having been elaborated in a scientific way, as they did not incorporate knowledge about local circumstances. Also, they considered the time span proposed in the measures as unrealistic, given natural and investment cycles (Billaud/Pinton 2002: 74–76).

Against this background, the government decided to adopt the participatory project approach that had proven so successful in implementing Article 19 and designing the PDD programme. It initiated so-called pilot projects with a farmer in the role of an independent manager. Substantively, most farmers focused on stopping the decline of grass land, a widely shared objective amongst them. In addition, water quality problems got attention as did, though less, organic farming.

As had happened earlier, this induced learning processes between farmers and environmental groups. Farmers could thus design changes in their practices that they deemed sensible, and appropriate the policy so as to tailor it to local circumstances and needs. They proposed that, rather than fixing practices in detailed, formal contracts, a more loose contract approach would be adopted that would allow farmers to further experiment with novel approaches. This would also imply the flexibility to adopt measures that worked best, both agronomically and ecologically (Billaud/Pinton 2002: 54).

According to Billaud/Pinton, these measures eased the implementation of the 1992 CAP reforms. Like the earlier experiments, they have generated a significant 'social echo', creating support for different practices amongst French farmers. The effect of that achievement was, however, limited by the short time horizon (5 years) of the measures; that some impact could arise was because of the fact that the experiments launched in 1989 had provided a basis (Billaud/Pinton 2002: 94). Also, financial support was limited by the size and uneven spread of available budgets over the regions, as well as by discouraging bureaucratic procedures.

From the viewpoint of our analysis two other findings are of interest. First, Billaud and Pinton (2002: 94) observe that farmers appear more willing to implement measures that do not change their practices too radically – the bottom line is that they should feel able to take these changes, in an economically sound way. Even stronger, some economic benefit in many cases appears to provide the incentive needed for change (Van de Graaf/Grin 1999). Precisely in these respects, experiments had proven such an effective approach. One potential explanation why the changes explored in these experiments remain relatively limited is that they need to fit a structural context (including existing market structures, available knowledge, governmental policies) that over time has co-evolved with modernization and intensification and tend to provide less support and economic viability to drastically different types of practices (Roep/van der Ploeg/Wiskerke 2003; Bos/Grin 2008 for evidence from Dutch experiences). This underlines the importance of institutional change, a condition for innovating societal practices (Billaud/Pinton 2002: 49).

The second finding concerns the fact that there are interesting differences between regions that support the implicit presumption above that the policy's success could be attributed to earlier developments and to the project approach adopted. Billaud and Pin-

ton (2002: 63–80) compare two regions, Burgundy and Poitou-Charentes. Both regions are facing problems with drinking water quality, and both have a mix of intensive and extensive farming practices. They differ from each other, first, since the executive department of Poitou-Charentes was already familiar with agri-environmental measures, while the issue was largely new to the department in Burgundy. Second, in Poitou-Charentes the relationships and collaboration between agricultural and environmental groups was much better developed than in Burgundy, although there were occasional attempts to renew the dialogue between for example the managers of a regional park and the farmers (Billaud/Pinton 2002: 75). In line with our presumption, Poitou-Charentes saw indeed many more participants (818) than Burgundy (400) in grass-premium initiatives (Billaud/Pinton 2002: 69). Water protection attracted most applicants in both regions. Interest in organic farming was larger in Burgundy than in Poitou-Charentes and it rapidly grew from the second year onwards with the budget as the limit (Billaud/Pinton 2002: 70).

61.4.2 Germany: Challenge of Turning a Critical Debate into Changed Agricultural Practices

61.4.2.1 German Agricultural Policies and Practices Before 1992

Post-war German agricultural policy was really focused on overcoming the shortage in food production and to ensure some income security for the farmers through a combination of modernization and market and price policies. This focus was laid down in the 1955 Agricultural Act (*Landwirtschaftsgesetz)* it shared with the five other countries, including France, with whom it co-founded the European Communities. Not coincidentally, thus, the CAP, when it was established a few years later, was well compatible with German policies (Ackrill 2000). This massive policy support helped agricultural modernization gain momentum and helped Germany to greatly expand its food export already in the course of the 1970's (Bowker 1985: 173 ff.).

Still, many German farmers had been critical against the CAP in general since its inception, and especially against the pressure towards modernization implied in it. Historically, rural society sees itself as an important pillar of German identity (Craig 1982). They felt marginalized and unable to manoeuvre themselves out of their bad economic and social position, and abandoned by politicians, who should have come to their rescue, but 'instead' went for a modernization of farms (Bruckmeier/Riegert 2002: 232).

Already in the 1970's in Germany – like for instance in the Netherlands, but unlike in Portugal and France – other societal parties became also critical of agriculture. A critical public debate emerged on the environmental effects of agriculture (Feindt/Gottschick/Mölders/Müller/Sodtke/Weiland 2009: 11–14). This debate was a clear example of the politicization of side effects. It triggered a variety of actors from civil society and especially from science to develop clear visions and a wide range of proposals to realize them. Yet, while these processes of subpolitics generated proposals beyond normal institutional constraints, their Achilles' heel was that there were hardly any links between these critical scientists and the primary sector. Proposals did not incorporate local and informal knowledge, farmers hardly understood the economics of extensive agriculture, and the distance between them and the new paradigm developed by scientists remained large. Farmers neglected or rejected these proposals. Also, their impact on policies remained very limited.

The debate continued but only after German unification in 1990 the government adopted and started to implement visions for a more ecologically sound agriculture. As we already noted above, unification implied several reasons for Germany to leave the one-sided focus on productivity increase; in addition, EU Regulation 2078/92 offered a new impulse for realizing the ideas generated earlier (Patterson 1997; Bruckmeier/Riegert 2002: 119–122).

61.4.2.2 Implementing EU Agri-environmental Measures in Germany

It took a while until agri-environmental measures were implemented in Germany. Re-unification took a lot of energy. In addition, the process was complicated by the federal political system (Bruckmeier/Riegert 2002: 124). According to the constitution, in agricultural policy the Länder are responsible for structural policy, education and nature protection, while the federal government deals with social aspects and taxes. Furthermore, the *Länder* are responsible for environmental issues, thus also for the implementation of the agri-environmental measures. The federal government is only responsible for funding the policy.

Yet, following EU Regulation 2078/92 federal and state authorities decided to formulate together a joint framework for supporting the market and local production first and then the Länder would adopt agri-environmental programmes of their own emphasizing

nature protection and conservation. Also, a 'Basic Programme' was agreed upon comprising a few objectives each Land would include: a) extensive arable land and permanent crops, b) extensive grassland use, with specified maximum cattle density, and c) organic farming. The *Länder* could then quantify these objectives in a way that reflected their specific situation, and add specific measures for their regions (Bruckmeier/Riegert 2002: 125–126).

Indeed important differences between regions existed in terms of types of agricultural production traditions and associate structures. Some Länder reserved more money for these measures than others and promoted their implementation more than others. This partly was due to the fact that some were familiar with environmental measures regarding agriculture and had already promoted an extensification before 1992 (Bruckmeier/Riegert 2002: 133–135).

Underlying federal and state policies was the belief, fed by earlier scientific endeavours, that agriculture and environment go hand in hand with each other. Yet, a huge gap appeared to exist between governmental actors and the primary sector that hardly shared this belief and the underlying assumption. Implementation, especially of the measures most alien to established agricultural practices, remained limited (Bruckmeier/Riegert 2002: 128).

While the 1992 EU Regulation was a new impulse to realize earlier generated ideas, the agricultural sector – that had scarcely participated in the earlier debate – did not really work along to turn it into a success. As noted above, they never had very warm feelings towards CAP and national policies, and Bruckmeier/Riegert's survey data show that they did not feel personally responsible for improving their position as well as the environment. Against this background, farmers adopted primarily those measures that could be easily integrated in their farming practices, and fit instrumental and economical motives (Bruckmeier/Riegert 2002: 163–6). Through political campaigns, governmental and other actors tried to influence policy formation. While a variety of governmental and non-governmental (environmental and agricultural) organizations expressed their views, eventually the Länder governments decided, using hearings to build the policy in a "symbolic consensus" (Bruckmeier/Riegert 2002: 129–130). However, there were no deliberations or even negotiations between authorities and the farmers. Also, implementation was done through rather traditional bureaucratic routines; any interaction was lacking between implementing agencies and the primary sector regarding the application of the resulting measures at the farm level. This did not help to improve the already tense relationship between the government and individual farmers, and it was hardly satisfactory for the latter that they shared this fate with many others. This has certainly contributed to the lack of success (Siebert/Laschewski 2009: 170).

61.4.3 Portugal: CAP Reforms in a Country Relatively Untouched by the Earlier CAP Modernization Policies

61.4.3.1 Portuguese Agricultural Policies and Practices before 1992

The case of Portugal, a southern European state that entered the European community in 1986, differs from that of France and Germany. Portugal lacked the powerful modernization programmes due to limited budgets the EU founding members had adopted in the post-war years (Rodrigo/Ferragolo da Veiga 2009: 214). It had become exposed to the CAP many years later, when the CAP had become tuned to the needs and realities of early member states that had gone through a process of significant intensification and modernization (Ackrill 2000). In Portugal, the structure of the agricultural domain reflected primarily subsistence farming, and farms were often family owned following traditional practices. Thus, well into the 1980's, agricultural production remained relatively extensive, and the country produced only half of its domestic food supply.

In Portugal this way of farming came under increasing pressure. The primary sector lacked competitiveness on the world market. Farmers felt that they received too little money for their products, especially in view of their high production costs. They saw their bad economic situation as the main problem in agriculture. Urban life became also increasingly attractive for new generations, leading to massive rural to urban migration. The countryside was increasingly abandoned and important demographic changes occurred: the farming population was getting older, and especially men were taking jobs in the cities what resulted in a "feminization of farming" (Patrício/Valadas de Lima 2002: 170; Covas 1990; Bock 2004).

By 1990, the Portuguese government was primarily interested in an intensification of agricultural production, deemed necessary to preserve the primary sector. The government hardly considered the changing nature of rural areas as a problem in and of itself, but mainly as a consequence of the stagnant modernization of the primary sector. Environmental concerns

play a role in its agricultural policies only to the extent that they are deemed necessary to maintain the production function of rural areas. The primary sector focused on economic survival and many farmers wanted to maintain traditional practices (Patrício/Valadas de Lima 2002: 167–168).

61.4.3.2 Implementing EU Agri-environmental Measures in Portugal

Against this background, Portugal faced the CAP reforms quite differently than the German and French governments had done. It considered the environmental problems described in EU Regulation 2078/92 primarily as the consequences of the intensive production modes in more northern states. Thus, it saw a clear northern bias in the reforms, and felt that the interests of countries like Portugal had been neglected. More specifically, it badly lacked agri-environmental measures in the reform package that were tailored to the specific problems facing Portugal (Patrício/Valadas de Lima 2002: 167–168).

When it implemented EU Regulation 2078/92 into national policy, the Portuguese government focused on those measures that would help resolve the social problems of its rural society, help maintain traditional farming practices, and help preserve the environment for future production. Policy measures were based on the assumption that the character of most Portuguese farming practices protected the environment. It used the agri-environmental policy in support of these practices and adopted these measures (Patrício/Valadas de Lima 2002: 183 ff.):

1. offer of training and demonstration projects for farmers, rural specialists and technicians;
2. reduction of the pollution caused by agriculture through water quality protection by reducing and rationalizing the use of pesticides and promoting organic farming:
3. extensification and the preservation of traditional agriculture;
4. conservation of the landscape and natural resources through the maintenance of forest areas, and undertaking agriculture in ecologically sensitive areas.

Measures that might help mitigate the flight from the rural areas and desertification attained more priority than others. Most of the budget was spent on extensification and preservation of traditional agriculture. This was in line with the general idea and discourse in Portugal, that agriculture and the environment are in harmony with each other. Agri-enviromental measures were thus first and foremost interpreted and elaborated as ways to protect the farmers (Patrício/Valadas de Lima 2002: 186–7). Only a small percentage of the budget was spent on the training programme. Meeting the problems of the (small) sector of intensive agriculture in Portugal through that measure got little priority. Also tackling pollution was of relatively little concern.

Portuguese farmers, just like their government, viewed the agri-environmental measures as a support more for agriculture than for the environment. In general, they resisted a role as environmental protectors, and those measures which they deemed economically most attractive had most impact (Rodrigo/Ferragolo da Veiga 2009: 210).

A crucial problem was that the number of available rural and technical experts was rather limited, and varied amongst regions. Therefore, most information and knowledge had to be transferred orally (Patrício/Valadas de Lima 2002: 187). This lack of training capacity also contributed to the limited reach of the little knowledge of the programme. Only a small number of farmers joined the programme, and those who did were primarily economically motivated. Part of the problem was that the (ageing) farming community had for a long time not improved their production methods and neither had they introduced new production techniques at any significant scale (Patrício/Valadas de Lima 2002: 199).

Patricio and Valadas de Lima conclude that the CAP reforms confronted Portugal with several fundamental choices. First, "if policy-makers recognize the potential role of farmers as preserving and maintaining rural society than a social policy is necessary. The maintenance of rural society requires not only a policy preserving traditional agricultural systems of production but one which supports the social and cultural dimensions of rural society" (Patrício/Valadas de Lima 2002: 202). And such survival of the family farm also requires better economic preconditions.

But, second, will this type of production, subsistence farming, eventually survive? Is more intensification not necessary to prevent the rural exodus and abandoning of the land? If this is what Portugal needs, the extensification policy of the EU is not really helping Portugal.

Finally, as Patrício and Valadas de Lima (2002: 204–207) argue, the agri-environmental measures offer considerably more opportunities and reduce environmental problems. In that sense, this policy is also suitable for Portugal. While in Portugal Regulation 2078/92 could not build on earlier debates, policies

and practices, implementing these measures may prove to be the first step towards fuller recognition of the problems that are also caused by traditional agriculture.

61.5 Conclusions

Returning to our research questions, we may understand CAP reforms indeed as an expression of the way in which global risk society makes the side effects of modernization feed back into the modernization processes that generated them in the first place. *In casu*, the modernization process concerned rationalization and scale enlargement of agrarian production, tied together in national policies and the EU's CAP that promoted intensification. Side effects indeed brought together different communities of fate. These effects included, first, overproduction which, together with European and American protectionism, affected the economic chances of farmers in the southern hemisphere. Over time, this had led to increasing pressure form the South on the world trade organizations. Second, the environmental effects were sensed by European environmental groups and policy-makers. Both concerns were addressed by CAP reforms that focused on an extensification of agrarian production in Europe.

Thus put, and leaving the question aside of the long term impacts, it seems a perfect example of the global risk society theory's idea that reflexive modernization in the sense of institutional reforms may result from an encounter of communities of fate. Yet, at least two qualifications are in place. The first is that the reflexive modernization that occurred may certainly not be ascribed solely to the two communities of fate just mentioned. At least as important were two forces rarely considered in risk society theory as a positive force: the emergence of the neo-liberal paradigm, and the fact that globalization turned also northern countries into a 'community of fate': given global competition, the USA and Europe (as well as Japan) could hardly decide on their own how to respond to southern pressures. From the viewpoint of those interested in the politicization of side effects, this is a case of how the 'wrong' means may realize the 'right' objective. In that sense, the case illustrates that it is too simplistic to argue, as is often done, that regions in Africa and Asia are bound to remain marginalized in the global economy, lacking access to the global market. The Cairns Group demonstrated that it may be possible strategically to connect their concerns to other, northern concerns and interests. Yet, we must stress that this did require significant strategic agency, not only on the side of the Cairns Group, but also from, amongst others, Ray MacSharry. Also, and more fundamentally, it could not have occurred had it not been that one and the same structural factor, the price support system, was behind monetarist concerns, intensification, and associate ecological problems and inequitable trade relations. This system thus could become the common ground where communities of fate could join forces.

The second qualification is that such reflexive modernization may generate its own communities of fate. The CAP reforms produced not only winners, but also losers, such as the farmers in Germany who felt betrayed and marginalized, and the rural poor in Portugal who felt that the reforms, like the CAP, were tailored to solve very different problems than the ones they had. This reminds us of Manuell Castells (2000: 168), who has argued that a 'fourth world' is developing, comprising people from all regions, including the European Union.

This takes us to the question *how* CAP reforms were realized. On the basis of section 61.3, we must immediately note that, at the EU level, it was certainly not only, and even not in the first place, subpolitics which shaped this outcome. On the contrary, it was – admittedly, extra-ordinarily skilful and non-standard – hard boiled politics that was quintessential to MacSharry's successful exploitation of the opportunities offered by such trends as the changing world trade situation, the emergence of the monetarist paradigm, and the end of the Cold War. The case should be taken as a profound warning against a too romantic picture of subpolitics as 'the prime mover' of reflexive modernization. This is not to say that subpolitics had been unimportant. First, MacSharry partly drew upon the fact that since around 1970 all kinds of subpolitics had sensitized both national and EU policy-makers for the need to take into account environmental concerns. The comparison between France and Germany on the one hand, and Portugal on the other, indicates that the reception of, and resistance against, the agri-environmental measures co-depended on the degree to which, in Beck's terms, earlier politicization of side effects had helped to break open institutional unawareness. Second, as the comparison between the French and the German case in section 61.4 shows, the financial support for the extensification and ecological improvement may simply have been neglected, had it not been for farmers who had been participating in subpolitical initiatives.

How then, more precisely, did CAP reforms as examples of Beck's meta-governance, lead to changes in agrarian practice? Let us make some comparisons between our case studies in order to demonstrate that it was precisely at this level that subpolitics appeared important. First, comparing Portugal with France and Germany, we see that in the perception of the 1992 CAP reforms were much better where the ground had been prepared by previous subpolitical activities. The other way around, CAP reforms may eventually appear to contribute to the emergence of subpolitics as well as changed practices. While some might argue that there simply was no reason for such subpolitics in the Portuguese situation, we have shown that this is at best a position in the debate, rather than a given: also in Portugal, the point was made that agricultural production led to environmental problems; and that dealing with these problems might contribute to improving the rural areas' social and economic viability.

Second, comparing Germany and France, we also see that subpolitics may prepare the ground for translating meta-governance, such as the CAP reforms, into changes in agrarian practice, especially if it mobilizes tacit, informal knowledge in addition to formal knowledge. In France, it was precisely the fact that farmers and local environmental groups had brought in such knowledge in the 1989 and 1991 experimental projects that generated legitimacy for the CAP reforms. While farmers initially criticized the CAP's underlying scientific assumptions, it was these projects, and the room they attained through administrative decentralization, that helped them to relate the measures to their own practices. Conversely, in Germany, concern on side effects had led to proposals, developed by scientists, and based on formal knowledge. Thus farmers did not see how to relate these concepts to their own practices. As a result, these proposals could inform national and regional policies, but could hardly legitimize them, certainly not to the extent needed for effective implementation. These findings confirm and specify Beck's point on the need for subpolitics to involve local actors and to benefit from their knowledge to produce contextually relevant concepts.

The previous points together suggest another theoretical conclusion. They indicate that neither structural change nor innovative, 'subpolitical' practices should be conceived of as *the* motor for reflexive modernization; rather, they may presuppose and drive each other. And they raise a next, much more complex question: how structural change (as an act of meta-governance, Beck/Bonss/Lau 2003), and changes in a diversity of practices, may come to reinforce each other so as to develop into a prolonged transition towards sustainable development (Grin 2010: 265–314). That is a question for further study, which would have to focus on a much more prolonged period of development.

Let us now return to the question we asked in our introduction: how may different communities of fate actually join forces, across space and in spite of differences in context and prehistory, in order to generate the transformative power needed to re-orient development patterns? In sum, we have seen that the needs and wants of different communities of fate may come together *if* they are all related to the same structural factor(s). Even then, significant 'political' work needs to be done in order to actually realize structural changes. These changes on their turn may help promote (innovative) practices of the various communities, when these have been prepared through earlier subpolitical practices. Strategic agency is needed to bring about such connections.

Changes in the financial incentive structure, as in the CAP case, are but one possible kind of structural change. Translating the above lessons, for instance, to agricultural reform in India and Mexico (chap. by Nair and Conde), another crucial factor may be structural changes that lead to the development of a different kind of agricultural knowledge and technology. Transnational intermediaries could bring together the knowledge needs of practices and strategically connect them to each other and to national and international research programming practices, such as EU Framework programmes, the IPCC or national science foundations (Grin 2010b). Examples are the recently emerging European intermediaries for urban responses to climate change. In an evaluation of these intermediaries, Hodson and Marvin (2009) conclude that in order to succeed, such "intermediaries must constantly work at developing and re-developing the knowledge base which they have access to" in order to help cities to integrate a wide variety of formal and local forms of knowledge and societal perspectives. They also must be able to connect to local practices as well as to transnational venues in the worlds of policy, science, and the market. This clearly demands a peculiar set of non-standard competences, implying that there is indeed reason to trust this task to new intermediaries that may build up the required competences.

As a second conclusion, simultaneously, without further measures those 'communities of fate' whose needs and wants are not well served by that particular

structural change may be the losers of the process. While this may, under circumstances, be the price that must be paid for resolving some pertinent problems, the example of the Portuguese farmers suggests that in other cases parallel policies may be conceivable to serve these groups. Here again, competent intermediaries, as spiders in complex webs, may be the best way to mitigate the risks of unduly creating losers. In all likelihood, for our example, this requires that a diversity of intermediaries may be needed: in addition to the expert group for technical advice on organic production which the EU started to form in the autumn of 2009, also non-governmental organizations such as the International Union for Conservation of Nature.

62 Genetically Modified Organisms: A Threat for Food Security and Risk for Food Sovereignty and Survival

Úrsula Oswald Spring

62.1 Introduction

After the first agricultural revolution ten thousand years ago, people have gradually increased the yield by crossing different varieties of crops. As a result of multiple adaptations five basic food crops have emerged: rice in Asia, wheat in the Fertile Crescent (originally from Ethiopia), maize and beans from Mesoamerica, and potatoes from South America that offers the nutritional base for 6.6 billion people. During the 21st century, agriculture will be confronted with great challenges. Due to population growth until 2050 more than nine billion people must be fed. Most of them will live in poor countries, still threatened with hunger (FAO 1999; 2000, 2008b). Most of these countries are also affected by *global environmental changes* (GEC), and they will face more floods and droughts, a decline in biodiversity, and in the fertility of soils. Due to a rapidly growing food demand due to biofuel and a gradually declining supply, additional land, water, and seeds for food purposes are needed (FAO/WHO 2003; FAO 2005; Ghosh/Jepson 2006).

A public dispute has developed on the benefits and dangers of *genetically modified organisms* (GMO) or transgenic crops (Stone 2002). The promoters of GMO offer miraculous seeds that are able to overcome the negative effects of climate change, salinity, plagues, loss of fertility, and drought. Potrykus (2003) accused the critics of a "crime against humanity", when they demand further analysis of possible effects on the environment and health and regulatory processes to reduce risks related to GMO. *Transnational enterprises* (TNE), some multilateral organizations (e.g. FAO), and governments have been promoting GMO as a kind of panacea. The critics – often allied with international governmental (IGOs)[1] and nongovernmental organizations (INGOs)[2] – spoke of 'Frankenstein food'. In several countries consumers have demanded labelling GMO products, and pressured their governments to guarantee innocuous, healthy, and nutritional food (Royal Commission 2005; TWN 2006; Ackerman 2002; Bongiorno 2005).

This chapter addresses the complexity of the threats and risks associated with GMO (Ayra 2003; Boell Foundation 2002) for food sovereignty (Oswald Spring 2009). Transgenics represent a cornucopian answer to the existing and probably increasing food crises that is further aggravated by the use of grains for biofuel. Today one billion people suffer from hunger, above all children under five years, where 947 million are living mainly in poor countries. Some 65 per cent of all hungry people come from India, China, the Democratic Republic of Congo (at war), Bangladesh, Indonesia, Pakistan, and Ethiopia. Only China, India, and some other Asian countries could reduce the number of hungry people. 36 millions belong to Sub Saharan African countries and 51 millions to Latin America (FAO 2008c). Due to neoliberal agrarian policies, speculation with food prices in the stock market and an unprecedented increase in food prices, the use of food crops in biofuel have increased the number of hungry people in several countries in Central Asia, in Sub-Saharan Africa, Asia, and Latin America.

Can GMO feed 8 or 9 billions people without damaging human health or creating greater ecological footprints? What could happen when a small number of transnational monopolies control seed production worldwide? How are the income, livelihood, and survival of peasants affected and their self-sufficiency in food? What will occur with the food market for poor people when the world food is produced by a tiny number of TNEs? How will a reduced number of

1 See i.a.: UNESCO (2002); UNCTAD (2000).

2 See Greenpeace (2004, 2005): Friends of the Earth (2006, 2007); ETC (2006); WWF (2005); Oxfam 2006; Diverse Women for Diversity, see: Shiva/Mies (1997); Shiva (2008); Oswald Spring (2002, 2005).

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seeds affect biodiversity and how can further pollution be avoided? Are GMOs also posing health threats, and what are the long-term risks of this technology for humankind and nature?

To respond to these questions, first the concept of transgenic or GMO is introduced in relation to a wider context of biotechnology (Harvard University 1999). GMOs are compared with the evolutionary process of traditional seeds. Since 1995 in few countries GMO crops have boomed, what has posed risks to crops in open fields and for biodiversity. Due to many mergers of transnational chemical and pharmaceutical enterprises a few TNEs in this sector can impose prices and models of production and consumption. Smaller producers are either pushed out of business or must produce under contract for these TNEs (62.2). Then the risks of potential impacts of GMOs on health and possible long-term threats for human beings, animals, and biodiversity are examined. This is followed by an ethical evaluation of the cornucopian model of TNEs (62.4) that addresses potential threats and proposes a precautionary principle to reduce the related risks. It suggests limits for economic expansion when common goods and the biodiversity are threatened.

62.2 Cornucopian Response to Food Security

Within the framework of the *Convention on Biological Diversity* (CBD), the Cartagena Protocol on Biosafety (2000) defines "modern biotechnology" as the application of:

> (a) In vitro nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or
>
> (b) Fusion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection (Secretariat of the Convention on Biological Diversity 2000)

FAO's *Glossary of Biotechnology* defines biotechnology broadly as in the CBD and narrowly as "a range of different molecular technologies such as gene manipulation and gene transfer, DNA typing and cloning of plants and animals" (FAO 2001).

62.2.1 Genetically Modified Organisms or Transgenic

According to the FAO (2005: 13):

> Three distinctive types of genetically modified crops exist: (a) 'distant transfer' in which genes are transferred between organisms of different kingdoms (e.g. bacteria into plants); (b) 'close transfer', in which genes are transferred from one species to another of the same kingdom (e.g. from one plant to another); and (c) 'tweaking', in which genes already present in the organism's genome are manipulated to change the level or pattern of expression. Once the gene has been transferred, the crop must be tested to ensure that the gene is expressed properly and is stable over several generations of breeding. This screening can usually be performed more efficiently than for conventional crosses because the nature of the gene is known, molecular methods are available to determine its localization in the genome and fewer genetic changes are involved (FAO 2005: 13).

62.2.1.1 History of Evolution

Long before human beings existed the first one cell organisms experienced modifications, probably through the interaction with viruses and bacteria, adapted to the natural environment, and transmitted the DNA to the next generation of cells. Based on extensive empirical observations Charles Darwin (1859) developed his theory of evolution on the mechanisms of natural selection and the evolution of more complex organisms, where the fittest survived. In 1865 Johann Gregor Mendel developed the first laws of heritage based on genetic selection. In 1953 James Watson and Francis Crack discovered the double helix structure of the *Deoxyribonucleic Acid* (DNA), and in 1973 Herbert Boyer and Stanley Cohen succeeded to genetically modify or recombine the transmission of genetic characteristics of *E. Coli* in a salmonella gene (Cohen/Chang/Boyer/Helling 1973).

Herbert Boyer founded the first company that used recombinant DNA technology and in 1978 Genentech announced the creation of an *E. coli* strain that produces the human protein insulin 'Humulin'. When the US Supreme Court resolved in 1981 that GMO could be patented, many private biotechnological laboratories were founded. In 1982 the US Food and Drug Administration (FDA) approved this first genetically modified medicine. In 1983, experiments with GMO started for tobacco and tomato that were slowly displacing the hybrid seeds produced during the green revolution.

Table 62.1: Evolution of agricultural development. **Source:** Adapted from van der Walt (2000) and FAO (2002; 2005: 6-7).

Technology	Era	Genetic interventions
Traditional	Ca. 10,000 years BC	Civilizations harvested from natural biological diversity, domesticated crops and animals began to select plant materials for propagation and animals for breeding.
	Ca. 3,000 years BC	Beer brewing, cheese making and wine fermentation.
Conventional	Late 19th century	Identification of principles of inheritance by Gregor Mendel in 1865, laying the foundation for classical breeding methods.
	1930's	Development of commercial hybrid crops.
	1940's to 1960's	Use of mutagenesis, tissue culture, plant regeneration. Discovery of transformation and transduction. Discovery by Watson and Crick of the structure of DNA in 1953. Identification of genes that detach and move (transposons).
Modern	1970's	Gene transfer through recombinant DNA techniques. Use of embryo rescue and protoplast fusion in plant breeding and artificial insemination in animal reproduction.
	1980's	Insulin as first commercial product from gene transfer. Tissue culture for mass propagation in plants and embryo transfer in animal production.
	1990's	Extensive genetic fingerprinting of a wide range of organisms. First field trials with genetically engineered plant varieties in 1990 followed by the first commercial release in 1992. Genetically engineered vaccines and hormones and cloning of animals.
	2000's	Bioinformatics, genomics, proteomics, metabolomics.

62.2.1.2 Mutagenesis and Natural Breeding Techniques

For thousands of years, indigenous people, and above all women, observed the natural evolution of plants and started a cross breeding process to enhance the quality of seeds or of domestic animals. These natural modifications improved the quality and productivity of crops. During the 20th century with the molecular technique small segments of DNA were inserted to remove unwanted genetic linkages which required backcrossing and the process was relatively slow while researchers had to wait for the production in the next cycle (table 62.1).

The results of these scientific efforts were hybrid seeds, promoted during the green revolution, that were able to improve multiple times the yield productivity, but induced also pollution of agro-chemicals into soils, the air, and water. FAO data indicate that for all developing countries, from 1960 to 2000, yields rose for wheat by 208 per cent; for rice by 109 per cent; for maize by 157 per cent; for potato by 78 per cent and for cassava by 36 percent (FAO 2008; ISNAR 2001).

62.2.1.3 Genetically Modified Organisms or Transgenics

Different molecules are combined *in vitro* into one molecule to create a new gene, which is transferring the modified novel traits into an organism or seed. *Genetically Modified Organisms* (GMOs) contain altered genetic materials through genetic engineering techniques, also called recombinant DNA technology. Thus, GMO implies the modification of the genetic characteristics of a micro-organism, plant or animal by inserting a modified gene or a gene from another variety or species. GMOs may be micro-organisms designed for use as bio-pesticides or seeds that have been altered genetically to give a plant better disease resistance or growth. The main difference of GMO in relation to breeding is allowing the addition of a single or multiple characters of novel genes from *unrelated* plants, microbes, and animals into the genome of a plant.

For transgenics, different techniques are employed:

a.) recombinant nucleic acid techniques with the insertion of nucleic acid molecules, involving the formation of new combinations of genetic material through insertion. They are produced by different means (any virus, bacterial plasmid or other

vector system) and incorporated into a host organism in which they do not naturally occur but where they are capable of transmitting the genetic information;

b.) techniques involving the direct insertion of a hereditary material into a molecule or organism, prepared outside by micro-injection;

c.) cell fusion (including protoplast fusion) or hybridization methods, where live cells with new combinations of heritable genetic material are formed through the fusion of two or more cells by biotechnological methods.

The main difference of a GMO is the transfer of its hereditary mechanisms, not through the normal process existing in nature, but forced by the above techniques.

In agriculture most GMO seeds produce resistance to herbicide roundup or combat insects through a gene called Bt (*Bacillus turengiensis*; Oswald Spring 2002: 55–56). Recently, breeding aims in plants are generating crop improvements. While conventional breeding techniques rely on the random rearrangement of existing genes between two closely related parent plants, genetic engineering offers possibilities to known genes to be inserted (even from completely unrelated organisms such as fungi or bacteria), giving specific crop traits to plants.

Genetic engineering is used to combat plant diseases such as virus infections where no treatment was previously possible. GMOs may enhance food quality not only in industry, but from crops on oilseeds, stark crops, and vitamin A. Confronted with climate change, water scarcity, salty soils, heat waves, floods and droughts, GMO seeds are being developed to resist these known stresses. For example, silk proteins, biodegradable plastics, or industrial enzymes and vaccines are opening new processes for the pharmaceutical industry. Vaccines in banana reduce the risk of using needles and the obligation of refrigerators. Finally, several fruits and vegetables are genetically modified (tomatoes, melon, apples) to retard the maturation process. This often happens also during the process of transformation.

Diverse GMO products were developed and three generations can be distinguished globally:

- *First generation:* referring to characteristics induced as agricultural inputs (Roundup, Bt), able to combat plagues, insects and weeds;
- *Second generation* where characteristics of post-harvest are modified such as tomatoes, melons, and others through the introduction of a gene that can extend the maturation process or the elimination of the maturation gene;
- *Third generation* where the nutritional value of a product is modified, such as 'golden rice' in Asia, or seeds resistant to drought, to acid soils, and those able to produce vaccines and medicaments.

62.2.2 Evolution of Transgenics

In 1992, when the *US Food and Drug Administration* (US FDA) declared genetically engineered organisms as innocuous without requiring any regulation; this triggered a global boom for commercial production (figure 62.1). In 2007, the area expanded from 12 *million hectares* (Mha) to 114 Mha, where maize alone increased from 10 Mha to 35 Mha.

Figure 62.1: Genetically modified plants (in Mha), **Source:** GMO Compass of Genius GmbH, Darmstadt (Germany); at: <http://www.gmo-compass.org/eng/news/> (15 February 2008).

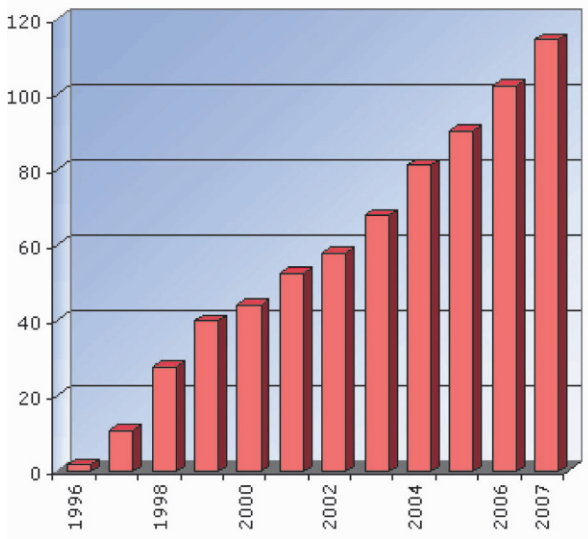
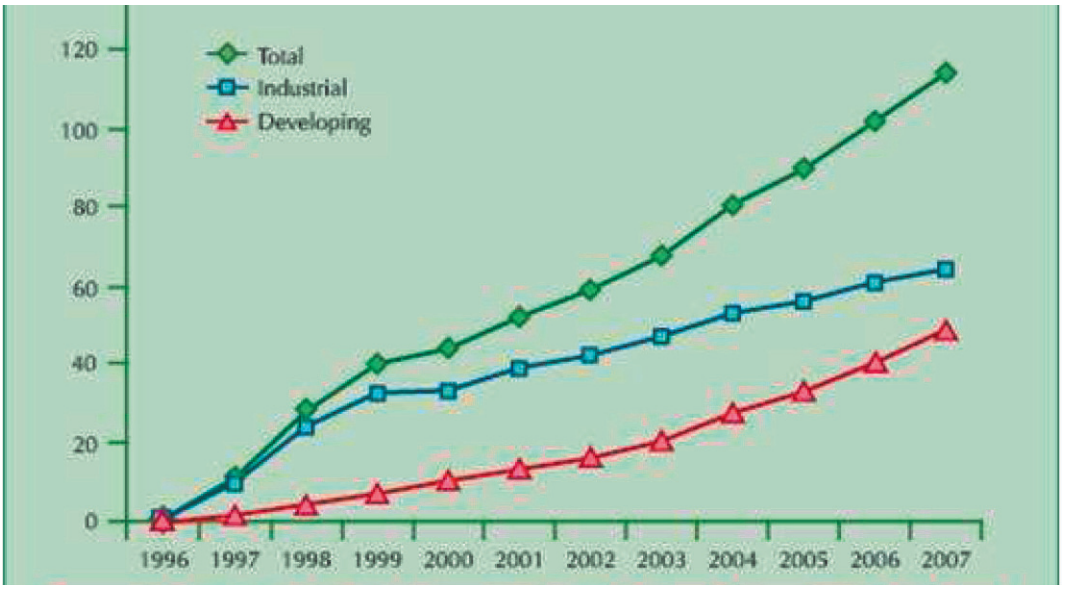


Figure 62.1 refers to a rapid global expansion of GM crops since 1999. From 1996 to 1999 GMO crops increased from 1.7 Mha to 39.9 Mha, and between 2003 and 2004 they expanded from 13.3 Mha to 67.7 Mha. In 2005, after ten years of GM field production, about 8.5 millions farmers in 21 countries were cultivating 90.5 Mha, thereof 55 per cent in the USA. James (2004, 2005) estimated for the year 2010 an extension to 150 Mha in 30 countries. ISAAA (2006) estimated GM crops in 21 countries, were 8.5 millions farmers bought 71 per cent of seeds that were resist-

Figure 62.2: Global areas of GM crops in million hectares (1996-2004). **Source:** ISAAA (2007); at: <http://www.isaaa.org/resources/publications/briefs/37/executivesummary/default.html>.



ant to herbicides, 18 per cent to insects, and 11 per cent to both.

In 2007, 22 countries used transgenic technologies (figure 62.2). GM crops were concentrated in the USA with 57.7 Mha of soya, maize, cotton, canola or rapeseeds, squash, papaya and alfalfa; followed by *Argentina* (19.1 Mha of soya, maize, cotton); *Canada* (5.4 Mha of canola, maize, soya); *Brazil* (5 Mha of soya, canola); *India* (6.2 Mha of cotton); *China* (3.8 Mha of cotton, poplar, papaya, tomato, sweet pepper); *Paraguay* (2.6 Mha of soya); *South Africa* (1.8 Mha of maize, soya, cotton); *Uruguay* (0.5 Mha of soya, maize); *The Philippines* (0,3 Mha of maize); *Australia* (0.1 Mha of cotton) and *Mexico* (0.1 Mha of cotton). *Colombia* (carnation, cotton), *Chile* (maize, soya, canola), *Honduras, Spain, France, Portugal*, the *Czech Republic, Germany, Slovakia, Rumania* and *Poland* with less than 0.1 Mha of GMO produced maize (ISAAA Briefs No 37–2007; FAO/WHO 2008). There are also smaller productions of potatoes and other food crops. The GMO production is basically concentrated in four crops: soya, cotton, maize and canola (table 62.2).

The expansion of GM crops is limited to few crops and regions (table 62.2; figure 62.3), where countries with huge populations have produced GMO to overcome food scarcity. While China and India improved their food production, India still has most hungry people, what shows that production alone will not resolve world hunger.

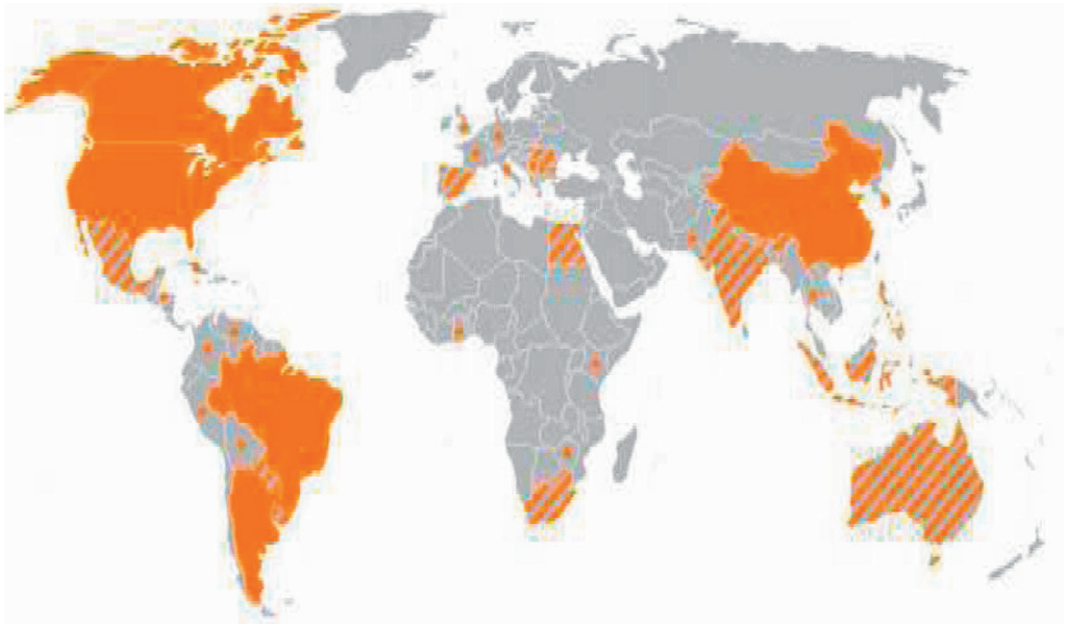
Table 62.2: Areas and types of GM seeds worldwide. **Source:** ISAAA (2007), Brief No. 37; at: <http://www.isaaa.org/resources/publications/briefs/37/executivesummary/default. html>.

Product	Area	Area GM	Proportion GM/total area (in per cent)
Soya	91	58.6	64
Maize	148	35.2	24
Cotton	35	15	43
Canola	27	5.5	20

The greatest controversy over GMO exists in Europe, where in 2008 some 108,000 ha were dedicated to Bt maize. France banned the CM cultivation of corn and 21,000 ha were abandoned, what was compensated by Romania (7,000 ha), Poland (3,000 ha), Czech Republic (8,380 ha), and Slovakia (1,900 ha). With 79,269 ha Spain had the greatest area of GM crops and the largest area of GM maize within the EU. In 2008, Portugal produced on 4,851 ha and Germany on 3,173 ha of corn.

The *International Service for the Acquisition of Agri-Biotech Applications* (ISAAA 2007) estimated that in 2007 global biotech crops amounted to US$ 6.6 billion (maize: US$ 3.2 billion; soybean: US$ 2.6 billion; cotton: US$ 0.9 billion; GM canola: US$ 0.2 billion), or 16 per cent of the global crop and 20 per cent of the commercial seed market (US$ 34 billion). A total of 76 per cent of the GM crop market was in

Figure 62.3: Countries with GM-crops in 2006. **Source:** ISAAA (2006). Legend: Light grey: no GMO; dark grey: GMO without constraints, light/dark grey: GMOs are experimentally accepted with legal constraints.



industrial countries and 24 per cent in developing countries (US$ 1.6 billion). This includes the sale of seed plus technological fees. For 2008 the market for GM crops was projected at US$ 7.5 billion. Between 1997 and 2007 the value is estimated at US$ 42.4 billion.

European Union (EU) countries adopted special regulations for GM crops and require a strict labelling. Some countries have declared unilateral moratoriums on GM-food products, such as France in 2008. Other crops followed including sugar beets, oilseed rape with a herbicide tolerance, and potatoes with modified starch (Altieri 1996, 2001). Several European countries are not commercially growing GM crops, but they have accepted slow ripening tomatoes, soya resistant to herbicides (glyphosate), insect-resistant maize, and herbicide-resistant rape seeds for oil. In response, the USA launched a trial at the *World Trade Organization* (WTO), accusing the EU of creating trade obstacles.

62.2.3 Biotechnology and Food Security: Threat to Biodiversity?

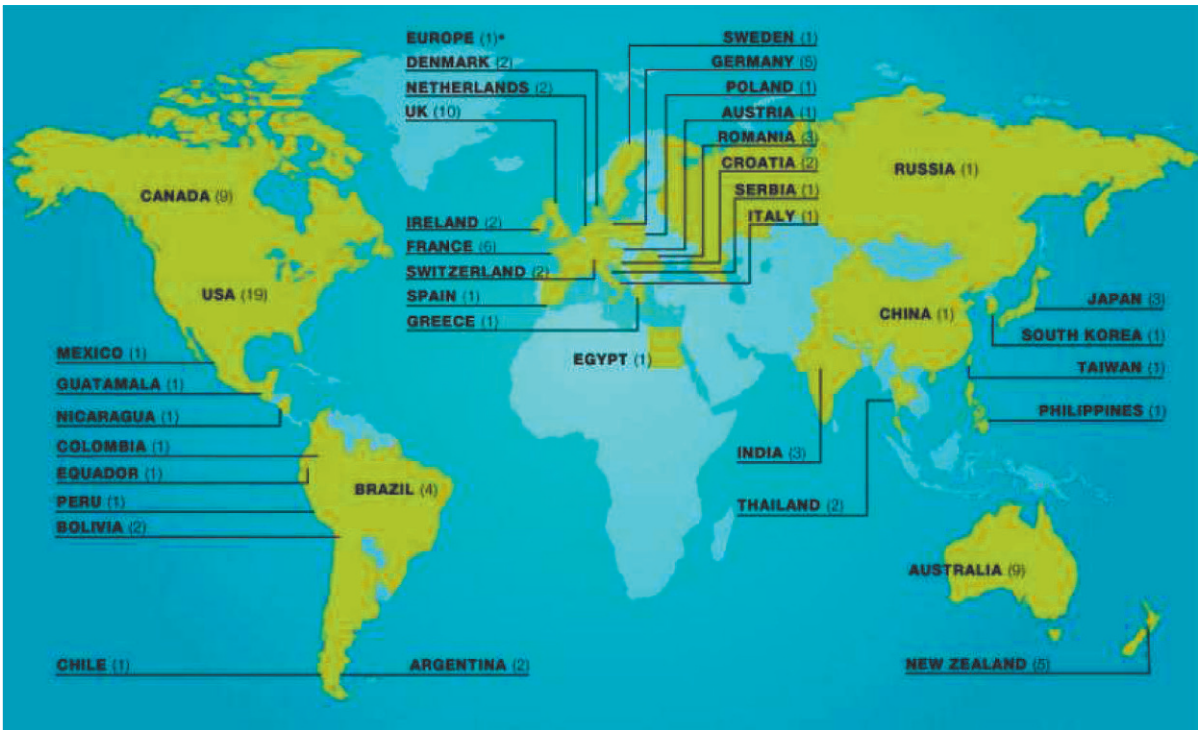
Biotechnology is a much wider field than GMOs, encompassing genomics, bioinformatics, marker-assisted selection, micro-propagation, tissue culture, cloning, artificial insemination, embryo transfer, and other related technologies. However, GM crops are the most public pressing concerns and for some governments it has become a policy issue. There are also opportunities, risks, and threats related to the process which will be analysed below. During the rapid expansion of GMOs, some accidents occurred (figure 62.3) with non-authorized genes that provoked major critiques. Several countries noted a loss of biodiversity[3] both nationally and globally. Among the 217 countries (2007) only 13 are mega diverse[4], and they combine 70 per cent of the biodiversity on earth.

Gene Watch UK and Greenpeace (2006) documented cases of pollution, illegal crops, and collateral negative effects on the environment. In June 2005, GM maize with Bt10 (StarLink), an unauthorized product, was found in Japan. Syngenta acknowledged that it exported these seeds between 2001 and 2004 to the USA without permission under the *Codex alimentarius*. This GM seed produces resistance against

3 Biodiversity includes the variety of all forms of life, from gene to any species, living within the ecosystems of this planet. It encompasses all agricultural species developed during human history and adapted for food. Peasants, women and indigenous people depend on this biodiversity for their survival.

4 Brazil, Mexico, Costa Rica, Colombia, Ecuador, Venezuela, Peru in Latin America; China, India and Indonesia in Asia; Kenya and South Africa in Africa are all developing countries, and only Australia is an industrialized nation.

Figure 62.4: GM Pollution, accidents, and collateral effects of GM in the world. **Sources:** GeneWatch, UK; Greenpeace International (2006: 35).



the antibiotic ampiciline (Nature 2005). Genetically modified soya tolerant to Roundup (a potent herbicide from the same multinational enterprise) generated resistance in the *Conyza canadensis*, due to a genetic transfer which produced a thirteen fold increase of this weed. New plagues may require farmers to use more potent herbicides (Owen/Zelaya 2005).

In Canada, similar processes occurred with GM strains in canola from different laboratories, what required the use of nine different herbicides due to plant resistance (Schmeiser 2002). Therefore, each crop has a different pollination radius and gene flow from out-crossing, what poses for natural relatives dissimilar threats that must be taken into account when field trials are undertaken (table 62.3).

The USA is not only the first producer of GM crops, but has also experienced the highest number of accidents. This means that the legal enforcement has been weak and during the Bush Administration the interests of TNEs prevailed, e.g. within the Environment Protection Agency (EPA). Thus, the controlling body pursued a policy that represented the interests of GM monopolies. No global control system exists that can prevent accidents and punish violators. With a faster growth in GM crops, new abusive practices will rise which may threaten the environmental security of some countries and possibly of the whole world.

Table 62.3: Frequency of gene flow from out-crossing. **Source:** Eastham and Sweet (2002: 9).

Crop	Crop to crop	To wild relatives
Oilseed rape	High	High
Sugar beet	Medium to high	Medium to high
Maize	Medium to high	No wild relatives are known
Potatoes	Low	Low
Wheat	Low	Low
Barley	Low	Low
Fruits: strawberries, apples, grapes, plums	Medium to high	Medium to high
Raspberries, blackberries, blackcurrants	Medium to high	Medium to high

The benefits and risks of GMO in biodiverse countries refer to the ecological stability of GMOs. Their collateral impacts could be harmful or fatal to ecosystems. A report on mustard seed that was engineered for herbicide resistance concluded "that

twenty times as many resistant progeny received their resistance from the transgenic plants as from the mutant plants. It is unclear why these transgenic plants had such an abnormally high incidence of out-crossing, but the results demonstrate that genetic engineering can substantially increase the incidence of out-crossing in a selfish species," probably by an unintentional disruption in the recipient organism of the sequence controlling pollination and fertility (Bergelson 1998).

Cross-pollination raised concerns that pollen of modified plants can be dispersed over large areas by wind, animals, and insects (table 62.3). Recent research with creeping bent grass supported this concern when modified genes were found in normal grass up to 21 km away from the experimental site. This hybridization of GMO with free living relatives is reported and the extension of changes depends on the plants.

> Danish field trials have shown that oilseed rape modified for herbicide tolerance can easily cross wild Brassica species such as wild mustard. Consequently, cross-pollination between GM and non-GM oilseed rape has been detected at distances up to 2 km (IUCN 2004: 30).

Potatoes do not exceed 10 m and US EPA recommended for Bt maize a distance of 200 m with non-GM crops. Herbicide glyphosate is creating less resistance than Bt insecticides. In Australia herbicide resistance was documented in 1995 to ryegrass, quackgrass, birdsfoot trefoil, and *Cirsium arvense* (Gil 1995). The resistance to glufosite passed from *Brassica natpus* to populations of weedy *Brassica napa* and persists under natural conditions (Snow/Moran 1997). In Europe, the herbicide tolerant gene transfer from *Brassica* oilseed to *Brassica nigra* and *Sinapis arvensis* is being researched (Goldberg 1992).

Bt proteins are becoming highly bioactive substances used everywhere in agro-ecosystems. Most herbivore ingests plant tissue containing Bt-genes, which they can pass on to their natural enemies in more or less transformed forms. Theses genes can affect unintended victims such as monarch butterfly or lacewing (*Chrysoperla* carnea), adversely affected by gene Cry1Ab. In laboratory conditions the mortality of monarch butterflies was documented, but in the field differences with traditional field management could not be found. These facts received a high-profile press announcement that Bt-genes poisoned butterflies and moths, but the critique did not distinguish between a Bt-gene expressively inserted in maize to avoid the damage from caterpillars and unintended effects of wild species.

The benefits are sometimes a reduction of agrochemicals and an increase in agricultural production with a maximization of yield productivity or lower losses of harvests and during storage. This can support food security, whenever the problem of hunger is not the lack of food, but the lack of money to buy it. A third positive effect is related to wider development processes, to research and job opportunities, whenever, in field research the contrary is documented, due to a lack of integrated rural development policies, where agribusiness with monoculture and high technology is expelling manpower from rural areas. Most scientists agree that the reduction of pesticide is a positive answer, especially the use of organophosphate and pyrethoid insecticides. Recently, the carbon-storage in GM wood was discussed that can reduce the greenhouse gases and mitigate climate change. Edible vaccines permit not only to vaccine massively people without needles, due to the fact that transgenic bananas and tomatoes could produce a vaccine against cholera, saving millions of persons from diarrhoea. As an additional positive effect, cold storage of vaccines is avoided and a vector of transmission of HIV/AIDS through needles is eliminated.

Achieving a balance between positive and negative effects on biosafety issues (box 62.1) justifies a continuous need for monitoring and research that must be independent from commercial or industrial development, and from governmental interests. In Europe there is much concern on the option and technologies that permit coexistence between GM and traditional farming. This includes research on biological containment strategies that prevent cross-pollination and enable coexistence without threats of pollution.

62.2.4 Transnational Transgenic Enterprises: Threats to the Economy and to Food Sovereignty

The key argument for transgenic food is the eradication of famine in the world and the nutritional improvement for people by creating food safety[5] according to the life sciences (Oswald Spring 2009).

5 "*Food security* exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern." (FAO/SDWW 2001; Oswald Spring 2009a)

Box 62.1: Most common biological threats posed by GM crops. **Source:** IUCN Programme (2000:17-19).

1. Genetic contamination by interbreeding of GMO with wild relatives and other sexually compatible species in the area. Reduction of the fitness of non-target organisms through acquisition of transgenic traits by hybridization.
2. Competition with natural species, when one trait increases productivity faster and therefore an organism can become invasive. When interbreeding with wild species, it may force them and generate a possible extinction.
3. Rapid evolution of resistance of insect pests (Lepidoptera to Bt).
4. Risk of super-pests or super-insects can grow in monoculture with GM-crops, while they homogenize biodiversity and debilitate immune systems of plants and may turn them more vulnerable to disease and pest attacks.
5. Increased selection pressure on target and non-target organisms, when a pest-resistant GM-crop could induce agricultural pests to evolve distinct population that are resistant to certain toxins.
6. Disruption of biocontrol mechanisms and natural control of insects and other pests through intertrophic-level effects of Bt-toxins on predators.
7. Unexpected effects on non-target herbivorous insects (i.e. Monarch butterflies) through transgenic pollen of surrounding wild vegetation.
8. Transgenic crops can produce environmental toxins that move through the food chain into water and soil and may affect invertebrates and nutrient cycling.
9. Ecosystem impacts, while combined processes can go beyond one single species, affecting the trophic chain or inducing the collapse of a particular ecosystem.
10. Vector-mediated horizontal gene transfer and recombination can create new pathogenic organisms.
11. Broad-spectrum herbicides and insecticides will expand, increasing resistance problems.
12. Impossibility of follow-up: once GMO is released to the field there is no ability to call them back or to eliminate them. This process is not only related to GMO, but is widely documented by the introduction of alien species that destroyed or displaced the native ones.

Peasant movements, above all Via Campesina, have criticized this productivity approach and struggled for *food sovereignty* as a cultural holistic process, where food production and consumption are linked to social justice, land reform, livelihood and cultural diversity. Hunger is not only related to lack of food, but also to scarce money and income. For the poor it is a problem of access due to lacking financial resources.

Regarding the economic impacts of GMOs three main concerns must be observed. The *first* is related to the high costs of GM seeds as a result of the monopoly position of a limited number of TNEs. The *second* approach requiring risk-benefit analyses has been often lacking and in most cases the evaluation of costs of non-acting or opportunity costs (or the loss of valuable opportunities) are underestimated or not taken into account. *Third*, in most countries in the south the natural resources (water, soil, air) are considered as free, belonging to the communities who care about their conservation. The modernization process rarely takes into account social costs of displaced communities, abolished cultures, and destroyed potential environmental services. For an integral economic approach direct information on land productivity, livelihood of peasants, and regional food production is required, together with studies on oligopolies of seed controls and GM technologies, the costs of scientific development and surveys of transgenics already used in the field. All these factors should be listed and later the impact of GM seeds and the agriculture without gene modification should be compared.

Comparative studies show the complexity to quantify agricultural activities, as multiple factors intervene (seeds, land, water, fertilization, pesticides, energy, biodiversity, environmental services, labour, technology, machines, and repercussion in health, environment, and disasters) and new risks must be included. The *European Union* (EU) evaluated the impacts of GM soya, cotton, maize and canola, and their resistance to insects and herbicides (Gómez-Barbero/Rodríguez-Cerezo 2006: 34–38). Most studies in different parts of the world found that GM crops require less agro-chemical products. Besides some direct positive effects in income, farmers have more free time due to simplified production processes. In some cases, GM are taken as a kind of insurance against the effects of climate change and droughts. On the field size the studies did not find differences between large and small farmers (FAO 2005).

For crops, the best results were obtained in China, Kenya, Argentina, and Mexico for Bt-cotton. But in India the seeds that were developed for northern conditions did not always produce the same results. By loosing their output and accumulating large debts for purchasing GM seeds, in many cases Indian and Korean farmers committed suicide.[6] Poor countries lack research centres to produce their proper seeds and depend on technology import from industrialized countries which often requires fees for patents and

royalties. FAO/WHO (2003) noted that countries with well developed agricultural research establishments and explicit procedures for biosecurity and clear property rights can assimilate GM technologies much faster.

A field study with 638 cotton farmers in La Laguna in Mexico (Traxler/Godoy-Ávila/Falck-Zepeda/Espinoza-Arellano 2003) found that the yield increase/ha was 11 per cent, and the use of chemicals dropped by 77 per cent, but the costs for seeds increased by 165 per cent and net benefits were only 12 per cent, of which the farmers obtained 86 per cent and the TNEs 14 per cent. In the USA in 2003, Bt-cotton increased the income of farmers by US$ 105 million, the TNEs gained US$ 80 million in profits and consumers saved US$ 45 million. In China, due to the role of the public sector in seed production, small producers avoided high prices for seeds. Globally, of the profits for Bt-cotton, about 75 per cent went to producers and 25 per cent to multinational seed suppliers (FAO 2005).

Beber and Potrykus (2001: 10) compared 'golden rice' with GM-Vitamin A and iron genes with a traditional Vitamin A drug supplement. They found in 100 million people treated with drugs (including costs of administration and distribution) the costs per year were US$ 50 million, or US$ 500 million in ten years. The costs for iron supplements as drugs were the same. If GM seeds are developed through a government programme with bio-fortification including Vitamin A and iron, the costs would be US$ 25 million/decade for both. These are economic savings for the Indian health system. But people eat rice with other traditional food products (NAVDANYA 2001: Annex 1).

Monsanto justified the high prices of GM seeds with research and development costs of US$ 200 and 400 million in a decade. This explains why the price for GM-seeds is ten times higher than for traditional seeds. Farmers may not stock seeds for the next year. When they use GM seeds they must pay for the patents. Many enterprises have established their own monitoring system to penalize anybody who illegally uses their seeds. Even for natural GM pollution by wind, water or insects, farmers must pay the TNEs for their *intellectual property rights* (IPR).[7] To better protect its patents, Monsanto used the 'terminator' technology that destroys the germplasm of seeds, thus stopping reproduction. Due to the pressure of governments and scientists, who documented that this required tetracycline (a wide spectrum antibiotic), Monsanto stopped this technology.

The high price for GM seeds is also due to the oligopolic structure of few seed producers, most of them are huge TNEs. In 1998, Monsanto bought Delta/Pine Land and since then Monsanto controls 57 per cent of the US market for cotton seeds, and can thus impose the price. This leaves farmers few alternatives for cheap seeds (table 62.4). Furthermore, Monsanto is eliminating a toxin within the cotton seed for feeding animals and humans (Monsanto 2006).

Table 62.4: GM seed market of cotton in the USA in 2005. **Source:** USDA (2005).

Company	per cent of the seed market
Delta & Pine Land (bought by Monsanto)	43.37
Stoneville (Monsanto)	13.93
Bayer CropScience	25.32
Phytogen (Dow AgroSciences)	2.64
Others	14.74

The world market for GM seeds reflects this monopoly. Four agro-chemical and pharmaceutical TNEs control this market, two US companies *Monsanto* (including Pharmacia and Upjohn) and *Du Pont/Pioneer*, *Syngenta* in Switzerland (a merger of the Swiss Novartis, former Ciba Geigy and Sandoz with the British-Swedish Astra-Zeneca) and *Sanofi-Aventis* (merger of Hoechst in Germany with Rhône-Poulenc in France). Globally, these four TNEs sell half of traditional seeds and almost all transgenics. These four oligopolies control 75 per cent of the world seed market of vegetables. This vertical integration allows market controls and forces farmers to work only with this technology. Thus, they lose control of their produc-

6 The Ministry of Agriculture in India noted that between 1993 and 2003 about 100,000 peasants committed suicide, and between 2003 and October 2006 about 16,000 suicides by farmers occurred each year, in total almost 150,000 suicides for the period from 1993 to 2006, with an average of 30 dead/day in 14 years. These fatalities reflect a missing adaptation of technology to southern conditions and they refer to economic pressures on poor peasants (Shiva 2009, 2009a).

7 In Canada, Percy Schmeiser's (2002) canola seeds were polluted with Bt-genes from Monsanto. He was sued by Monsanto and lost his case in the Supreme Court. He was condemned to pay for the patent of the Bt-seeds and thus lost his livelihood as a natural producer of canola seeds.

Table 62.5: Summary of the status and trends in major bioprospecting industries. **Source:** Millennium Ecosystem Assessment (2005: 109).

Industry	Current Involvement in Bioprospecting	Expected Trend in Bioprospecting	Social Benefits	Commercial Benefits	Biodiversity Resources
Pharmaceutical	tends to be cyclical	cyclical, possible increase	human health, employment	+++	P,A,M
Botanical	high	increase	human health, employment	+++	mostly P,A,M
Cosmetics and natural personal care	high	increase	human health and well-being	+++	P,A,M
Bioremediation	variable	increase	environmental health	++	mostly M
Crop protection and biological control	high	increase	food supply, environmental health	+++	P,A,M
Biomimetics	variable	variable, increasing?	various	++	P,A,M
Biomonitoring	variable	increase	environmental health	+	P,A,M
Horticulture and seed industry	low	steady	human well-being, food supply	+++	P
Ecological restoration	medium	increase	environmental health	++	P,A,M

Legend: +++ = billion dollar, ++ = million dollar, + profitable but amounts vary
P= plants, A = animals, M= microorganisms

tion process. Often their land gets polluted or they lose it due to high debts from the purchase of seeds.

These oligopolies also control the trade with agricultural products. Enterprises, such as Cargill, Monsanto and also Maseca (a Mexican), rejected in 2007 to buy maize and wheat produced with seeds developed in Mexico by the *National Institute of Agricultural Research* (INIFAP). They qualified these grains as unusable for flour and pasta. In some cases these oligopolies have become monopsonies that control both the sale of seeds and the purchase of cereals. Freedom of consumers for traditional seeds is further limited due to higher prices for natural products and small markets.

Globally about 1.4 billion poor peasants, increasingly women, produce 15 to 20 per cent of food with traditional seeds that are carefully selected each year and conserved for the next cycle. This subsistence production does not reach the market and they are in environmental terms sustainable (Barraclough 1995). In social terms, they represent a kind of family insurance, guaranteeing the daily intake of basic food. Accidents with GM pollution may destroy this agricultural diversity and leave these peasants without opportunities for survival, and force them to abandon their land due to hunger. For millennia these peasants have also developed traditional medicine and practised a rational use of biodiversity with environmental services for other communities.

TNEs are interested in their knowledge and *bioprospection* emerged as a new multi billion US dollar business branch of the pharmaceutical, botanical, cosmetic, crop protection, horticulture, and seed production industry (table 62.5).[8] According to WTO rules, the IPR of TNEs are protected by patents. The original owners of this knowledge can rarely prove their IPRs. In the US and elsewhere, many natural products are transformed by TNEs, mostly without compensation to the community that has developed, maintained, and supplied this knowledge for millennia (table 62.6). When living organisms are taken from their original owners without compensation, people often refer to *biopiracy*.

8 Traditional medicine, natural colours, and multiple sub products are useful in industrial and pharma-ceutical processes. As they are transformed, it is difficult to prove that the origin of the product was a plant or a root (e.g. the barbasco for anti contraceptive pills and steroids).

Table 62.6: Compounds of natural products and semi-synthetic modifications approved in the USA. **Source:** Millennium Ecosystem Assessment (2005: 110).

Generic	Brand Name	Developer
In the United States and elsewhere		
Cladribine	Leustatin	Johnson & Johnson (Ortho Biotech)
Docetaxel	Taxotere	Rhône-Poulenc Rorer
Fludarabine	Fludara	Berlex
Idarubicin	Idamycin	Pharmacia & Upjohn
Irinotecan	Camptosar	Yakult Haisha
Paclitaxel	Taxol	Bristol-Myers Squibb
Pegaspargase	Oncospar	Rhône-Poulenc
Pentostatin	Nipent	Parke-Davis
Topotecan	Hycamtin	SmithKline Beecham
Vinorelbine	Navelbine	Lilly
Only outside the United States		
Bisantrene		Wyeth Ayerst
Cytarabine ocfosfate		Yamasa
Formestane		Ciba-Geigy
Interferon, gamma-la		Siu Valy
Miltefosine		Acta Medica
Porfimer sodium		Quadra Logic
Sorbuzoxane		Zeuyaku Kogyo
Zinostatin		Yamamouchi

62.3 Risk Analysis as a Scientific Response

62.3.1 Potential Threats to Health Security

Several studies have documented that agro-chemicals could be substantially reduced with GM seeds (FAO 2005). This could increase the income of farmers, and protect the environment and human health from undesirable toxic effects of organophosphates and organoclorates. Besides these undeniable advantages other multiple doubts exist. Only very few independent researchers who study the full food chain and its repercussions for human health have the capacities to prove that hazards for the health system may develop when GM seeds are massively produced and eaten either directly or indirectly from meat of animals that were fed with transgenics.

In the literature, one case has been widely documented that refers to the pollution of L-Tryptophane, an essential amino-acid in brain functions. The laboratory Showa Denko KK (USA) utilized not only transgenic soya beans, but changed at the same time also the system of filtration for the production of Trypotophane by using less carbon in the purification process. From 60 pollutants found in the lab, six produced the *eosinophilia-myalgia syndrome* (EMS), causing 37 fatalities, 1,500 people handicapped, and another 500 affected through consumption of this drug. After reviewing this case, the US Federal Drug Administration (FDA) concluded that the purification process was responsible for the pollution and not the GM seeds:

> The incident cannot be taken as clear evidence of the inherent risks of genetic modification or the need to prohibit the use of genetic modification outside laboratory containment. There are, however, some useful lessons. For example, the short time it took the United States authorities to withdraw the production in question illustrates the need for such authorities to maintain the ability to respond rapidly to indications of harmful effects. The length of time it took to identify accurately all the toxins responsible for the harm, however, highlights the need for ongoing research into the hazards of the technology (Royal Commission on Genetic Modification 2005: 44).

This procedure is relevant as other complex problems are related to potential health hazards. Any GMOs contain a 'genetic construction' of sequences of DNA and each could imply proper risks in relation to vectors developed between the promoters. The first arise when viruses are used as transgenic vectors (the so-

called genetic pistol). Like the virus, these genes can infect the body and the GMO could get converted into a new reservoir of unknown illnesses or a means to sustain the evolution of new pathogens when the physiology and biochemistry is altered (Oswald Spring 2000).

In the case of the sequence of a strong promoter, e.g. the virus of the cauliflower mosaic (CaMV35S) could activate genes that were before inactive, thus creating potential new illnesses. There are fears that GM genes are resistant to antibiotics (e.g. Monsanto's 'terminator technology'). There are other concerns on the horizontal transfer between genes from one species to another, when the vegetable material rests in the soil and starts a process of decomposition. During this process the GM DNA is drained into the soil, where it can get stabilized through the absorption of polymers such as acid and humid particles in the soil that may pollute other crops and micro-organisms.

Another health problem is related to maize that was modified by StarLink (Cry9C) that has been produced by Aventis since the year 2000. It was banned by the *US Department of Agriculture* (USDA) and only permitted in animal food, when it was linked to allergies. Aventis had to stop its sale, USDA issued a formal recall and the US government purchased its seeds. The polluted maize was found in eight countries (Canada, Bolivia, Egypt, Japan, Nicaragua, South Korea, USA, and China). In 2003 genetic strains could still be spotted in the fields. Greenpeace (2005) found it in rice in China. Similar problems occurred in Brazil with a nuts gene protein in soya beans that could create allergies, and with a 'marker' gene that could render cells resistant to antibiotics.

Negative or hazardous research results are often not published by TNEs and scientists had to sign confidential letters forbidding them future publications on such cases. Monsanto did not publish any information on MON863, a GM maize with Bt-toxin (Cry3Bb1). In April 2004, *Le Monde* referred to doubts by French scientists on the security of this GMO. A comparative study on rats had shown that after 90 days MON863 had produced significant alterations in the white blood cells that are further indicators for kidney affection and inflammatory processes. These independent data proved that the health of rats was affected. This GMO interfered also in the metabolism of humans and animals, once this transgenic was liberated. Therefore, the permission was denied (Greenpeace 2004). But the lack of transparency on the publication of results refers to a lack of ethical considerations of TNEs and in some countries to severe deficits of rigorous independent evaluations. TNEs can not simultaneously be judges and producers of new GMOs before they can be widely marketed. Independent bodies must evaluate the risks of a new product and continue to monitor it.

Worries also relate to remaining parts of transgenics in the human body. During cooking and digestion with enzymes and micro-organisms most of the DNA is broken up into so small parts that are no more functional. With more sophisticated analytic methods traces of Bt maize were found in the lymphocytes of cows and in muscles, liver, spleen and kidney of chickens. Furthermore, pregnant rats have transmitted fragments of DNA through the placenta to their foetus (ESF 2001). Only when the GM DNA reaches the large intestine is it fully degraded. The survival of the DNA of GM soya in the small bowel in rats was supported with data found also in sheep and humans. The gene transfer in the small intestine must be considered for future safety assessment of GM food (Scientific American, April 2001: 6). Heritage (2004: 170–171) emphasized

> on the balance, the data presented ... support the conclusion that gene flow from transgenic plants to the gut micro flora does occur. Furthermore, because transfer events seem to have occurred in three of seven subjects examined, it may be that transgenic gene transfers are not as rare as suggested by the UK GM Science Review Panel.

Michael Antoniou (2002) concluded:

> to my knowledge [data] have demonstrated clearly that you can get GM plant material in the gut bacteria...it suggests that you can get antibiotic resistance marker genes spreading around the stomach which would compromise antibiotic resistance.

Watson and Crick discovered the structure of DNA as the blueprint of life, where the characteristics can be predicted and replicate themselves in a stable way. Recent research on the human genome questioned this. By looking at proteins such as RNA, but concerned with illnesses such as BSE, scrapie and other degenerative brain diseases, the biochemical analysis could not find any nucleic acids, nor DNA or RNA. Based on these new findings their theories on DNA as the basis of all life were challenged. This is probably the most complex issue related to GMOs as bacteria and viruses are often used to introduce a particular characteristic into a seed. "The horizontal gene transfer is a relatively new concept that has been described as the capacity of genetic information to be passed between species in ways that are unrelated to the usual parent-offspring inheritance of gene" (IUCN 2004a: 17).

This horizontal gene transfer occurs frequently among viruses (Jain/Rivera/Lake 1999).

There is also new evidence that not all genes rely on mutations, but can copy themselves. The salivary amylase, an enzyme encoded by the *AMY1* gene, helps humans to digest starchy food. In a comparative study between high-starch eaters and low ones researchers from the University of California and from Arizona State University found "that rather than having mutations that boosted *AMY1*'s activity, the high-starch eaters had extra copies of the gene. On average, the high-starch eaters had seven copies of the gene, whereas the low-starch populations had only five" (Cohen 2007: 1483). This could mean if a gene is working well it can copy itself several times, what poses a new threat for transgenics. Therefore in most countries precautionary means were developed. Their results suggest that other factors exist beside the DNA transmission and they act as constituent processes of life, but there is no solid knowledge yet to fully explain them.

These comments refer to risks and as the DNA is part of all plants and animals, it belongs to all parts of the human diet. Thus, GMOs should be monitored more carefully on their effects on human beings. Epidemiological studies in the USA have shown that clinically food allergies in small children have increased after 1995, when GM seeds were introduced. The TNEs that produce baby food have stated that all their products are free of GM genes. Paediatricians have recommended avoiding transgenics in the diet of babies (above all GM soya) to reduce the risk of food allergy in small children. But most food products contain ingredients of soya and soya is mostly transgenic. There exist also doubts about the impact on the food chain of GM-food (Oswald Spring 2006a).

The analysis has revealed that transgenic food offers benefits by reducing agro-chemicals and thus of pollution of soils, water, food, and the air. But doubts on animal feed with GM food have not been overcome, when they later enter the human food chain. The clinical increase of allergies among children in the USA calls for utmost precaution.[9] Moreover, accidents and global GM pollution indicates that any technology could represent failures, and errors that could be fatal for the health of millions of people and for the biodiversity of the whole planet. If risks exist, only careful surveys and the precautionary measures can reduce these threats (Puttagunta 2000).

62.3.2 Risks of GMO Maize for Mexico

For gene flow maize there is a medium to high risk crop due to open pollination. Empirical evidence has shown that a recommended isolation distance of 200 metres would avoid hybridization, but no known wild relatives of maize exist in Europe (ESF 2001) or in South Africa (Haasbroek 2004).

Maize originates from Mesoamerica, and developed over 9,000 years when wild varieties of *Tripsacum* were crossed with teocinte (*Zea mexicana*). For thousands of years the indigenous people in Mexico have selected plants and have developed maize from a small corncob of one centimetre to up to 20–40 cm (*Zea mays*). Maize is reproduced by cross-pollination and pollen is able to mix with different genetic varieties of maize. In Mexico maize has been produced dynamically and therefore it is continuously changing as a result of human and natural selection. Thus, across the country different regional strains of maize exist, as the basic food crop for Mexicans, maize was adapted from the tropical rain forest up to the height of 3,000 metres on the hills of the Popocatepetl. Mexico has a total of 44 principle races and 300 varieties that can combat weeds (Greenpeace 2003; Wisniewski/Fragne/Massonneau/Dumas 2002). This biodiversity is unique in the world.

According to the *Convention on Biological Diversity* (CBD), biodiversity has "ecological, genetic, social, economic, scientific, educational, cultural, recreational, and aesthetic values" that are needed for human life. This cultural diversity has led to more than 600 different food varieties, and for '*nixtamal*' (cooked maize with chalk) at least 112 recipes exist. This culinary, cultural, and environmental diversity gives maize an important status not only in Mexico but also as a patrimony of humankind.

9 The USFDA established four levels of precaution: BL1-P with basic limits such as controlled access to greenhouses and mechanisms avoiding the propagation of GM by insects, cross-pollination and rodents. BL2-P for agents with potential moderate threats demand additionally cement soil. Mosquito nets to avoid the entrance of small insects and sterilization processes for transgenic material before confining. BL3-P for agents with serious threats, where liquids and solids must be sterilized, windows fully sealed and ventilation equipped with filters. The entrance must be controlled and protection clothes are obligatory for workers inside the facilities. BL4-P is required for extreme dangerous organisms related to exotic pathogen organisms, where all mentioned security issues are reinforced (IUCN 2000, 2004a).

Native species of teocinte exist all over Mexico in maize fields. They are associated with cultural, symbolic, and spiritual values as representations of Mother Earth. They grow together with maize. Thus, many peasants are threatened by the introduction of GM maize and they are concerned about their cultural, personal and community safety, but also about their biodiversity, traditions, and beliefs. Regarding this cultural context,

> Mexican government officials reported contamination of local varieties of maize with transgenic sequences in communities in the states of Oaxaca and Puebla. In January 2002 the Mexican government further reported that in 11 of the communities' contamination levels were between three and 13 percent; in four localities levels of contamination found were much higher – between 20–60 per cent. In Diconsa (Mexican government food distribution agency stores), 37 per cent of the grains were found to be transgenic (CEC 2004).

The RR maize (tolerant to some herbicides) and Bt maize (resistant to insects) represent risks introducing new elements to the environment that threaten the existing biodiversity. As the country of origin and adaptation of maize, Mexico has a special mandate to conserve its biodiversity.

Mexico is a member of the *North American Free Trade Agreement* (NAFTA), of the *North American Agreement for Environmental Cooperation* (NAAEC), of the Convention on Biological Diversity (CBD) and its Cartagena Protocol on Biosafety, of the WTO (including its Trade-Related Aspects of Intellectual Property Rights: TRIPS), and of the Ad Hoc Intergovernmental Task Force on Foods derived from Biotechnology of the Codex Alimentarius. Based on these legal obligations Mexico must establish *Sanitary and Phyto-sanitary* (SPS) Agreements, taking also *Technical Barriers to Trade* (TBT) in the framework of WTO into account. The CBD applies to the transboundary movement, transit, handling, and use of all *living modified organisms* (LMO; Art. 4). The Protocol regulates the transboundary movement of LMOs,

> consistent with their international obligations, socioeconomic considerations arising from the impact of living modified organisms on the conservation and sustainable use of biological diversity, especially with regard to the value of biological diversity to indigenous and local communities (CBD, Art. 26).

The high level of poverty and the dependence on subsistence agriculture for most maize producing peasants that represent a significant number of indigenous populations are the results of a rural crisis that evolved during the past four decades. This crisis has severely affected the most marginal in the remote rural areas in the south-east of Mexico. Even if the gene flow between land races of maize and modern GM varieties is infertile or produces fertile progeny, the gene flow also occurs between maize and teosinte, where nobody knows how long these genes persist after the hybridization. The gene flow in Mexico is a dynamic process with in situ management of genetic resources of maize and peasants' trade or interchange of seeds from different sources occurs permanently and therefore with risks of GM pollution.

The NAAEC recommended more field research on positive and negative effects from particular varieties of GM strains, taking socio-cultural matters of poor peasants and of indigenous people into account. Besides better education and training, small farmers should be involved and GMOs should be labelled with specific indications of the strains, and of the transgenic maize entering into Mexico. There is a logistic problem how to mill 6 million tons of maize on the border to avoid a potential contamination of natural seeds. But there is also a phyto-sanitarian issue related to milled maize, because it can get quickly affected by aflatoxines (*Aspergillus flavus*), a dangerous fungus for both humans and animals.

From January 1994 to 2008, Mexico was importing yellow and white maize from the USA with a tax reduction of 206.4 per cent (table 62.7).[10] Over 40 per cent of maize sold in Mexico is transgenic and without labelling, and peasants often reproduce it in their fields. Production costs and yields differ: In Mexico the average is US$ 79.68/ton with a yield of 2.4 tons/ha, while in the USA it is only US$ 19.89 and 8.4 tons/ha. This is a result of differences in the mechanization process, geological and social conditions, and in the extension of fields. Until 2008 the production of white maize was protected by negotiated import taxes, but since then any maize may be imported without customs clearance (Mexico, Chamber of Deputies 2008)..

In this complex situation, TNEs have exercised pressure on the *Intersecretarial Commission of Biosecurity and GMO* (CIBIOGEM), the national regulatory board, to allow the production of transgenic maize in open fields (Gobierno Mexicano 2003). But there is no knowledge about the effects of GM maize in open fields and the flux of pollen is not sufficiently

10 Beside this reduction, Mexico has not applied the obligatory taxes for the surplus of maize importation, to protect the livestock grower.

Table 62.7: Minimal obligations to import, customs on imported maize and imports. **Source:** Banco de Comercio Exterior (Foreign Trade) for the years 2000 to 2008.

Year	Minimal imports	Customs on maize (per cent)	Yellow maize	White maize	Broken maize	Total maize
2000	2,986,325	145.2	–	–	260,108	5,558,791
2001	3,075,915	127.1	5,648,904	489,173	862,878	7,000,955
2002	3,168,192	108.9	4,023,798	645,176	2,029,902	6,698,876
2003	3,263,238	90.8	5,401,119	323,666	2,684,989	8,409,774
2004	3,361,135	72.6	5,095,596	346,101	2,300,380	7,742,077
2005	3,461,969	54.5	5,110,590	66,225	2,705,080	7,881,895
2006	3,565,828	36.6	7,278,315	253,533	3,203,173	10,735,051
2007	3,672,803	18.2	9,500,000			
2008	3,782,987	00.0	913,069.8 (only January)			

known. No real experiments were undertaken under field conditions that include studies on the genetic flux, its impact on natural maize, its footprints on near relatives, on biodiversity, the throphic chain, and on future generations of maize. In such a study, environmental and socio-cultural restrictions should be taken into account, along with the impacts of potential extreme hydro-meteorological events (hurricanes, drought, and landslides). Indigenous people, peasants, and women have only a low level of education and they lack a culture of prevention. Given these difficulties, Mexico should not permit the cultivation of transgenic maize in open fields to conserve for future generations its biodiversity as a key potential for development.

Box 62.2: Complex situation of maize production in Mexico related to globalization and Free Trade Agreements. **Sources:** Data compiled by the author.

The inventory of maize in the world and in Mexico has diminished for various reasons (table 62.8). Due to population growth the demand for cereals will grow globally. Also the change of the diet in China and India with more animal proteins further increases the demand for cereals. Then there is the use of maize for biofuels (Bourne 2007). And finally, there has been a yield decline due to overexploitation of soils, desertification, salinization processes and disasters (droughts, floods). In Mexico this resulted in very low reserves of maize that can neither guarantee food security for the people nor for animal feed. This decline is a direct consequence of a lacking rural policy and of false investments priorities that have affected the maize-producing small peasants who increasingly face the impacts of climate change in rain-fed fields. Therefore, a different governmental policy must be adopted that offers the people both safe and high quality maize.

Maize production in Mexico has developed a highly complex and structured system of production and industry. Due to NAFTA and speculative interests, Mexico imported an increasing amount of cereals, substantially above the amount agreed with the US and Canada (table 62.8). While the white maize for human consumption is still mostly produced in Mexico, the yellow and broken maize for tortilla industry and livestock is imported from the USA, most of them is transgenic, but without labelling.

Table 62.8: World inventory of maize stock (million tons) **Source:** USDA (2007).

Countries	2004/2005	2005/2006	2006/2007
USA	53.7	50.0	19.1
China	36.6	35.2	33.4
Mexico	4.5	2.7	2.7
Others	36.0	37.1	31.2
Total	**130.8**	**125.0**	**86.4**

The lacking food security policy had repercussions on the price. From October 2006 to January 2007 the price of white maize increased from US$ 135/ton to more than US$ 273/ton, as a result of the rise in international prices and the speculation by big monopolies (Cargill, Maseca) and local intermediaries. The higher price was also a result of an increased demand of maize for biofuels due

to new subsidies by the US government. Thus, the price of the tortilla – the basic food staple for Mexicans – suddenly doubled in some weeks from 6.5 up to 15 pesos/kg (table 62.9). Massive protests within Mexico forced President Calderón to reach an agreement with the tortilla industry. As a result the official price was fixed at 8.5 pesos for six months, but the tortilla was mostly sold around 10 pesos. This crisis implied a serious warning to adopt a rural policy that supports the national production of maize, but also avoids dangerous experiments with transgenic maize. In the future, even without speculation, the price of maize will further rise due to declining international reserves and the greater demand of maize for humans, animals and biofuels, but also due to growing losses caused by GEC. Therefore, food security for peasants and poor people should be the goal of the Mexican government. Data of the last Household Review indicate (INEGI 2008) that around 2 million Mexicans became food poor in 2008, due to this price rise, and thus countered a decade of poverty alleviation.

Table 62.9: International maize prices in Mexico (in 1.000 Pesos per ton; 12.9 Pesos = 1 US$; 18.4 Pesos = €, in August 2009). **Source**: INEGI (January 2007).

City	White Maize (humans)	Yellow Maize (animals)
Mexico City	3,125	2,400
Guadalajara	3,154	2,437
National Average	2,575	2,147

62.4 An Ethical Approach Responding to Growing Food Demand

The studies reviewed above have shown both the potential, but also new risks and threats posed by GMOs, and they referred to much ignorance on the processes related to transgenic food. Undoubtedly there is a need for more sustainable food production. With the present production model the soil and water – also understood as 'virtual water' (Allan 2009) – are getting depleted and polluted. The complexity of these socio-economic, health, environmental, and cultural factors posed by transgenic food is aggravating risks for society and the environment.

Beck (2007) refers to a world risk society related to the modern technologies (genomic, transgenics, nanotechnology), where the society as a whole is exposed to irreversible threats. Habermas (1984a, 2002) defines ethical limits of these scientific developments when future generations will lack an opportunity to ratify this process or to revert it, or when GM-genes are breeding with wild relatives. Thus, risk was defined in different ways: as a function of hazards multiplied by the frequency and impact, and aggravated by social vulnerability (CENAPRED 2004; Birkman 2006), or as "the probability of harmful consequences, or expected loss of lives, people injured, property, livelihoods, economic activity disrupted (or environment damaged) resulting from interaction between natural or human induced hazards and vulnerable conditions" (IARF/DR 2006). For GMOs risk means harmful consequences for humans, their activities, and the ecosystems.

Thus, transgenic seeds in a megabiodiverse country such as Mexico with high levels of cross-pollination in maize, and peasants with low level of education and elevated marginalization could introduce irreversible processes both for specific communities and for the country as a whole. This would result in the definitive loss of biodiverse wild crops for humankind. Therefore a generational and intergenerational responsibility is needed that takes up the principle of sustainability (Brundtland Commission 1987) and risk reduction through prevention. Challenging the life of future generations may be considered as unethical (General Council of the United Church in Canada 2003).

As Beck insists, risks are unequally distributed in the world and affect more the highly vulnerable societies. GMOs and transgenic food seeds were developed in the north by a small number of TNEs. But they will primarily affect the south, due to marginalization and poverty, high biodiversity, population growth and severe effects of GEC, creating new potentials for complex disasters. Experts at the University of Michigan (2006) studied in Sub Saharan Africa the risks and benefits of transgenic crop seeds and their interrelation with the USA. Their conclusions are also valid for Europe, Asia, and Latin America. The pollution with GM crops may reduce biodiversity. The homogenization of the productive process with a small number of GM seeds could erode genetic reserves, create monocultures of food, and vulnerability to plagues in basic crops. The 1846 Irish famine resulted from a disease in the monoculture of potatoes. But there are also unknown health threats for human beings and nature. Confronted with these risks, the European Union declared a partial and some countries a total moratorium on GM seeds, while research continues.

Is it ethically permissible to create global risks due to an oligopolistic control of the highly profitable GM

seed market? Can this cornucopian model (Gleditsch 2003) control risks within the limited understanding of science, technology, and progress? Many accidents have occurred worldwide and proven the inherent risks. Therefore, a bioethical approach is needed to analyse possible implications of both biological research and biotechnology on health, the environment, and society.

Whereas traditional biotechnology brought an increase of food production and reduced mobility and morality in humans and animals, nevertheless the recent discovery of the human genome and of gene manipulation in live organisms offers researchers and enterprises a powerful instrument to alter the natural cycle of evolution and of life. These technologies require regulations of the economic interests of companies and scientists. They must protect the common good and the human race, its civilization process and the conservation of nature (Oswald Spring 2002: 57).

62.4.1 Bioethics: Precautionary Principle and Prevention

When confronted with this cornucopian model where GMOs promote tomatoes and broccoli to combat cancer; rice, sweet potatoes, and cassava as vitamins (Golden rice: Beber/Potrykus, 2001; IFPRI 2006); soya and peanuts for controlling allergies; bananas for vaccines and oil as medicines that is recommended by physicians against cancer and cardiovascular problems, the question remains what are the costs for the most vulnerable? Since the mid 1990's, the US government supervised transgenic food and the USFDA is responsible that no known or new toxics enter into the food chain or products generate resistance to antibiotics or alter the nutritional levels of food processes. The complexity of the outcomes with multiple socio-economic, environmental, and health concerns in the long run cannot be assessed by a single governmental agency. There exist benefits, but there are also new and increasing risks posed by transgenic food crops (table 62.10; figure 62.4). The effects differ for the USA, the EU, and for the poor countries of Asia, Africa, and Latin America that are often the most biodiverse regions but also experience the highest level of undernourishment.

For poor countries GM crops imply multiple risk factors (table 62.10):

1. Political risks are high in countries with ineffective governance and legal deficits, but high levels of corruption. There are few concerns on the mega-biodiversity as a patrimony of humankind. Thus,

Table 62.10: Global and regional risks and benefits from transgenic food crops for Africa, Latin America, and Asia. **Source:** Adapted from a study by the University of Michigan (2006).

Political
• Inadequate supervision
• Corruption
• Technological dependency
• Dependence on GM seeds from foreign countries
• Limitation of food sovereignty
• Destruction of local seed markets and native crops
• Food insecurity
Economic
• Destroying markets for exportation
• High costs of GM seeds and patents
• Dependency on foreign technology
• Privatization of world genetic patrimony
• Monopoly and oligopoly of world seed market
• Submission to the international trade model
• Horizontal integration of GM business (seeds, pesticides)
Societal and socio-economic
• Affecting children with weak immune system (allergies)
• Reduction of jobs (Bt-cotton reduced number of rural workers)
• Conservation of seeds is forbidden and also reuse during the next cycle
• Monoculture of food crops with health risks
• Legal persecution due to 'natural' pollution with GMOs
• Poverty and hunger increase among the socially vulnerable
Environmental
• Damage and loss of biodiversity by cross-breeding
• Contamination of soils and water
Scientific and Cultural
• Destruction of autochthonous sciences
• Destruction of peasant economy
• Changes of traditional food culture
• Cultural dependency
• Gap in science and technology
Benefits:
• GM crops resistant to plagues
• GM crops resistant to different pesticides
• If GM seed would be cheap and yield production improved, hunger could be reduced with cheap food
• GM crops requires less jobs
• GM crops uses less pesticides and insecticides
• GM crops could mitigate negative effects of desertification

the control on GM seed companies must be globally, but nationally and locally implemented. These countries require from independent institutions and experts scientific advice to conserve their natural capital.
2. Benefits from this technology must be shared and public research should not subsidize TNEs. Academic research should support countries threatened by food scarcity, desertification, and where yields can be improved with organic agriculture or GM seeds resistant to plagues and adverse soil or water conditions.
3. Local socio-economic conditions must be improved. Inequality and inequity within vulnerable groups must be reduced. GM technologies aggravate existing gaps among social groups. Poor peasants depend on self-sufficiency crops from small plots of land. GM pollution may destroy their precarious livelihoods.
4. Environment is a global patrimony for humankind. Plants, wildlife, and ecosystems must be protected. All parts of Mother Earth require nutrients and should be protected from unnecessary risks or threats to biodiversity. Humankind depends on environmental services and no economic interests or short-term profit should destroy the complex natural equilibrium.
5. The present level of development evolved from traditional knowledge. Modern science and technology should enhance this indigenous knowledge helping to restore the destroyed ecosystems and maintain the complex ecosystems by feeding and nurturing humans and nature.

These five approaches create obligations for cooperation at the global, national, and local level between industrialized and developing countries:

1. There should be a *global agreement* for dealing responsibly with the risks of GM seeds to control these enterprises, to prevent potential hazards, and to resolve accidents. Research on GMOs must be monitored and controlled in a non-bureaucratic way to grant the most vulnerable countries a right for access to modern technologies on reasonable terms and without threats for their biodiversity.
2. At the *national level*, industrialized countries must control their GM firms and support independent scientific research, accessible to poorer countries. In countries of origin of basic food crops, GM seeds and imports of GM food should be prohibited by national law.
3. At the *local level*, campaigns must be launched on risks and preventive measures and adapted to the educational standard of poor peasants and indigenous people to improve biodiversity and biosecurity and prevent future hazards.

Practical conclusions may be summarized with these principles of bioethics:

1. GMOs should be researched by independent scientists and their effects on health, environment, and society should be assessed. Technology for the evaluation must be improved and related security issues must be better understood, especially the processes of the horizontal transfer of genes.
2. So far, the massive use of transgenic food crops has not improved food security (IUCN 2004; FAO/WHO 2008). On the contrary, it poses new risks for the health and environment by creating potential resistance, new pests and viruses, resistant crops and plants to herbicides, and possible toxins that may enter the food chain, affecting complex biodiverse ecosystems and interrupt existing trophic chains (figure 62.4; table 62.3).
3. Oligopolies controlled by few TNEs that produce GM seeds have increased local seed costs and increased food insecurity (tables 62.3, 62.8, 62.9), whenever they have reduced productive costs for commercial farmers. Their interests in short-term profits without bioethical considerations increase risks and there is no possibility to predict long-time effects for a massive and indiscriminate use of transgenic seeds.
4. Peasants without basic education do not understand the risks of GM seeds and could pollute native species. Biodiverse production and selling of organic crops are feasible alternatives for achieving food sovereignty.
5. GMOs should be planted in open fields in countries without wild relatives and only when they are closely monitored, to avoid irreversible damages and a loss of biodiversity (table 62.3).
6. Microbes and transgenic microbiologic transgenic crops may reduce pollution processes. They may represent a feasible cost-benefit alternative for bioremediation,[11] when they are not threatening

11 Bioremediation is the use of biological organisms such as plants, microbes of GMO to aid in removing hazardous substances from the soil, the air or the water.

existing biodiversity (table 62.2; figures 62.1, 62.2, 62.3).
7. Countries with limited financial and legal capacities should rely on independent researchers, and adopt national laws, and implement them with regard to dangerous experiments with transgenic crops. This includes financial compensations and from GMO producers for damages caused by accidents (table 62.10).
8. A clear labelling should be required for any GM food that allows the people to make their own choice and to decide whether they want to consume transgenics or not.
9. Only a responsible prevention may avoid new and unnecessary risks. Therefore global treaties and independent research should contribute to avoid accidents.
10. Global legal agreements and national laws should protect biodiversity. Countries should decree regions without GM crops in open fields (table 62.3), GM crops that could pollute this biodiversity and should be prohibited. These GM free areas should obtain international financial and technical support.

In synthesis, modern agriculture with monocultures, synthetic agrochemicals, GM seeds, irrigation and heavy machinery, i.e. both the 'green revolution paradigm' with modern life styles, and the 'life-science paradigm', are not sustainable (Oswald Spring 2009). Both paradigms erode biodiversity in plants and animals, lose natural fertility of soils, exhaust and contaminate water resources and aquifers, pollute air, and affect negatively human health. All these factors may challenge and in some cases even destroy the basic elements of survival of humanity and nature.

Nevertheless, further population growth requires more food, while water and land are increasingly limited, above all in southern countries. GM seeds are expensive and the present hunger crisis has shown that scarcity is related to poverty and lack of money to buy food. Therefore self-sufficiency and food sovereignty promote a sustainable model of production. Yield increases are obtained through crop rotation, association of different crops (maize, beans and squash), biological control of pests and illnesses, nitrogen fixation from the air to the soil, integral management of soils, water, flora and fauna, mixed agriculture and the integration with environmental services. This combination opens up opportunities for a 'green paradigm' that can offer poor peasants in the South and small farmers in the North possibilities to create environmental conditions for an increasing diverse food production also for poor people (Oswald Spring 2009). This model of biological and cultural diversity today feeds three billion poor people and offers a livelihood with dignity to future generations (Oswald Spring 2001).

62.4.2 Ethics of Sharing vs. Intellectual Property Rights

Since the WTO was established, *Intellectual Property Rights* (IPR) have been main concerns of TNEs. They are directly linked to the controversy on GMOs. Many sources of genetic materials come from developing countries and are considered as being their common goods. Indigenous people have used the species and their traditional knowledge has evolved over thousands of years through trial and error. Therefore the 'benefit-sharing' principle should be applied to traditional and poor societies that support environmentally sustainable activities such as reforestation, integral river basin and water management, and conservation of biological diversity to mitigate GEC. However, no negotiation process exists to compensate the autochthonous people for bioprospection. Shareholders of TNEs benefit from this knowledge. They justify the lack of compensation for biopiracy with the high costs for developing new technologies.

TNEs sue peasants when their traditional crops get polluted with GMOs through 'natural contamination' (air, water, animals). Within the WTO rules the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPS) grants these enterprises a right to request penal actions in national courts and oblige small peasants to pay for these unwanted genes (Schmeiser 2002). This process not only threatened the food sovereignty of poor peasants and indigenous people, but has also increased injustice.

62.4.3 Risks Mitigation

62.4.3.1 Gene Banks and Labelling

Gene banks in biodiverse countries can guard ownership rights against the greed-driven TNEs that want to patent genetic plant material that was the result of thousands of years of ingenuity of indigenous societies. They protect the definitive loss of wild species. But crops are dynamic organisms and the best conservation of biodiverse crops is the permanent use of regionally adapted seeds without GMOs.

At the Earth Summit in Rio de Janeiro in 1992, the *Convention of Biodiversity* (CBD 2002) was signed

that entered into force on 29 December 1993 to which 190 countries and the European Union have become members. In January 2000, the *Cartagena Protocol on Biosafety* was adopted in Montreal that entered into force on 11 September 2003.[12] Until December 2008, 153 countries and the European Community had ratified the protocol, but the USA, the host nation of most GM TNEs, has opposed doing so (also Russia, Australia, and Israel). Several other countries have signed the protocol but so far did not ratify it, among them are Argentina, Canada, Chile, Haiti, Jamaica, Pakistan, and Uruguay,[13] several of these countries are intensive users of GMOs (figure 62.3).

Art. 7 of CBD identifies the activities that could or are probable to have negative effects on the conservation of biological diversity. *Art. 8* establishes the conservation *in situ*, where each part has to establish the means to regulate, administer, and control the risks deriving from the utilization and liberation of living modified organisms that are able to affect the biological diversity and human health.

The *Cartagena Protocol on Biosafety* (2000) requires from its members an *Advanced Informed Agreement* (AIA) procedure to ensure that countries can make informed decisions on whether to import GMOs into their environment. Shipments of GMO commodities must also fulfil strict documentation requirements. Exporters must notify the identity of GMOs, its level of security, the taxonomic situation of the receptor organism, its centre or origin, and the genetic diversity in its normal habitat. In Annex III, the resulting characteristics, its probable use, and the volumes of GMOs must be notified. As sufficient and validated data on the effects of GMOs on biodiversity are lacking, a precautionary approach is required in megabiodiverse countries to avoid future losses, based on Principle 15 of the Declaration of Rio on Environment and Development, in the framework of the Protocol of Cartagena and national laws implementing biosafety.

62.4.3.2 Biosafety

The EU has already an extensive legislative framework on GMOs that was complemented in 2003 by a regulation on transboundary movements of GMOs in line with the provisions of the Biosafety Protocol. Rules and procedures for liability and redress for damage caused to the environment from transboundary movements of GMOs are expected to enter into force by 2010. The European Food Security Authority is to resolve disputes among EU countries on the sale of GMOs and decides with a qualified majority or in case of opposition without a vote. This was applied in the case of the approval of corn MON863 against the will of citizens who opposed GMOs.

Researchers, enterprises, and efforts by SIGMEA[14] look for appropriate tools and mechanisms such as biological containment methods, distances of isolation, and pollen barriers. New research is needed to document the impacts on the food chain and explore unexpected side effects. As GMOs offer standardized and rapid methods to transfer inheritable qualities faster than in the traditional way, these modifications are not found in nature. Therefore biosafety protocols are required (ISBR 2002). Furthermore, GMOs have triggered an intensive debate about the benefits and threats or risks to life, the ecosystem, and especially unmodified organisms (Linacre/Falck-Zepeda/Komen/Mac Larn 2006). The popular viewpoints range from generally safe and beneficial processes, to unknown risks and threats, to processes of discovering illegal activities by TNEs. They rely on a critical understanding and distrust governments, TNEs, and the scientists employed by these TNEs.

Through the involvement of independent scientists biosafety could be improved by finding potential side effects and the real interests behind a specific process. Recently a scientific approach emerged where the demand is for optimum yields with a minimum of agro-chemicals that can feed the growing global population. There are many examples for diverse and sustainable ways of production with traditional agriculture.

62.5 Conclusions with Precautionary Means

GMOs have resulted in higher prices for GM seeds. GMOs have not solved the global problem of hunger. Today there are more hungry people on Earth than ever before, and the risks inherent in this model of

12 For a history of the CBD see at: <http://www.cbd.int/doc/publications/CBD-the-first-years.pdf>.

13 "See the members of the Cartagena protocol; at: <http://www.cbd.int/biosafety/signinglist.shtml>.

14 The overall objective of SIGMEA is to set up a science-based framework, strategies, methods and tools for assessing the ecological and economical impacts of GM crops and for an effective management of their development within European cropping systems, i.e. to create a practical toolbox." <http://sigmea.dyndns.org/>.

production may create new threats and require utmost precaution. The high number of suicides by peasants with harvest failures after using GM seeds refers to economic failures and fatal societal consequences in some countries.

With regard to public health, increasingly more doubts emerged on the horizontal gene transmissions due to the fact that DNA is unable to explain many combinations in the transmission of genotype of the simplest forms of life. Biodiversity and food culture have slowly developed during the past ten millennia and long-term risks inherent in this technology and biosafety concerns are not resolved. The use of pesticides and the labour force could be substantially reduced, but multiple 'accidents', often a result of an unethical and profit-driven behaviour of TNEs, require greater precaution (figure 62.4).

Food security should not be left in the hands of economic interests; rather, governments, international organizations and societal organizations must protect the genuine long-term interests of society. Complex emergencies (environmental destruction, desertification, economic and food crises, hunger riots and international conflicts) could destabilize wide regions, inducing massive migrations and refugees (IOM 2007, 2008).

The key question remains how the world and its productive sectors can solve the growing demand for food for about nine billion human beings by 2050, and for the animals to feed them. The persistence of hunger has shown that production is not the key issue, as enough food exists in the world to overcome famine and chronic undernourishment. The problem is linked to the access to food at low prices, where the most vulnerable lack enough money to purchase it, many of them living in rapidly growing urban slums in developing countries.

As poverty also exists in marginal rural areas, and the livelihood of poor peasants is increasing getting destroyed by regressive globalization, the political focus should shift from food security to food sovereignty and from modern techniques of food production to holistic development policies. New models of self-sufficiency in remote rain-fed areas with traditional methods of production and local seeds should be integrated into environmental services and microbusinesses within an economy of solidarity. Furthermore, biological equilibrium is not only threatened by GMOs, but also by GEC, thus precaution and prevention will even become more important in the decades ahead.

The basic principles of this precautionary approach include at least three defences:

1. Lost species and damage or destroyed ecosystems will never be regained with GMOs. Therefore, fatal outcomes and further loss of biodiversity must be avoided at any cost. *Genetic use restriction technologies* (GURT) include the abolition of terminator seeds, which destroy the reproduction mechanisms of a plant, but could create wider effects such as antibiotic resistance in soils, plants, and humans. Also the release of GMOs in the country of origin and adaptation of a basic food crop, such as maize in Mexico, should be forbidden, in order to conserve for humankind the biodiversity of genes of this vital plant and its native races.
2. A multi-faceted approach to GMOs includes a holistic environmental management, environmental and food education, with precise and extensive information of sustainability, including recycling, reuse and reduction practices, clean production, waste management, adaptive processes to GEC and alternative energy sources, water conservation, and cleaning and soil fertility, and biodiversity conservation. Not only uncertainty about GMOs, but active conservation and alternatives to risky technologies are central objectives for sustainable resource care.
3. In the South, risk reduction management includes precaution as part of an integral livelihood, understood as long-term socio-economic, cultural, environmental, and political stability of complex and dynamic interrelations. Thus, hazardous effects on the people and environment should be avoided and biodiverse practices should be promoted by multilateral organizations, organized society, academics, and private business. In the northern context, GM research and surveys offer a kind of filter to avoid processes that could pose undue risks due to a lack of information and precaution. In the South, missing education opportunities and manipulation through mass media often impede the understanding of rising risks and threats. Therefore, governments have an obligation to explain comprehensively the potential dangers related to new technologies and to create mechanisms of protection such as labelling.
4. Diversity of food was an important part of the civilization process, and it was always linked to rituals and fiestas. Only these modern technologies were able to convert a genuine human pleasure into a risky process, where long-term effects on health

can still not be understood and where new scientific analysis bring up increasing new preoccupations.

5. Therefore, the traditional way to produce within a paradigm of green agriculture, with natural waste recycling and locally adapted seeds, mixed agriculture and integration of environmental services, represents today the most feasible manner for harmless food crops. It includes cultural alternatives, community integration, and governmental support with active involvement of society and business. This different paradigm of cultural and biological diversity is able to create a livelihood with dignity for poor peasants, marginal slum dwellers, and other vulnerable groups, without risks and threats for people and the environment.

63 Natural Disasters and Major Challenges towards Achieving Food Security in the Sahel: The Experience of CILSS

Issa Martin Bikienga

63.1 Introduction

Natural hazards and environmental disasters are major challenges that require a policy response from all African policy-makers that are responsible for the survival and future of their populations. This is particularly due to the extreme poverty which often forces their populations to overuse natural resources and causes an ecological imbalance. Hydro-meteorological hazards increasingly produce significant adverse effects as a result of human activities that increase the vulnerability of the ecosystem. In addition to these worrying developments, water-related natural hazards are projected to increase in intensity and frequency due to climate change and environmental pollution. Thus, activities to advance food security and sustainable development through international strategies and other poverty reduction instruments must take natural disasters and their impact into account in the medium and long run. Food security and sustainable development are closely linked to vulnerability due to climate change and natural disasters.

This chapter will discuss solutions for these challenges by addressing natural disasters worldwide and in Africa (63.2), and analysing specifically the linkages among natural disasters, food security, and sustainable development in the Sahel (63.3). It reviews the activities of the *Permanent Inter-State Committee for Drought Control in the Sahel* (CILSS) on food security, the prevention of natural hazards and societal disasters, and on sustainable development (63.4). It concludes with practical proposals for international community (63.5).

63.2 Natural Disasters on Earth and in Africa

An African regional workshop on environmental disasters on 28–30 July 2003 in Nairobi assembled experts from international, intergovernmental, and non-governmental specialized organizations with the goal to exchange their experience on policies, programmes, and tools for the preparedness for and prevention of natural and technological disasters that have serious environmental consequences, and to develop ways and means for promoting cooperation within Africa.

In his opening speech Mr. Svein Tveitdal, director of UNEP's Division of Environmental Policy Implementation (DEPI), argued that natural disasters have grown in number and frequency, and affect most African countries. Especially droughts (figure 63.1) and floods (figure 63.2) pose a threat for food and water security in Africa. While natural hazards are global phenomena, in Africa the rate of reported catastrophes has risen during the past decade, while it has declined in Asia and America. Compared with all globally reported natural disasters (1992–2001) the share of Africa rose from 15 per cent (1992) to 26 per cent (2001), while the share of Asia fell from 44 to 41 per cent and that of America from 24 to 18 per cent.

Between 1992 and 2001, the major disaster type was flooding (figure 63.2), with 207 reported events and 19 million affected people, followed by droughts and famine (figure 63.1), with 113 cases recorded and 113 million people affected, followed by windstorms, with 49 events that affected 5 million people. These events accounted for 89 per cent of all hazards that hit Africa with serious impacts on human health, infrastructures, and the environment.

In the Sahel, a major threat is posed by locust invasions. The agro-pastoral losses caused by the desert locusts in 2004 in most of the Sahel persuaded the governments of these countries of the need for a continuous surveillance system to monitor this disaster. The 2004 locust invasion was the major concern for many CILSS member states, especially for the most affected countries: Mauritania, Senegal, Mali, Niger, and Burkina Faso. The damage caused to rangelands

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Figure 63.1: Number and Occurrence of Drought/Famine Disasters by Country (1974-2003). **Source:** EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels, Belgium.

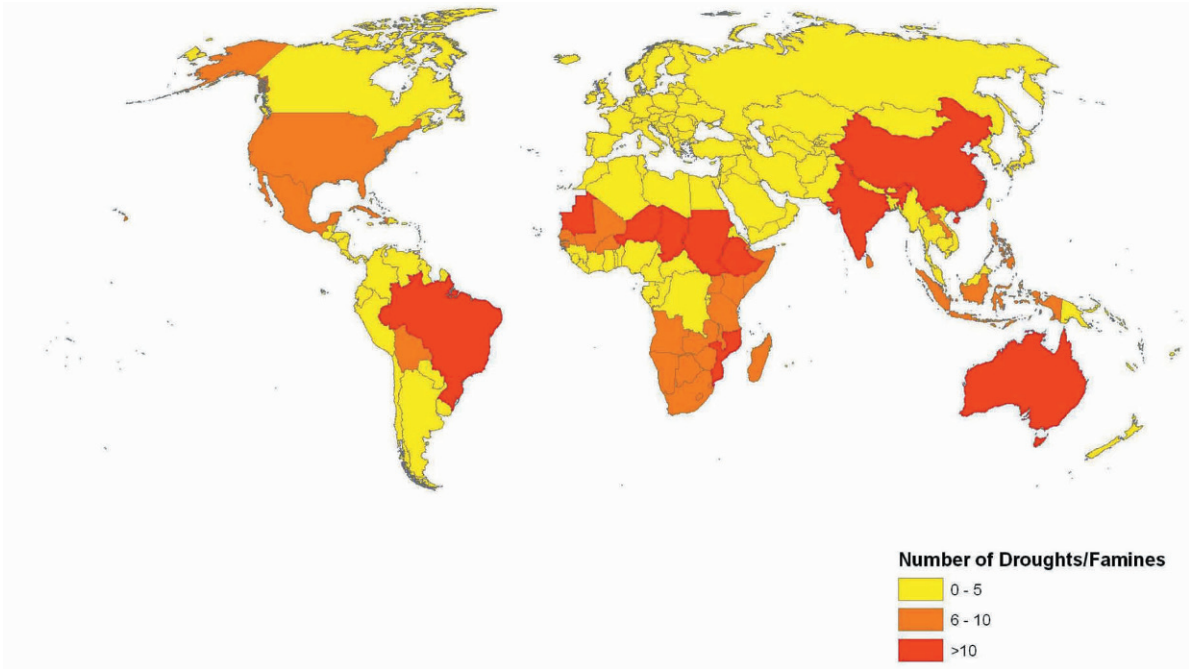
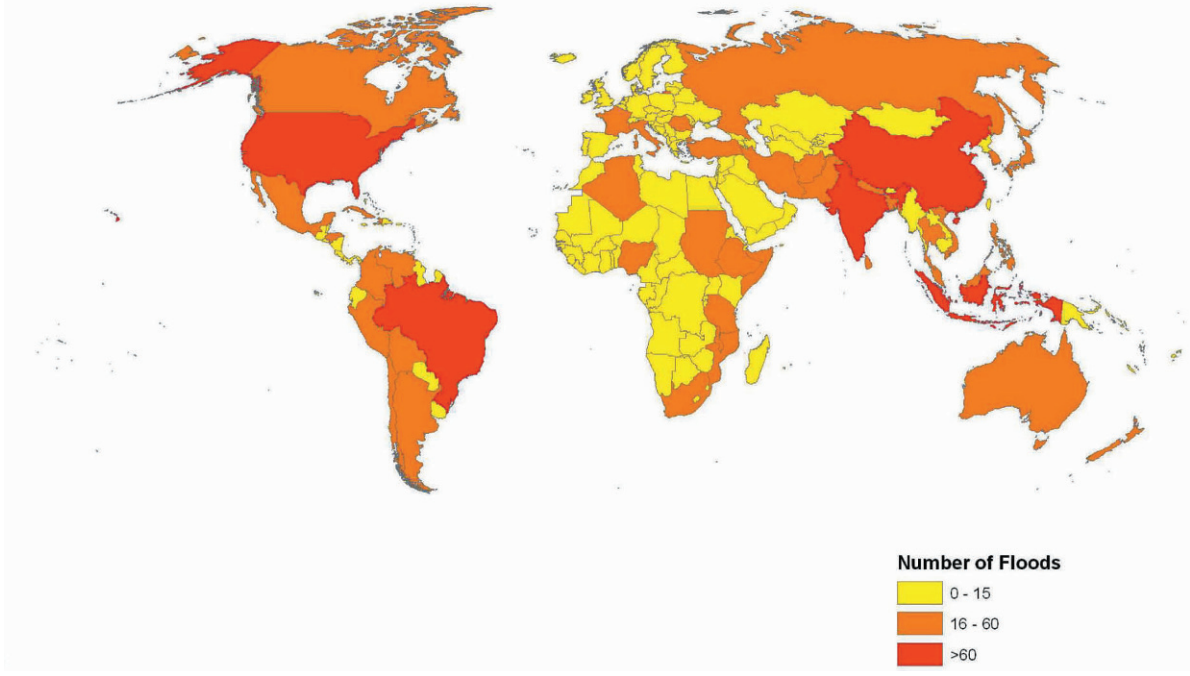


Figure 63.2: Number and Occurrence of Flood Disasters by Country (1974-2003). **Source:** EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels.



ranged between 50 and 95 per cent in the most affected areas. In Mauritania the shrubs fed on by animals were most affected and this resulted in an early transhumance, hence the risk of concentration, epizootic diseases, and conflicts between farmers and pastoralists in reception zones. The most significant crop

Figure 63.3: Worldwide Epidemic Occurrence (1974-2003). **Source:** EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels, Belgium.

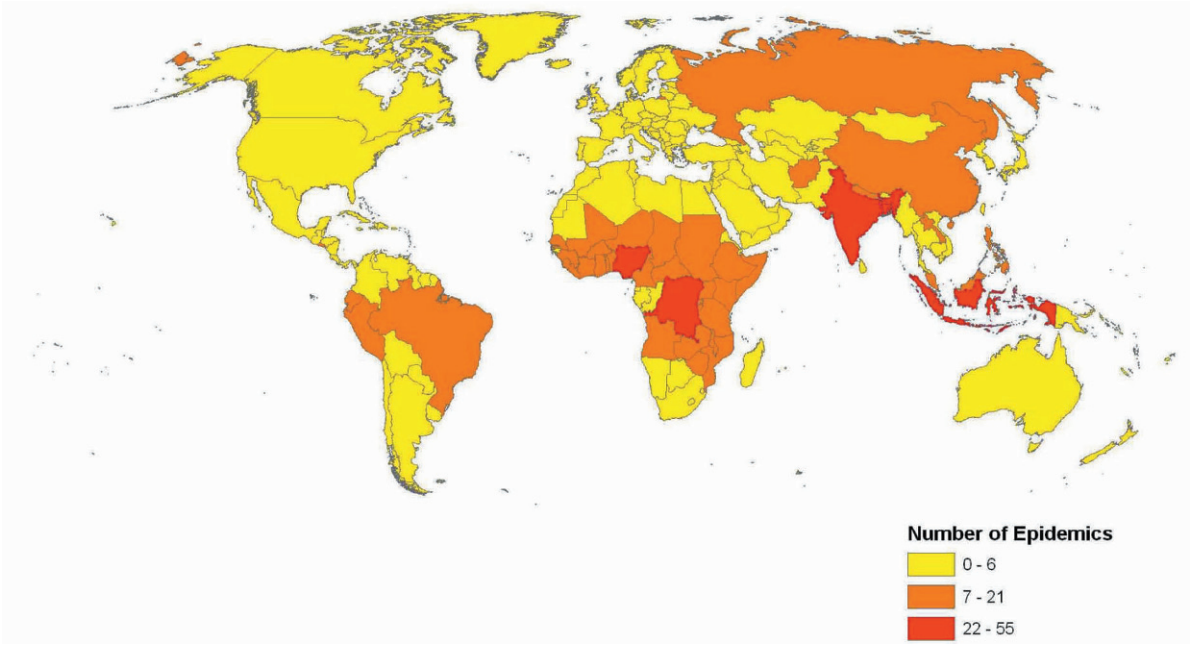
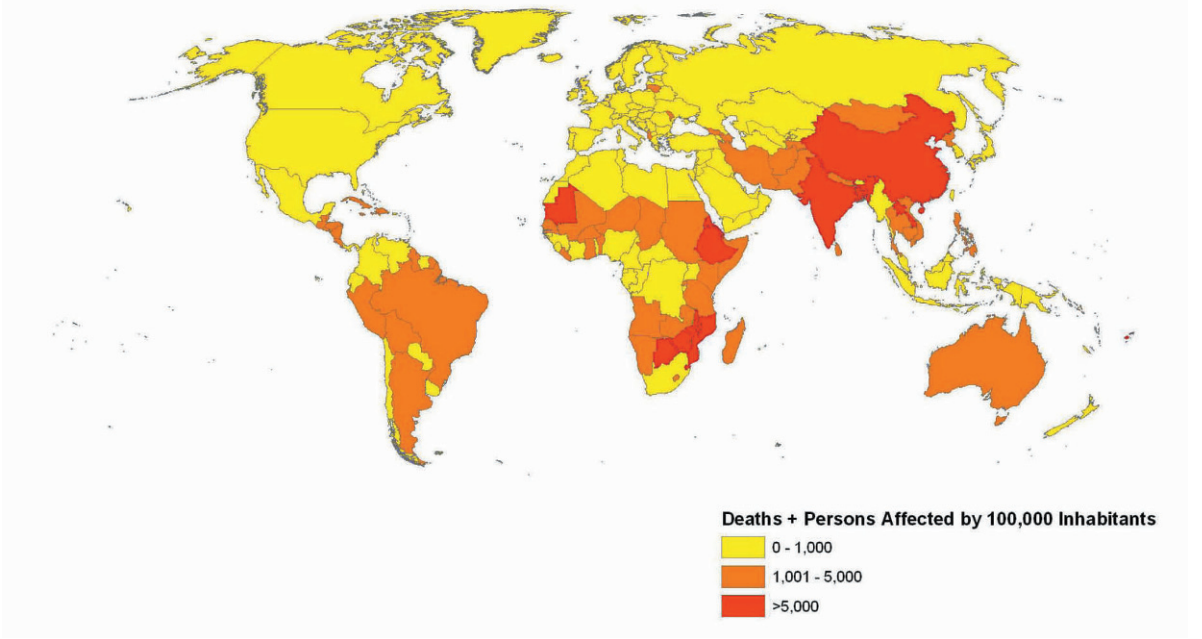
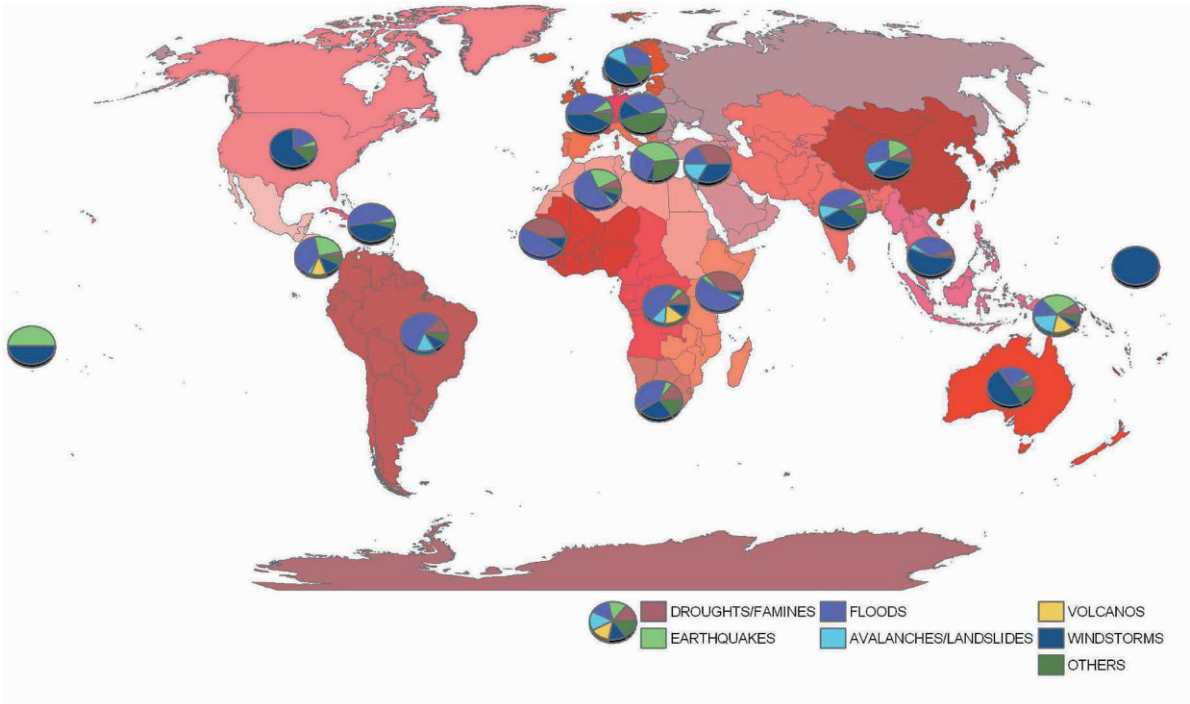


Figure 63.4: Total Number of Deaths and of people Affected by Natural Disasters per 100,000 inhabitants (1974-2003). **Source:** EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels, Belgium.



damages were recorded in Mauritania where a 95 to 97 per cent decline in yields were observed for millet and early sorghum, of a 35 per cent for late sorghum and bottomland crops, and a 30 per cent drop for irrigated rice. The rainy season market-gardening crops were totally destroyed. In Senegal, Mali, Niger, Cape Verde, and Burkina Faso, certain communities in the northern limit of the agricultural zones experienced food problems as a result of the damage caused by endemic crop pests (grasshoppers, grain-eating birds,

Figure 63.5: Disaster Type Proportions by UN Sub-Regions (1974-2003). **Source:** EM-DAT, The OFDA/CRED International Disaster Database; at: <www.em-dat.net>, Université Catholique de Louvain, Brussels, Belgium. .



etc), the locust invasion, and drought. In these farming communities the majority of its population is structurally vulnerable to food insecurity, but they contribute less than 20 per cent to national production.

Other factors have also contributed to a worsening of the conditions for these harsh natural disasters in Africa, including: a) climate change and its impacts; b) demographic growth and an increase in the people's vulnerability; and c) a lack of or weak early environmental warning systems. All these factors clearly show that in the 21st century food security and sustainable development will be seriously jeopardized by natural disasters.

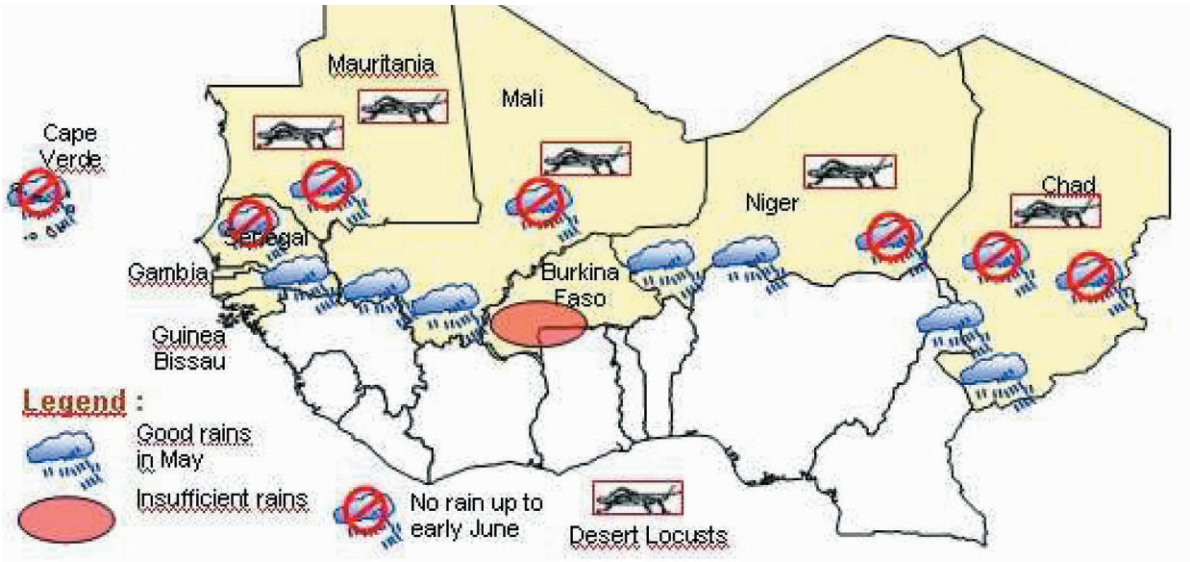
63.3 Natural Disasters and the Threats Posed to Food Security and Sustainable Development in the Sahel

63.3.1 The Environment in the Sahel

Covering an area of 5.4 million km^2 of sub-Saharan West Africa, the Sahel region includes nine countries, namely, Burkina Faso, Cape Verde, The Gambia, Guinea Bissau, Mali, Mauritania, Niger, Senegal and Chad. These countries make up the CILSS member states. The region is characterized by a variety of agro-ecological zones:

- The *Saharan zone*, in the north, which is a dry zone, with annual rainfall below 200 mm. This arid region covers parts of Chad, Niger, Mali, and the major part of Mauritania;
- The *Sahelian zone* with an annual rainfall between 200 and 600 mm with an agricultural production primarily of cereals grown only during a short and irregular rainy season. The zone is characterized by its austere climate marked by the harmattan winds blowing for many months throughout the year;
- The *Sudano-Sahelian zone*, with an annual rainfall oscillating between 800 and 1,000 mm. In this zone with an annual rainfall below 800 mm, the farmers produce 90-day-cycle cereals such as sorghum and millet. This zone extends to the northern part of The Gambia, and the southern parts of Mali, Niger, and Senegal;
- The *northern Guinean zone*, with annual rainfall between 1,400 and 1,800 mm, is a wetland allowing for the production of most cereals, roots and tubers, as well as export crops. This zone includes the best arable lands and is also most populated.

Figure 63.6: The Locust Invasion (as of 9 June 2004) affecting the Sahel Countries. **Source:** FAO; at: <http://www.fao.org/DOCREP/006/J2517E/J2517E00.HTM#bkf>.



This agro-ecology covers the major part of Guinea Bissau;

- The *coastal zone*, with annual rainfall above 800 mm, where primarily roots are grown. This includes the coastal part of Guinea Bissau.

In year 2000, the CILSS member states represented approximately 56 million inhabitants, of which about 70 per cent live in rural areas. A majority of these rural people live in extremely arid and semi-arid environments, and 95 per cent of them rely on arable land that is extremely vulnerable to desertification. Recent studies show that 27 million Sahelians, that is to say approximately 62 per cent of the population, live below national poverty lines, ranging between 46 per cent in Cape Verde and 86 per cent in Senegal.

The annual population growth rate is 2.7 per cent and the population tends to double every 25 years. According to minimal projections, the Sahelian population will rise up to above 100 million people by the year 2025, of which 50 per cent would be living in urban areas.

In the 21st century a major challenge for the Sahel is how to feed its fast growing population. By the year 2015, the Sahel must provide food for a population of about 85 million people. In year 2000, the urban population accounted for about 30 per cent of its population but the urban growth rate is above 6 per cent. This transformation constitutes both a constraint and an opportunity for food security. It is a constraint insofar as urban development is very expensive in terms of satisfaction of the requirements for basic social services and infrastructure development. It is an opportunity insofar as it constitutes a whole set of outlets for the agricultural and food produce. But it is also an opportunity as it creates a growing demand for agricultural and food products.

The climate in the Sahel is very fragile and is characterized by strong rainfall variations, with very long dry seasons and short rainy seasons lasting between one and four months. The isohyets shifted from 200 to 300 km southwards during the past 30 years. Severe droughts occurred between 1968 and 1973 that caused major losses in human and animal lives, a significant degradation of the environment that resulted in famine and malnutrition. Although the region has not experienced any serious drought of comparable extent since 1985, the threat of a severe drought remains a source of constant concern.

Agriculture is an important sector in all CILSS member states and it contributes with approximately 31 per cent to their GDP. During the past decade, the GDP increased by about 5 per cent/year, to US$16 billion in 1999. It is estimated that only 18 million hectares are cultivable, i.e. approximately 12 per cent of 156.3 million hectares that are available for agriculture in the Sahel. Subsistence farming and livestock production play a predominant role in the economies of CILSS countries. The overuse of natural resources and deforestation, desertification, poverty, and the sensitive soil condition have worsened due to accelerated degradation and overgrazing, coupled with limited production resources upstream from the agricultural sector, which lead to low agricultural production

Table 63.1: Population Change and Projection for the Sahel Countries (1950-2050). **Source:** UN, Populations Division, 2006 Revision; at: <http://esa.un.org/unpp/>.

Sahel countries	Population change		Population projection		Projected increase
	1950	2005	2025	2050	2005-2050
Burkina Faso	4.0	13.9	23.8	37.5	23.6
Cape Verde	0.15	0.5	0.75	1.0	0.5
Chad	2.4	10.1	17.5	29.4	19.3
The Gambia	0.3	1.6	2.5	3.6	2.0
Guinea	2.6	9.0	14.5	22.7	13.7
Guinea Bissau	0.5	1.6	2.9	5.3	3.7
Mali	3.3	11.6	20.6	34.2	22.6
Mauritania	0.7	3.0	4.5	6.3	3.3
Niger	2.2	13.3	26.3	53.2	39.9
Senegal	2.5	11.8	18.1	25.3	13.5
Total	**18.65**	**76.4**	**131.45**	**218.5**	**142.1**
In comparison: Nigeria	34.0	141.4	210.1	288.7	147.3

levels far below their potentials. The CILSS countries have important water resources that permit agricultural production, fishing, and stockbreeding. Their irrigable land ranges between 4 and 33 per cent of cultivable soils.

The combined effects of accelerated demographic growth, fast urbanization, migrations, climatic variations, and irregular and unpredictable rainfall, added to the permanent threat of drought, have generated ecological and socio-economic crises in the CILSS member states. This crisis is manifested through ecological degradation, demographic pressure and unsound use of natural resources, and through food insecurity which negatively affects most vulnerable groups, in particular women, either pregnant or breast-feeding women, children, and young as well as old people. These problems constitute the main cause of poverty and hamper human and socio-economic sustainable development of the Sahel countries. For these reasons the CILSS programmes have been designed to address these problems first.

63.3.2 CILSS Mandate and Objectives of Sustainable Development

The *Permanent Inter-State Committee for Drought Control in the Sahel* (CILSS) was formed on 12 September 1973 in Ouagadougou (Burkina Faso) in the wake of the disastrous droughts of 1968 and 1973, with the mandate to achieve food security and to combat desertification and the effects of drought aiming at a new ecological balance in the Sahel. Ever since, CILSS has implemented many programmes that have promoted sustainable development in the Sahel within the framework of regional integration. The first efforts focused on emergency aid, but CILSS realized very early the need to direct its actions more towards structural development issues in order to achieve its long-term goals and to live up to the expectations of its member states.

In 1994, the 11th summit of the Heads of State and Government tasked CILSS, in the framework of its *Plan de Restructuration et de Relance Durable* (a restructuring and sustainable revival plan), to concentrate its efforts on achieving food security and combating the effects of drought and desertification to preserve the region's ecological balance.

At a Summit conference on 25 January 2004 in Nouakchott (Mauritania), the Heads of State and Government of CILSS countries after reviewing its reports highlighted its overall positive results. They stressed that CILSS should invest more in concrete actions and adopted these priorities for the 2004-2008 period, namely that it should do the following:

- refocus on its initial objectives of food security, desertification control, solving the problems of water, and policy coordination to identify synergies;

- promote its achievements (best practice) and share its expertise with other sub-regional intergovernmental organizations;
- prepare a specific food security programme that would reorient trade towards production of surpluses among member states;
- intensify the dialogue between IGOs and the states in order to eliminate duplications of activities among CILSS, national and other IGO programmes.

These reorientations reflect the mission of CILSS for the period from 2004 to 2008.

63.4 CILSS Contributions to Combat Natural Disasters

63.4.1 Activities of the AGRHYMET Regional Centre

The AGRHYMET Regional Centre was established as a specialized CILSS body in Niamey (Niger) for undertaking research, development, and training activities on agronomy, hydrology, and meteorology. Its major objectives are to contribute to sustainable food security, rational management of natural resources, and the environment in the Sahel through capacity building (training, equipment, and assistance) of the national institutions concerned, production and dissemination of information for the decision-makers (national authorities, partners, etc.) and users (institutions, NGOs, and producers). As a regional centre of excellence AGRHYMET focuses on:

- Training of management staff from CILSS countries and the rest of Africa;
- Agro-meteorological and hydrological monitoring at the regional level;
- Collection of agricultural statistical data and crop monitoring;
- Maintenance of regional databanks;
- Management and dissemination of information on natural resources monitoring in the Sahel;
- Documentation on agroecology;
- Maintenance of meteorological instruments and electronic system packages.

The information basis of the AGRHYMET Regional Centre is satellite data supplemented with local data collected by the national correspondents in CILSS member states. This information is to improve food security, desertification control, and natural resources management within all CILSS countries and in West Africa. It is processed, analysed, and disseminated through the internet, special bulletins, and sent to CILSS member states, and to technical and financial partners. AGRHYMET has strengthened its information system with the implementation of big regional projects such as:

- *Permanent Diagnosis* (DIAPER);
- *Early Warning and Agricultural Productions Forecasting* (AP3A);
- Adaptation to climate change in the Sahel.

63.4.2 Vulnerability of Sahel Countries to Climate Change Project

The CILSS member countries are all highly vulnerable to climate change due to widespread poverty, cyclic droughts, high dependence on climate fluctuations for its sensitive farming and breeding systems, soaring demography, low level of basic social infrastructures, and high deforestation associated with the energy requirements of its people which limits their adaptive capacities. Weather disturbances further reinforce the threats the environment and its people already face. They would undermine ongoing sustainable development efforts. Therefore, national and regional policies of sustainable development in the Sahel must mainstream henceforth the 'climate change' dimension, based on adequate scientific knowledge. To reduce the vulnerability of its people to climate change, the AGRYHYMET Regional Centre of CILSS obtained funding of CAN$ 5,000,000 from the Canadian Government for project in support of capacity development for adapting to climate change that pursues these goals to:

- develop the capacities of the AGRYHYMET Regional Centre to address climate change-related issues;
- promote and strengthen the capacities of Sahel countries and communities to cope with climate change;
- set up pilot projects of adaptation jointly with the populations on water resources, water erosion, pastoralism, agricultural production, and soil fertility.

Through the AGRYHYMET Regional Centre this project should help the people in the Sahel to:

- create knowledge on impacts of climate change on the natural resources management and environmental protection;

- increase the capacity of Sahel countries and their population to minimize the adverse effects of climate change;
- strengthen food security information systems at the sub-regional and country level;
- define indicators to monitor the evolution of vulnerability to climate change and adaptations to such change;
- transfer appropriate technology for controlling climate change;
- integrate new knowledge about climate change into the training programmes of students in the AGRYHYMET Regional Centre, with a view to future applied researches in this field;
- develop adaptation strategies to climate change to be incorporated into national sustainable development strategies;
- develop pilot strategies for adaptation to climate change with the grassroots communities, which could be integrated into future strategies, policies, and programmes for sustainable development of the states involved;
- establish a scientific partnership with at least one Canadian institution in the field of climate change.

63.4.3 Support to Locust Control

In response to the damage caused by desert locusts in 2004, supported by various donors CILSS launched very strong and immediate actions. In 2005, through its AGRHYMET Regional Centre, CILSS developed operational capacities of its member states on desert locust control by providing equipment and organising training courses for agents from crop protection departments, their supporting staff, and producers. Of the total funding of US$ 1,350,000, a major contribution was made by the *United States Agency for International Development* (USAID) and the *Arab Bank for Economic Development in Africa* (BADEA). CILSS also obtained funding for a project on locust control from USAID for a three-year term (US$ 1,236,000) to develop the capacities of the AGRHYMET Regional Centre to support CILSS member states in locust monitoring and control efforts.

Based on the AGRHYMET Regional Centre's mandate on food security and on its great capacity for analysing satellite images, meteorological and agricultural production data and its large communication network across the nine Sahel countries that are all facing the risk of locust invasion, this project will supplement the activities of FAO and of the World Bank through their African desert locust emergency control project. This project is to reduce the economic damage from desert locust while limiting the harmful effects of chemical control operations on the environment. Several regional and national activities are planned, including:

- capacity building of the Sahel Institute, a specialized institution of CILSS based in Bamako (Mali), on the certification and use of new environment-friendly pesticides for controlling locusts;
- improvement of the monitoring of locust populations for early control purposes;
- capacity development for crop protection services and of their support staff in CILSS countries to monitor and control locusts, grasshoppers, and other transboundary pests;
- applied research on environment-friendly control strategies (use of the 'green muscle' bio-pesticide and the locust Pheromone, Phenylacetonitrile or PAN) and their promotion;
- promotion of cooperation with Maghreb countries and the international community.

63.4.4 Land Use and Land Cover Project

The Land Use/Land Cover Project is to promote awareness and use of graphic and spatially explicit information on trends of natural resources among national and regional decision-makers and to get them involved in designing future scenarios which will help to formulate rational and sustainable intervention policies, leading to a better management of natural resources. The project comprises two phases:

- The first phase (1997–2000) devised the methodology for data collection, socio-economic studies, air photography by the Corona and Argon satellites in CILSS countries;
- The second phase (since 2001) focuses primarily on the long-term monitoring of the land use and cover in the Sahel and West Africa. It promotes an opportunity for documenting, describing, and quantifying the impact of trends on environmental and terrestrial resources in Western Africa.

Through this project, the AGRHYMET Regional Centre has been able to obtain a full-time series of data images from the 1960's to date, which represents an immense and significant resource. The interpretation of these images, and the study of anthropogenic actions and the climate on the earth resources, will make it possible to anticipate the most probable trends during the next fifty years, and the possibilities

of mitigating their negative effects. This project contributes to natural disaster forecasting.

63.4.5 African Monsoon Multidisciplinary Analysis Project (AMMA)

The Sahel countries, with their high dependence on agriculture, are particularly vulnerable to the late or irregular occurrence of the monsoon. This irregularity has seriously affected its population between 1970 and 1990, resulting in massive crop failures and mortality of cattle. The global climate models show that due to climate change the Sahel will face more irregular weather conditions. To help farmers adapt to the fluctuations in rainfall, it is necessary to develop tools that can forecast this change, and the potential yield and crop failure risks. Policy-makers also need early warning systems whose accurate forecasts enable them to better manage cereal stocks and to cope with national and regional deficits. These pertinent questions are addressed by the *African Monsoon Multidisciplinary Analysis Project* (AMMA) that is implemented by American, European, and African scientists and experts. It is financed by various donors, among them the European Union. Its specific objectives are:

- Characterization and assessment of the impacts of regional climate change on biophysical processes on the farm plot and farming system scales;
- Identification and evaluation of probable adjustments of agricultural systems and their components to climate change, including the selection of crops and their management strategies;
- Assessment of the impact of climatic variability on food security on a national scale;
- Characterization of key productivity trends of natural vegetation and its relationship to local climate;
- Identification of anomalies in vegetation trends across West Africa.

Through this project, the AGRHYMET Regional Centre implements several activities: analysis of rainfall data, assessment of the impact of climate change on water resources and agricultural output, assessment of the level of vulnerability of the farming systems, early warning for food security, capacity building of CILSS member states.

63.4.6 Regional Project for the Prevention and Management of Food Crises in the Sahel (PREGEC)

The strategic objective of this project is to enhance the capability in the Sahel to prevent and manage food crises resulting specifically from climatic hazards. Despite technical progress that can be achieved, the weather conditions in the Sahel are so fickle that crop failure can always occur. Only through the capacities of its people to control the political and technical dimension of food crisis prevention and management can the regional vulnerability be reduced. The project pursues two goals: a) to develop appropriate tools for the prevention and management of food crises; and b) to reduce the degree of vulnerability to food crises for the most underprivileged people within a harmonized sub-regional framework. The specific objectives are part of the general strategy of consolidating the political and technical control of the situation by the people in the Sahel that focuses primarily on the most underprivileged and vulnerable population to food crises. Four results are expected: 1) An operational and efficient sub-regional mechanism for the prevention and management of food crises is developed and set up within a consultative framework bringing together the states and CILSS. 2) The existing food crisis prevention and management mechanisms in the member states are strengthened and improved. 3) The Food Aid Charter in the Sahel is implemented. 4) The effectiveness of the Food Crisis Prevention Network is improved.

63.4.7 Vulnerability monitoring in the Sahel Project

This project is carried out along three thematic lines: a) prevention of food crises through consideration of national and regional early warning systems; b) poverty reduction through methodologies of vulnerability analysis and programme impact monitoring, and by developing adequate information for producers; c) environmental monitoring to assess the climate change zoning and the supportive measures provided for by the Kyoto Protocol.

63.4.7.1 Prevention of Food Crises

These activities want to improve the capacities for the prevention and management of crises at the regional and national level to achieve a higher food security level in CILSS countries. More specifically, it will contribute to a closer monitoring of the cropping season

A	Sustainable management of shared and/or transboundary natural resources.	Sustainable management of shared water resources.
		Sustainable management of shared and/or transboundary plant and animal resources.
		Sustainable management of energy resources.
B	Sustainable control of NRM constraints and risks.	Management and control of crop and plant pests.
		Early warning and mitigation of effects of drought.
C	Measures in support of sound natural resource management.	Scientific and technical cooperation.
		Information, training, communication.
		Development of intra-regional trade in local products.

to prevent cyclical food crises. Its components include: a) production of information for early warning purposes; b) preliminary estimates of harvests; and c) finally, drawing up of the provisional food situation for policy-makers and the international community.

63.4.7.2 Poverty Reduction through Desertification Control

Population growth, climate change, land degradation, and falling prices of raw materials have strongly changed the reference framework by making the current model quite inappropriate to describe the existing regional dynamics. A review of the development model, which addresses poverty reduction issues in a much broader manner in relation to food security and desertification control, should take account of a reality in the changing process and be able to identify the causes behind the progressive marginalization of the region.

Poverty reduction has increasingly become the primary objective to be achieved in the region during the last few years because all countries have developed appropriate strategies and policies to implement specific plans for the various population groups. But the results achieved so far have not lived up to expectations because the indicators available for each programme are either very limited or almost nonexistent. This project will provide national decision-makers with technical support for the planning and management of poverty reduction programmes.

63.4.7.3 Climate Change and the Environment

The *United Nations Conference for Environment and Development* (UNCED) in Rio de Janeiro in 1992 adopted two environmental framework conventions, including: a) the *United Nations Framework Convention on Climate Change* (UNFCCC), and b) the *Convention on Biological Diversity* (UNCBD) and launched negotiations for c) the *Convention to Combat Desertification* (UNCCD). These three conventions have produced tools for a sustainable management of natural resources based on the findings of the assessments by the scientific community. The potential synergies among them must be included in their implementation. Achieving these objectives rests to a large extent on the interaction of these conventions.

63.4.8 Sub-Regional Action Programme to Combat Desertification in West Africa and Chad

The UNCCD in article 11 calls for the situation in which "affected country Parties shall consult and cooperate to prepare, as appropriate, in accordance with relevant regional implementation annexes, sub-regional and/or regional action programmes to harmonize, complement and increase the efficiency of the *National Action Programmes* (PAN)." In accordance with this provision, under the aegis of CILSS, ECOWAS and CILSS, countries decided in July 1995 in Dakar (Senegal) to cooperate in the preparation and implementation of a *Sub-Regional Action Programme to Combat Desertification in West Africa and Chad* (SRAP/WA).

Its goals are in line with the spirit and overall objective of the UNCCD which is: "to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach which is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas." The goal of the SRAP/WA is to develop sub-regional cooperation on rational management of shared natural resources (NRM), and to contribute to the sustainable development of West African countries and Chad.

Three lines of action and eight areas of intervention were defined for the SRAP/WA:

The SRAP/WA is an orientation, reference, arbitration and coherence framework for actions to combat desertification and mitigate the effects of drought. Its ambition is to increase compatibility and synergies of activities of all desertification control stakeholders in order to consolidate the bases for sustainable development in the region. This sub-regional action programme includes a Sub-regional Coordinating Committee chaired by ECOWAS and a technical secretariat handled by CILSS. The issues at stake under the SRAP/WA include:

- to put an end to increasing poverty by protecting the production potential;
- to prevent and solve conflicts related to natural resource use;
- to remove the current risks of food dependency; and
- to harmonize, complement, and increase the efficiency of the national action programmes.

As can be noted, the SRAP/WA is a regional instrument for the prevention of natural disasters and the promotion of sustainable development on the West African scale.

63.5 Proposals for the International Community

In conclusion a few practical proposals are offered to address natural disasters and to attain sustainable development. These proposals are articulated around the following points:

Information Services

- To collect and disseminate information on the resources and capacities on the environmental dimension of disaster management;
- To facilitate communication and information exchange among international partners and among the sub-regions;
- To facilitate access to the sources of information for the development of prevention and management systems of the environmental consequences of disasters.

Education and Training

- To promote and provide training in the field of prevention and management of environmental disasters;
- To promote the holding of regional and sub-regional symposia on strategies for tackling environmental disaster-related risks;
- To develop tools and guidelines for capacity building, including disaster management policies and strategies.

Technical Services

- To facilitate cooperation on research and development on early warning;
- To promote considerations for indigenous knowledge on early warning;
- To provide the regions and sub-regions with technical assistance, expertise, and resources needed when environmental disasters occur;
- To support regional disaster management initiatives.

63.6 Conclusion

All African policymakers face natural and environmental disasters due to the extreme poverty of their populations, a fact which often forced them to overuse their natural resource base which has resulted in an ecological imbalance. Therefore food security and sustainable development, as well as the international strategies and other instruments for coping with food insecurity and poverty, must take natural disasters and their medium- and long-term impacts into account.

Through its specialized bodies, its projects and programmes, CILSS can contribute to an effective response to prevent and manage such environmental disasters. This action can still be strengthened by the scientific and technical assistance from various international, intergovernmental, and non-governmental organizations concerned with these problems.

64 Responding to Climate Variability and Change: Opportunities and Challenges for Governance

Sreeja Nair

64.1 A Changing World in a Changing Climate[1]

"*There is nothing permanent, except change*"

Heraclitus of Ephesus

The developmental pathways of the society have been associated with changes in the utilization patterns of natural resources and environmental goods and services. Given the need for societies to develop, the key challenge has been to manage the available natural resources and preserve the environmental structure and function so that they continue to support societal development in a sustainable manner. Among a multitude of stressors that have emerged as offshoots of unsustainable development, one of the gravest repercussions has been the change in the climate of the earth (beyond natural variability). The change in the climate attributable to human activities has already begun to register impacts on the earth's life-supporting ecosystems with serious implications for the society. Short-term and long-term changes in climatic variables can compound the impacts of existing stressors (such as rise in population and consequent increases in demand for space and other resources) on the environment and living systems.

Despite considerable progress in terms of understanding the changing climatic conditions, human existence and development are constantly plagued with the issue of uncertainty about the future climate. In the face of uncertainty, the biggest challenge and opportunity both, is the ability for forward-looking decision-making. Neither a top-down nor a bottom-up approach alone can determine successes or failures of policy frameworks in a dynamic world. Imposition of top-down rigid governance mechanisms might often fail to incorporate feedback and learning from the grassroots in response to changing environmental conditions (Urwin/Jordan 2007: 187). An equitable policy mechanism to address such complexities would be to craft specific policy solutions for the regions and communities at risk (Bohensky/Lynam 2005: 15 of 20). This paper is an attempt to discuss the multiple facets of how governance can influence the capacity of individuals and the society to best adjust to the risks associated with climate change. Since every individual is affected differently and responds differently, the paper tries to highlight why governance needs to be nested at different levels to reflect these ground conditions appropriately.

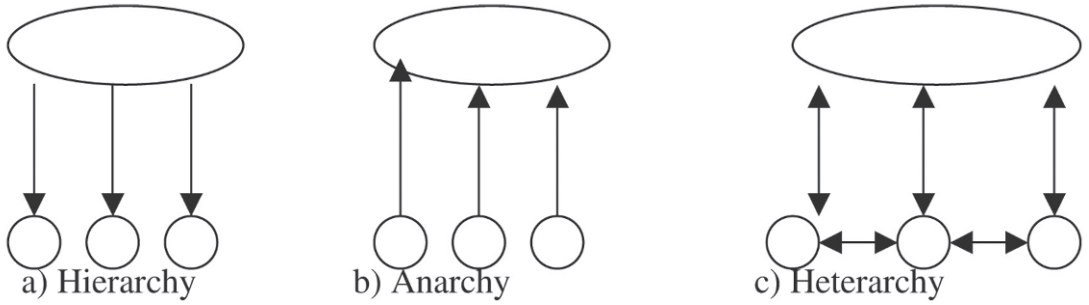
A case study of India's multi-level governance structure is used to support the discussion. India has 28 states, 7 union territories, 604 districts and over 600,000 villages with twenty-two scheduled languages and over 1500 minor languages.[2] Successful adaptation across a diverse country such as India, with a vast geographical area spanning mountains, flat terrains, deserts, forests, deltas and coastal areas, will require concerted action at different scales of governance.

1 The author is thankful to the *Federal Ministry of Education and Research, Germany* (BMBF) and the *International Human Dimensions Programme on Global Environmental Change Programme* (IHDP) for providing grants that supported the presentation of this paper at the 2008 Berlin Conference on the Human Dimensions of Global Environmental Change. The author also expresses deep gratitude to Hans Guenter Brauch for giving an opportunity to develop this presentation into a full research paper. The author also acknowledges the initial discussions with Dr. Prodipto Ghosh and Dr. Ligia Noronha, TERI as the motivation for development of this paper.

2 Retrieved from http://www.federalism2007.org/conference_reader.pdf, 28 April 2009, p 9 of 516.

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_64, © Springer-Verlag Berlin Heidelberg 2011

Figure 64.1: Mode of interaction in anarchy, hierarchy and heterarchy. **Source:** Eoyang/Berkas (1999: 5); at: <www.chaos-limited.com/EvalinCAS.pdf>.



64.2 The Response to Change: Vulnerability, Resilience and Adaptation

Considered as a composite unit, human society and nature, i.e. *Social-Ecological Systems* (SES), are *complex adaptive systems* (CAS) experiencing multiple cross-scale[3] interactions ('complex') and with time, adjusting to conditions of stress such as climate change ('adaptive')[4]. Essentially, the functioning of CAS fall between anarchy where interactions between group members determine the final characteristics of the entire group and hierarchy with a top-down decision-making approach (figure 64.1).[5]

A major barrier for policy implementation in response to uncertain future conditions has been the lack of a complete understanding of the mechanisms that influence the SES (Allison/Hobbs 2004: 1 of 25). Vulnerability of SES to climatic stress, is a factor of the level of exposure to the stressor, the degree to which the system is affected by the stressor ('sensitivity') and the ability of the system to adapt to the stressor ('adaptive capacity') (Smit/Pilifosova 2001: 894). Studies at the community level have revealed that the conditions that define vulnerability in terms of exposure, sensitivity and the capacities to adapt are community-specific (Smit/Wandel 2006: 286, 287). In response to long-term climate change, SES can undertake an "*adjustment in response to actual or expected climatic stimuli and their effects or impacts*" (Smit/Pilifosova 2001: 881). These actions constitute adaptation and can be initiated at the individual and/or organizational level by public entities, such as the governments (Adger/Arnell/Tompkins 2005: 77). Some factors that may define the capacities of societies to adapt may include access to technology, availability and distribution of resources, institutional setup, presence of infrastructure, access to education, access to opportunities for risk – spreading and the ability of decision-makers to manage information inter alia (Yohe/Tol 2001: 26).

In the face of stress, SES do not rapidly change their form owing to several self-reinforcing mechanisms that try to maintain the original structure and function as far as possible (Walker/Carpenter/Anderies/Abel/Cumming/Janssen/Lebel/Norberg/Peterson/Pritchard 2002: 1). Under stress, SES slowly assimilate the new conditions while trying to maintain their earlier critical processes, attempt to self-organize and build the capacity to learn and adjust to these conditions. These processes define resilience of the system (Carpenter/Brock 2008: 1). Both vulnerability and resilience are dynamic and change from person to person and time to time. While vulnerability is the suite of factors that create the potential for damage, resilience is the ability of the system to respond after the exposure to stress (acute or chronic). CAS are dynamic and have several stable states based on the interactions between their individual units and the external environment (Allison/Hobbs 2004: 3 of 25).

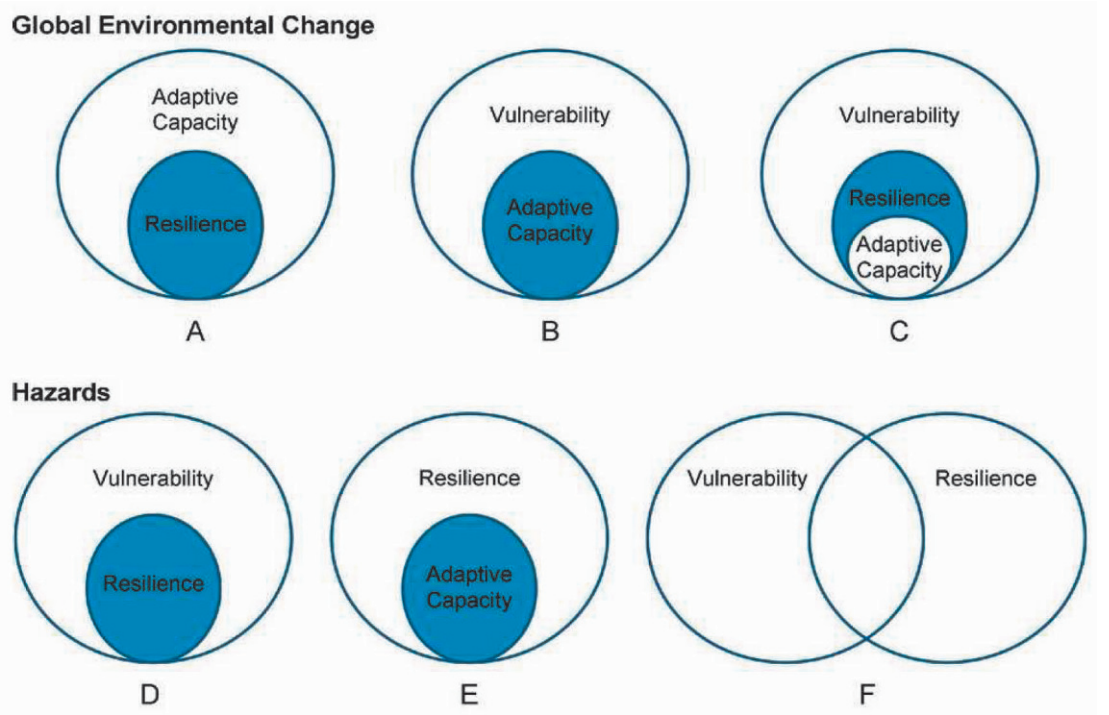
The identical treatment of the discourse on the resilience of ecological systems and social systems has

3 Scale allows for the measurement of any event or phenomenon. Scale, for example, can measure the variations across space, time, jurisdiction and/or institutions. There can also be 'levels' within a particular scale at which the phenomenon can be observed and measured (Cash/Adger/Berkes/Garden/Lebel/Olsson/Pritchard/Young 2006: 3 of 12).

4 Black-Hughes, C.; Eoyang, G.; Smilonich, D., 1997: "The Robin Hood Syndrome: Street Gangs as Complex Adaptive Systems"; at: <www.hsdinstitute.org/e-clarity/asp_documents_0001/Documents_Publish/83.pdf> (2 February 2008): 6 of 30.

5 Eoyang, G.; Berkas, T., 1999: "Evaluating Performance in a Complex Adaptive System. Complexity in Organisations"; at: <www.chaos-limited.com/EvalinCAS.pdf> (20 January 2008): 5 of 21>.

Figure 64.2: Conceptual linkages between vulnerability, resilience and adaptive capacity. **Source:** (Cutter/Barnes/Berry/Burton/Evans/Tate/ Webb 2008: 600).



often been contested. However, ecologists argue that just as resilience allows ecological systems to cope with change similarly resilience allows social systems to innovate, learn and cope with change gradually (Adger 2000: 350). Three properties define the future response of ecosystems, agencies and people to change; the potential for change and the range of options available, degree of flexibility of their internal system processes to respond effectively to external conditions and their resilience (Holling/Gunderson 2002: 32). When institutions become highly rigid and self-reinforcing they are less open to any change and hence less resilient (Carpenter/Brock 2008: 2). Being a dynamic process that evolves with time, vulnerability, resilience and adaptation crucially depend on timescales. While vulnerability in the short-term will depend on the ability of the system to cope with the climatic risk, vulnerability in the medium to long-term will depend on the ability of the system to adapt to that risk (Brooks/Adger/Kelly 2005: 153).

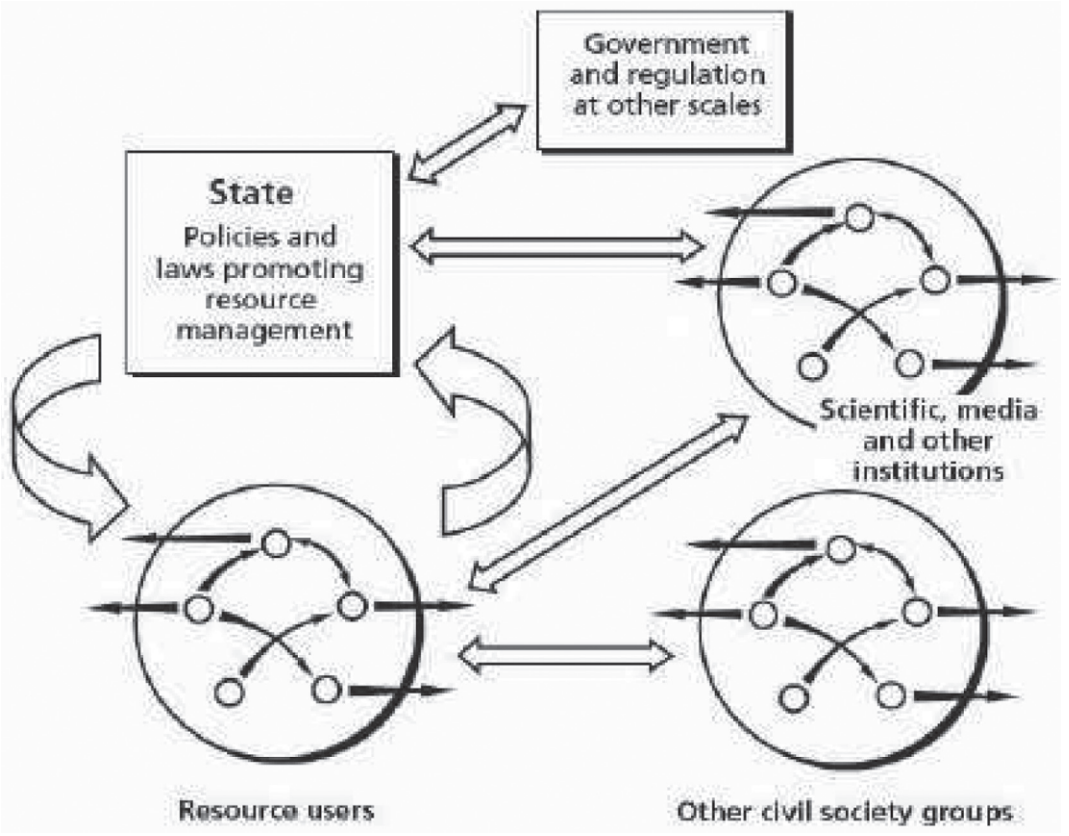
The concept of vulnerability, adaptation and resilience has been subject to interpretation through different perspectives including that of environmental change, political-ecology, sustainability, social justice and disaster risk-reduction (Vogel/Moser/Kasperson/Dabelko 2007: 350). According to some researchers, while resilience is the main component of adaptive capacity, others view adaptive capacity as a key determinant of vulnerability or both resilience and adaptive capacity under the aegis of vulnerability (figure 64.2). Policymakers and developmental planners have increasingly become interested in understanding these concepts to better inform humanitarian response to disasters and undertake proactive response measures (Dayton-Johnson 2004: 10 of 45). When the stressor is a climatic extreme event or a natural disaster, resilience is measured in terms of the ability to survive, cope and recover with minimum impact (Cutter/Barnes/ Berry/Burton/Evans/Tate/Webb 2008: 599).

64.3 Why Governance Matters?

Many of the impacts of climate change are new and challenging, hence the traditional coping strategies might fail and will not be applicable for most of these risks. Therefore there is a need for vulnerable communities to be innovative and devise new strategies. The 'Innovative Communities[6] Initiative' – a joint venture

6 The word 'communities' here refers to a group of people having some common criteria defining them. For example, geographic location, economic status, social background, political boundaries inter alia.

Figure 64.3: Co-management: fostering linkages between stakeholders at all levels. **Source:** Adger/Arnell/Tompkins (2005: 6); at: <http://www.ecologyandsociety. org/vol10/iss2/art9/>.



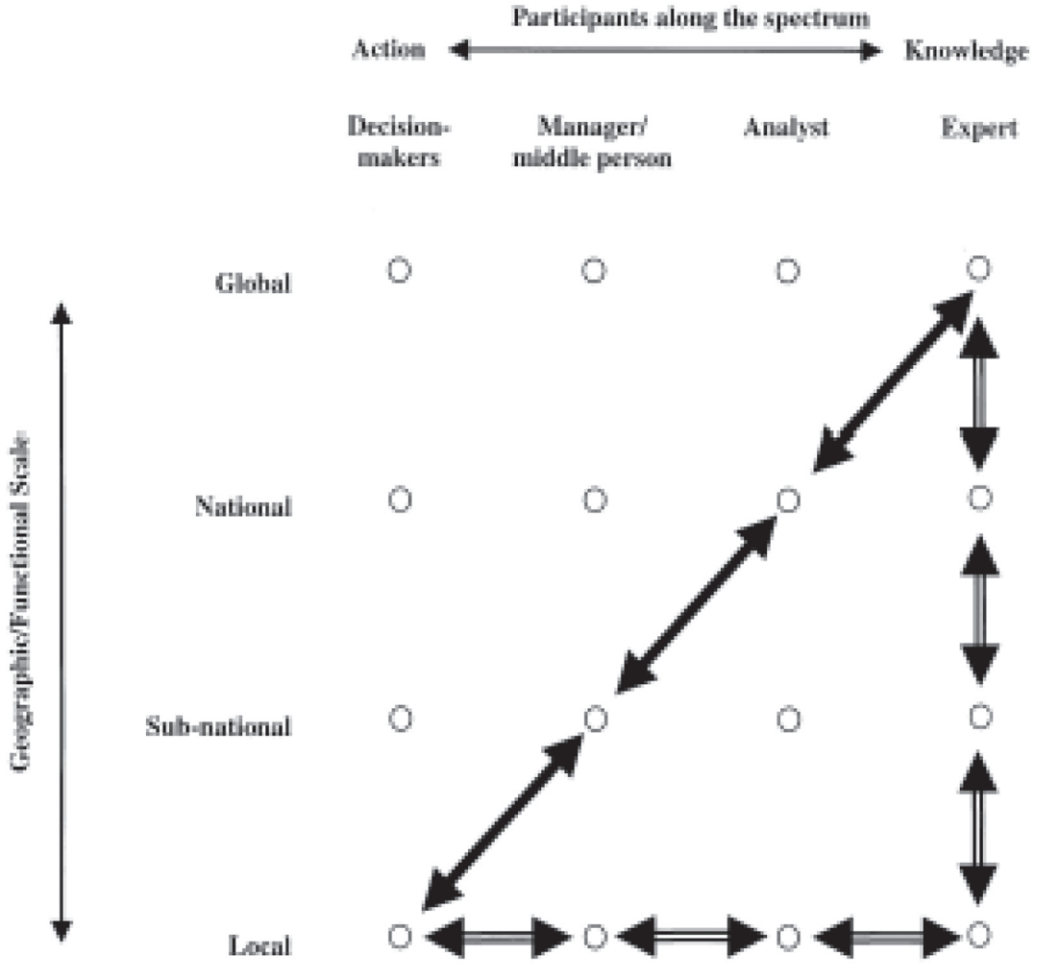
of *United Nations University* (UNU) and the *United Nations Environment Programme* (UNEP) defines innovative communities as those that can bring in novel solutions to respond to changing environmental conditions. Good governance facilitates the formation of innovative communities (UNEP-IETC 2003: 6 of 21). However, the challenge is to develop institutional structures that understand the underlying ecological and social processes at different scales and take them into consideration for decision-making (Folke/Carpenter/Elmqvist/Gunderson/Holling/Walker 2002: 440).

Adaptive governance is a concept that involves the evolution of institutions in response to changing conditions. This is especially critical to issues whose understanding evolves over time and engages a host of stakeholders, often with diverse views and interests. A governance structure that is adaptive would essentially need to co-ordinate between multiple stakeholders and interests across different scales and levels (Guerin 2007: 13). Another related concept is that of co-management i.e. sharing of rights and responsibilities between multiple stakeholders (figure 64.3; Cash/Adger/Berkes/Garden/Lebel/Olsson/Pritchard/Young 2006: 8 of 12). These linkages between stakeholders at different scales can be regulated through the creation of social networks as a platform for sharing of knowledge (Adger/Brown/Tompkins 2005: 6 of 14). This background leads to the next section on the need for governance mechanisms to be nested at different levels in order to address the differential vulnerabilities.

64.3.1 Why Does Governance Need to be at Multiple Levels?

The 'Rio Declaration on Environment and Development' (1972) emphasized the importance of establishing decision-making entities at different levels in order to appropriately reflect the interests and concerns of the vulnerable and disadvantaged communities. Institutions can facilitate the flow of information and sharing of resources between stakeholders at various levels (Cash/Moser 2000: 115; figure 64.4). An approach to enable the participation of vulnerable communities in decision-making and planning for their own well-being, would essentially need to be multi-level; which

Figure 64.4: Cross-scale interaction between institutions. Circles indicate potential points of entry for cooperating individuals or institutions. Black arrows and open arrows indicate hypothetical pathways. **Source**: Cash/Moser (2000: 115).



may involve the national and sub-national levels and interactions between them (Paavola/Adger 2006: 605).

Multi-level governance (MLG) is "a system of continuous negotiation among nested governments at several territorial tiers – supranational, national, regional and local" (Lemos/Agrawal 2006: 313). Institutions having a multi-level structure have the potential to improve the fit between theory and action at the ground level, especially in a heterogeneous[7] environment (Lebel/Anderies/Campbell/Folke/Hatfield-Dodds/Hughes/Wilson 2006: 4 of 21). While it is crucial for public policies to reflect ground aspirations, engaging all the stakeholders can be a cumbersome process in terms of the time and resources involved. This happens due to the existence of diverse interest groups, that can influence the dynamics of policymaking. For example, the strong engagement of civil society organizations does contribute to mobilizing social forces, creating consensus, ensuring transparency and decentralization (Reuben 2004: 202). Cooperation among various stakeholders such as the government, civil society and the private sector forms a critical pillar to lay the foundation for good governance (Punyaratabandhu 2004: 2 of 22).

Another drawback of a multi-level functional arrangement can arise due to the inefficiency of coordination among the diverse units within the same level and between levels. Furthermore the accountability is often directed towards the higher authorities but not towards the lower levels (Lebel/Anderies/

7 Heterogeneity may arise due to difference is social status, economic power, demographic profile etc. The constitution of heterogeneity may differ from region to region.

Campbell/Folke/Hatfield-Dodds/Hughes/Wilson 2006: 4 of 21).

64.4 Federalism and Multi-Level Governance in India

With the end of the British rule in India and the partition, it seemed that only a unitary rule controlled at the Centre[8] could maintain law and order in the country. Though a strong central rule was important in the newly-independent India, given the heterogeneity of the population in India, having another level of authority was inevitable. A federal structure of governance has two levels – the centre and the state, each being an autonomous legal and administrative entity. Under a federal framework each level has independent tax bases, a written constitution and independent courts to resolve potential disputes between the centre and constituent states. The Indian constitution has a clear division of power between the centre and the state governments, both elected directly through elections.

The Centre controls the issues that involve interstate matters, national security and foreign affairs; while subjects such as agriculture, land and water are under state governments. The centre possesses a higher fiscal power because it has under its control sources of revenue such as import/export duties and income and corporate taxes. On the other hand, the sources of income for the states are declining due to the pressing need to reduce taxes associated with land, education, health and development, owing to a rise in population. A part of the Central Government income goes to the state but the allocation of finances and investment priorities are defined by the Planning Commission which is under the purview of the Central Government. Furthermore, there are wide disparities between the socio-economic and demographic profile of different states in India that often makes it difficult to have adequate state-level representation in the decision-making process at the centre (Mitra 2000: 51).

Both federalism and MLG were designed to avoid the concentration of power at one centre. The MLG is in many ways an extension of a federal form of governance that only has two levels – the centre and the state. The points of difference are that while federal governance is still restricted to the political domain of government, MLG goes beyond that to engage multiple stakeholders, vertically and horizontally. Being concentrated in the political arena, the federal form of governance allocates the decision-making authority to the top level of government, however in MLG, decision-making assumes a shared nature with every unit having a say in the decision. With several functional units, there may be huge transaction costs in MLG thus making the decision process time-consuming and resource-intensive (Stein/Turkewitsch 2008: 11 of 35). The next section discusses how India evolved from a purely federal form of governance to a multi-level governance system that exists today.

64.4.1 From Federal to Multi-level Governance

Till 1992, the Indian federal structure of governance was two-tiered, with powers divided between the central and the state level only. Local government units existed in urban and rural areas as informal structures. In rural areas, Panchayat Raj Institutions facilitated the basic community services and justice. The 73rd and 74th Amendments to the Constitution in 1992 gave the rural and urban local governments a proper constitutional status. In many states, a three-tier structure of local government was formed with Panchayats being established at the village, block and district level (Rao 2000; figure 64.5).

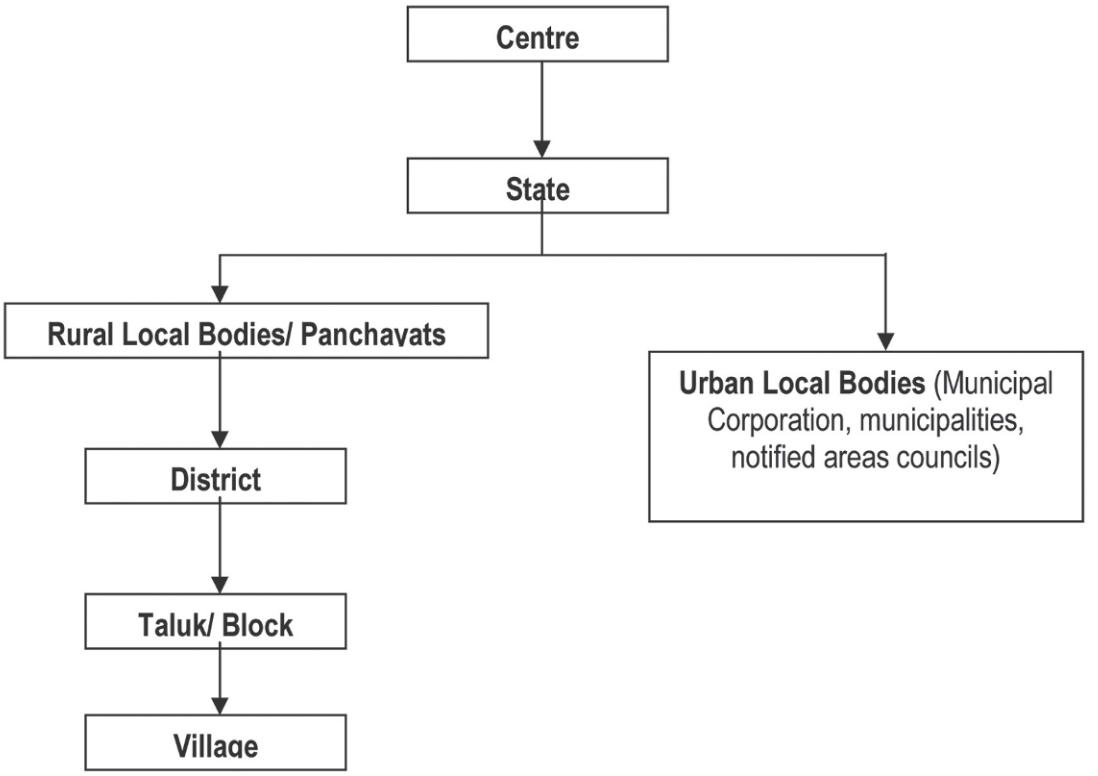
64.4.2 Decentralization and Local Governance

With the development of local level governance, the concept of decentralization became widely popular in India. Decentralization can be defined as the "transfer of powers from central authorities to lower levels in a political-administrative and territorial hierarchy" (Larson/Soto 2008: 216). Globally the concept of decentralization gained momentum from the mid-1980's also marking the dethroning of two global trends – colonialism and authoritarianism. This was the period that increasingly recognized the potential of the society as a solution to the problems related to the environment and natural resources rather than just being a source of the problem.

Decentralization can influence how decisionmakers at the lowest level of jurisdiction relate to those at the highest level; how local decision-makers connect to the grassroots community and how community members interact with each other and their environment (Lemos/Agrawal 2006: 303). One of the benefits of decentralization is that it often induces compe-

8 The Centre here refers to a unitary rule with powers concentrated at the national level or the highest level of authority in the country.

Figure 64.5: Structure of multi-level government in India. **Source:** Rao, G. (2000: 11); at <http://www.imf.org/external/pubs/ft/seminar/2000/fiscal/rao.pdf>.



tition among local governments for better efficiency in terms of responding to local needs. On the other hand, corruption can lead to unscrupulous bias towards certain elite or special interest groups (Hooghes/Marks 2009, 227: 225–241).

The efficiency of decentralization depends to a large extent on its design. Certain factors that govern efficiency of decentralization include the authority to react to local needs, accountability and mechanisms that enable a free flow of information to obtain feedback from the grassroots level. Factors that impede effective decentralization include the creation of parallel structures that overlap with those of the local governments, inadequate public participation and representation of diverse groups (especially women and minority groups) and lack of adequate functional and fiscal authority. Despite the third tier being created under the federal structure of India in 1992, the states continue to maintain their control over the Panchayats, in a way that often undermines the decision-making authority of the third tier – the local government (Jayal 2007: 42). One of the biggest challenges is associated with fiscal decentralization. The sources of revenue for the Panchayat are mainly derived from taxes on local resources such as land, animals, user fees and charges for local activities such as grazing, fishing. There are also many other routes of transfer of fiscal resources from the centre to the states. These are mainly in the form of grants provided by the Central Government as approved by the *Central Finance Commission* (CFC) and the Planning Commission and partial and full grants provided by various central ministries to their respective state ministries (Rao/Singh 2001: 8). The issue is that the local governments have not been empowered to raise their own funds and the funding received from the state is often premarked for specific activities, thereby restricting the fiscal autonomy of the *Panchayats* to spend these funds. This is critical because, adaptation activities are very region-specific and often require targeted investments. The inability of local governments to divert funds towards local level adaptation from these 'tied' funds can impede capacity building activities at the local level (Jayal 2007: 43).

Decentralization by itself will not necessarily produce systems that are more effective or more accountable to local needs and interests. This would require fiscal and political support from the higher levels of governance and decision-making. Another important factor is the presence of leaders and visionaries to

build sustainable partnerships and create institutional mechanisms and an enabling environ-ment for appropriate actions (Johnson 2003: 8 of 60). India abounds with examples of local leadership. For example, the case of village Hiwre Bazar in the Ahmadnagar district *of* Maharashtra and the *Adarsh Gaon Yojana* (AGY) or the 'Ideal Village Programme' that was launched across 300 villages in the state of Maharashtra in 1995 with the idea of developing one village from each taluka as an ideal village by providing safe drinking water, employment, fodder, education and health services. The steps under the full implementation of the programme included donation of labour, family planning, ban on grazing, ban on tree cutting and ban on liquor. Hiwre Bazar was a drought prone village with an average annual rainfall between 625–700 mm, rampant soil erosion due to heavy runoff, declining water tables and reduced water availability, making agriculture an unfeasible option for this village. In 1989, Popat Pawar was elected as the sarpanch (village headman/leader) and the village adopted a holistic development plan giving high priority to drinking water, irrigation and education. In the course of years under his leadership and the aid of AGY, the community also shifted to less water-intensive cropping patterns and is a prosperous village today.[9]

In terms of the proportion of the total government expenditure that occurs below the state level, India is one of the most fiscally decentralized countries in the world. However, a major concern that is encountered is in terms of revenue sharing with states. Some states are able to better manage funds owing to better endowments, less climatic stress and better socio-economic conditions as compared to their less-endowed counterparts (Kletzer/Singh 1996: 9 of 27). More than 2.7 million people have been elected to official posts for the three levels of Panchayats. However the formal transfer of functions has not been matched by a parallel transfer of funds for effectively performing specific adaptation functions. To address all these issues, during the Eleventh Five Year Plan (FYP) for the country (2007–2012) reforms would focus on building mechanisms for increased participation of communities in decision making and streamlining fiscal systems to match these activities (GoI 2006, 18 of 80). The Eleventh Five Year Plan of India has laid the details for district-level planning to prepare an integrated plan for the local level governments by taking stock of allocated tasks in terms of the institutional, financial and human resources available. This information would provide inputs into a vision document for each district and local-level government encompassing agriculture and allied sectors, water resources, infrastructure including power, water and sanitation, education, poverty alleviation, gender equality and social justice. Such a need-based assessment at the Panchayat level can aid in strategizing the activity-wise funding to be allocated to the local governments and accordingly assigning specific purpose grants and partial and/or fully untied funds (GoI 2008a: 16 of 25).

The planning process in India has been driven by the agenda of poverty alleviation. However, despite considerable poverty reduction efforts, about 280 million persons in rural India still fall below the poverty line[10] with many being agricultural labourers and artisans. Furthermore, there are wide inter-state variations in these rural poverty figures that can be strongly attributed to the regional variations in agricultural productivity among other factors. To plan targeted programmes for strengthening adaptive capacities given these regional variations, there is a need for the activities at the national and state level to link with those at the community level.

64.5 Adaptation to Climate Change in India: Opportunities and Challenges for Governance

64.5.1 Sectoral Impacts of Climate Change in India

The *Initial National Communication* (NATCOM) submitted by the Government of India to the *United Nations Framework Convention on Climate Change* (UNFCCC) highlights the potential threats to India due to changes in climatic variables and occurrence of climatic extreme events such as droughts and floods. These threats include:

- Changes in agricultural yields, pestilence and crop diseases and food insecurity;
- Reduction in the availability of freshwater;

9 Retrieved from <http://www.rainwaterharvesting.org/catchwater/aug2001/initiative.htm> (22 April 2009).

10 Government of India, Planning Commission, 2008: *Report of the XI Plan Working Group on Poverty Elimination Programmes* (New Delhi: Planning Commission); at: <http://planningcommission.nic.in/aboutus/committee/wrkgrp11/wg11_rdpov.doc> (6 January 2008): 5 of 91.

- Shifts in the forest boundaries and changes in species diversity;
- Impacts on sensitive ecosystems such as mountainous regions and coastal ecosystems including wetlands, mangroves and coral reefs;
- Sea-level rise and inundation of low-lying regions and coastal zones;
- Adverse impacts on human health due to changes in virulence patterns of disease-causing agents; and
- Impacts on infrastructure and energy demands (GoI 2004).

In 2008, the Council on Climate Change headed by the Prime Minister of India released the country's first *National Action Plan on Climate Change* (NAPCC). The objective of the NAPCC was to strategize national priorities in response to climate change and associated risks. The NAPCC identified eight national priorities including solar energy, enhanced energy efficiency, sustainable habitats, sustaining the Himalayan ecosystem, increasing forest cover, sustainable agriculture, information sharing and dissemination for climate change and water resource management (GoI 2008c: 9 of 56). Governance mechanisms will have to be bolstered in each of these sectors in order to adequately boost capacities of individuals, communities and institutions to effectively respond to the impacts of climate variability and change. Adaptation in the forestry and agriculture sector in India is discussed ahead, under the vulnerability and governance lens.

64.5.2 Adaptation in the Forestry Sector

Under a changing climatic scenario, vegetation model runs for India indicate a likelihood of shifts in forest boundaries and associated changes in forest types, changes in net primary productivity and changes in species diversity. These impacts will have large-scale repercussions on a population of nearly 200 million that is dependent on forests and forest produce for their livelihoods (GoI 2004: 94 of 266). The NATCOM also identified several strategies to enable adaptation in the forestry sector. These steps include:

- Forest fire protection and management;
- Promotion of sustainable harvest and reduction in over-extraction of forest-based products and non-timber forest products;
- Fuel wood conservation programmes;
- Forest conservation, afforestation and reforestation measures;
- Promotion of natural regeneration in degraded forest lands and agroforestry on degraded non-forest lands;
- In-situ and ex-situ conservation of endangered flora and fauna (GoI 2004: 103 of 266).

During the mid-1970's and 1980's several dialogues emerged around efficient institutional mechanisms for sustainable natural resource management. The idea of community–state partnership was put forward as a practical method to bridge gaps between the government and the grassroots communities (Kumar/Vashisht 2005, 28: 28–38). In 1988, the *Joint Forest Management* (JFM) programme in India, emerged as an attempt to establish synergies between the state forest department and the indigenous forest communities for forest conservation and restoration. JFM sought to build the capacities of forest-dependent communities using incentives for forest conservation. However, a critical analysis of JFM throughout India reveals that the state forest department still maintains stringent authority over the entire decentralization process, with the local governance structures being dependent on the state to a great extent, rather than being autonomous. JFM has received criticism because of the apparent deployment of the local community by the state government as a cost-effective way to maintain forests rather than a mode to create local capacities and self-reliance of the forest-based communities (Kumar/Vashisht 2005, 31: 28–38).

The Eleventh Five Year Plan for India envisages a district-level plan for the forestry sector that includes the conversion of forest villages into revenue villages, settlement of disputes over forests, livelihood rehabilitation of the displaced forest-based communities and mapping of all occupied lands with due validation from the local government, the state Forest Department and Revenue Department (GoI, 2008a, 19 of 25). Under the NAPCC, the Prime Minister of India announced a Green India Campaign for the afforestation of 6 million hectares. This mission will be taken on degraded lands with the help of local communities facilitated through JFM Committees and the state Forest Departments (GoI 2008c: 9 of 56).

64.5.3 Adaptation in the Agriculture Sector

The agriculture sector in India contributes to 21 per cent of the GDP, 11 per cent of the total exports and provides a source of income for 56.4 per cent of the total workforce (GoI 2007: 1 of 11). With over 600 million dependent on the sector directly or indirectly, the agricultural sector is vital to India's economy.

Nearly 66 per cent of cultivated land is rain-fed and nearly two-thirds of the total cultivation is done on arid and semi-arid lands. All these factors heighten the vulnerability of this sector to the impacts of climate change. Other issues that cause concern in the agriculture sector include rapid degradation of the natural resource base, slow development of relevant technology, lack of proper institutional mechanisms for financing, widening economic gap between irrigated and rain-fed areas, presence of perverse subsidies and rapid decline in groundwater levels, with small and marginal farmers being at maximal risk (GoI 2008d: 12 of 85).

Strong institutional mechanisms in the form of community-based organizations often play a major role for coping with the impacts of climatic stresses on the agricultural sector, especially considering the paucity of formal sources of financial assistance such as credit and insurance services in the rural areas. Key areas where governance can play a role in enabling communities to cope with impacts of climate variability and change on agriculture include the following:

- *Information availability and access*. Timely and quality information on climatic variables can enable farming communities to conduct advance decision-making to reduce risks and agricultural losses associated with changes in the climatic variables. There is a need to address the issues such as generation of region-specific data on a continual basis to represent different time periods, conversion of data into a form that is easily comprehendible at the grassroots level, dissemination of the generated information, ability of the vulnerable communities to access and use this information to alter their short-term and long-term decision-making related to agriculture (changes in cropping pattern, timing of irrigation, harvesting and application of fertilizers etc.) to minimize their agricultural losses and maximize the market benefits.
- *Development of appropriate technologies combining scientific know-how and traditional knowledge*. Traditional knowledge is representative of the local biophysical and social capabilities hence these indigenous strategies should form the basis for technological innovations in order to ensure local acceptability and function effectively under changed climatic conditions. Investments in research and development based on a thorough knowledge of the local conditions such as soil type, ground elevation, water availability – includes surface water and groundwater, farming practices etc. could be used to develop cultivable varieties that are tolerant to harsh enviro-climatic conditions (such as droughts, excess salinity, pestilence etc.). Furthermore, based on past and current climatic trends, new and improved scientific models and assessment techniques can be used to predict changes in climatic variables and associated impacts on water availability, soil nutrient availability, crop yields etc.
- *Climate-risk proofing of rural development activities*. Government-assisted programmes are often not directly aimed to reduce vulnerability to climate change; but indirectly they enhance adaptive capacities by reducing poverty and enhancing overall development and access to services. There are numerous options that can enable integration of direct and indirect vulnerability reduction strategies into regular developmental activities in the agricultural sector. These include crop-breeding techniques for introduction of drought-tolerant and salt-tolerant varieties, efficient irrigation techniques, early warning systems and strengthening of *information and communication technologies* (ICTs) in rural areas. To cope with the damage potential of climatic extremes, the deployment of a mix of structural and non-structural measures is critical. However, the key concern is to facilitate these mechanisms while ensuring equitable access for the communities and ensure a participatory mode of community-level management of resources and developmental investments. It is also essential to enable and strengthen access to financial products (such as credit/loans, insurance etc.) that enhances the resilience of the communities to climatic shocks and to identify the role of community-based organizations to promote such products.
- *Water Resources Management*. Since the agricultural sector is inextricably dependent on water resources, hence to ensure the sustainability of agricultural production and addressing food security concerns, there is a need to target water resources management. Apart from water conservation, the issue of supply and demand side management needs to be addressed. While agriculture suffers in certain areas because of continuous water shortages, others suffer because of excess water inundating or washing away the fields or spoiling the crops. This underscores the need for effective management of available water resources by addressing policy issues related to river basin management, groundwater and surface water management.

During the Eleventh FYP, the main assistance planned for the agriculture sector at the district level will be related to access to credit and other financial and risk-sharing and pooling mechanisms such as insurance. Specific steps would involve revival and restructuring of the agricultural credit and cooperative societies and groups, provision of credit and loans for purchase of land by the landless, enhancement of the public distribution system inter alia (GoI 2008b).

64.6 Conclusions

The impacts of climate change are already being felt on different ecological and biological systems. Though there are several mechanisms to temporarily cope with the impacts of short-term changes in the climatic variables, however, in the long-term adaptation is inevitable. Adaptation not only encompasses risk reduction strategies but also strategies to make use of the opportunities under the changing climatic conditions. These strategies may be taken up at the individual level or at the level of a community. Just as vulnerability is not the same across the society, similarly adaptation strategies will not be the same for all. Government bodies and other non-government stakeholders can enable vulnerable individuals and communities to adapt to climate change. The success or failure of these efforts depends on the governance framework under which all these stakeholders operate. A multi-level governance framework allows for adaptation strategies to be devised at the level at which the vulnerability is most felt. In structure, a multi-level governance framework can be considered to be an extension of a simple federal structure that operates on two levels – the centre and its constituent states. India since the time of its independence has had a federal structure of governance. In 1992, a third tier of local level government was added to this federal structure making it multi-level. The impacts of climate change are most felt at the local level owing to high vulnerability due to heavy dependence on climate-sensitive sectors, lack of adequate adaptive capacities and low levels of socio-economic development. Creation of this third tier paved the way for decentralization and an entry point to build capacities at the local level. However, effective decentralization faces several obstacles that limit the decision-making power and fiscal authority at the lowest level.

The Eleventh Five Year Plan of India seeks to address the bottlenecks in the path of effective decentralization and empowerment of grassroots communities. This will further allow for the development of appropriate adaptation strategies at every level of governance with particular importance to the local level. The vision of the great leader of India, Mahatma Gandhi was,

> in this structure of innumerable villages, there will be ever widening, never ascending circles. The outermost circumference will not wield power to crush the inner circle but will give strength to all within and derive its own strength from it.

To propel this vision into reality, it is essential to realize the opportunities and overcome the bottlenecks within the existing multi-tiered governance framework to enable effective adaptation to climate change.

65 Coping with Climate Change Impacts on Coffee and Maize for Peasants in Mexico

Cecilia Conde

65.1 Introduction

In the Mexican states of Tlaxcala (figure 65.1; no. 29) and Veracruz (no. 30), two case studies cases were developed to assess the impacts and possible responses to climate change and climate variability on maize and coffee producers. These two types of producers have differences but also similarities.

Maize production has been developed for more that 500 years in Mexico. Maize is the main source of food for the Mexican population, and it is cultivated mainly for subsistence purposes. Impacts on maize production have and will have severe consequences on food security in Mexico (Ziervogel/Nyong/Osman/Conde/Cortés/Downing 2006: 16). Currently, governmental policies oriented to support these subsistence peasants are scarce, and have been weakened since 1994 because almost all agricultural subsidies were withdrawn, in the context and due to the implementation of the *North American Free Trade Agreement* (NAFTA; Nadal 2000: 19). In this situation, it is difficult for maize farmers to develop or apply coping measures.

On the other hand, coffee production is mainly oriented to exportation, and became economically important during the last fifty years, when the demand of foreign markets and the agricultural policies in Mexico impelled peasants to switch from other cultivars to coffee production. Given the international fall or volatility of coffee prices, the organic production of coffee for some producers has been seen as an alternative, which might be consistent with environmental preservation and with adaptation to climate change (Muller 2009: 4).

Regardless of their differences, the coping capacities of these two types of producers have been diminished. In both study sites the increase of climatic extreme events have affected the agricultural production, but also the drop of prices and the lack of adequate agricultural policies have expelled rural population to urban areas or, mainly, to the United States of America (USA). Although the study was conducted only in one county (Tlaxco, Tlaxcala; figure 65.2) with maize producers (Conde/Ferrer/Orozco 2006: 182) and in one county (Coatepec, Veracruz; figure 65.2) with coffee producers (Gay/Conde/Eakin/Seiler/Vinocur/Wehbe 2006: 170), both cases shared main characteristics that might support some general conclusions for both types of peasants in Mexico.

For more than a decade, climate change studies have followed the path of generating climate change scenarios, introducing those scenarios to models that are used to assess potential impacts, and from there, draw some general conclusions regarding vulnerability and adaptation (Gay 2000: 95). New studies are now centred on understanding the sources of vulnerability, and the practices, barriers and opportunities of adaptation (Adger/Agrawala/Mirza/Conde/O'Brien/Pulhin/Pulwarty/Smit/Takahashi 2007; Carter/Jones/Lu/Bahdwal/Conde/Mearns/O'Neill/Rounsevell/Zurek 2007: 727; Lim/Burton/Huq 2005: 1). For that purpose, interdisciplinary research teams are assembled, stakeholders' involvement takes place since the beginning of the projects (Conde/Lonsdale 2005: 52), and new tools are being tested to elucidate and communicate current and future climatic threats. These new approaches have not diminished the quality of regional climate change scenarios, nor have they abandoned potential impact models, but they have shifted the emphasis to those issues that are regarded as urgent in Mexico, and that are highly demanded by policy makers.

The focus of these studies was on the observed climate changes, including more frequent or intense extreme climate events, which are of high concern for peasants in both regions. Considering the climatic trends, farmers perceived that their coping capacity is being reduced, not only because of climate variability and change, but mainly because their socio-economic conditions have reduced their ability to cope with those climatic events.

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Figure 65.1: Federal states of Mexico and the study area in Tlaxcala (No. 29 in the list of states) and Veracruz (No. 30 in the list of states). **Source:** OECD (1998: 3).

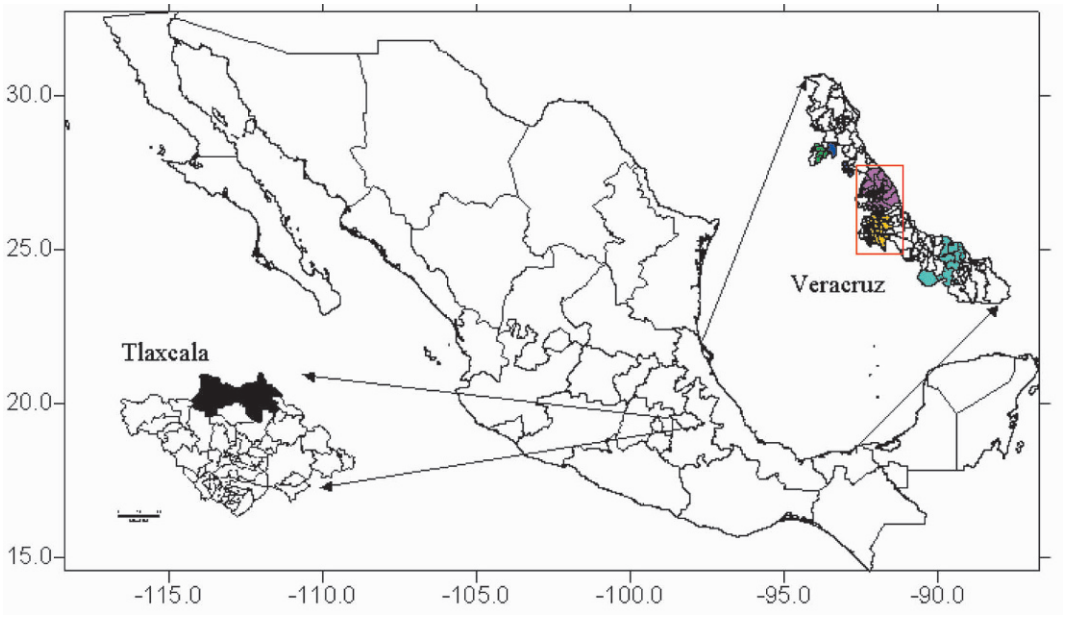
Given the current climate and future climate projections, in one study area (Tlaxco, Tlaxcala, figure 65.2), adaptive measures were implemented (Conde/Ferrer/Orozco 2006: 186) but only partial success was gained, indicating that adaptive measures were constrained to the achievement of the know-how or 'ownership' of those measures by the peasants involved in the project. That is, adaptation was determined not by those measures, but by the adaptive capacities acquired (or not) by the key stakeholders.

Based on that previous experience, the concern of the ongoing study in Coatepec, Veracruz (figure 65.2) will be the detailed analysis of the viability of possible adaptation measures. The coffee producers decided that the project should be focused on environmental services (Castro/Conde 2006: 1; Conde/Calderón/Castro 2008: 9); since they expect that they will have other sources of income with such services. No practical adaptation measures have been implemented so far. Instead, studies are currently being developed that sustain the payment of environmental services, such as carbon dioxide sequestration by coffee plantations, regional biodiversity conservation, and regional climate benefits rendered by the forests where coffee has been planted. Stakeholders' involvement in both studies can be considered nevertheless as an adaptation measure, because it might ensure the viability of future practical measures. Factors that determined the adaptive capacity of coffee producers is currently being assessed.

In this chapter, the background of climate change studies is first presented to explain why the current efforts are centred now on the enhancement of the adaptive options of the agricultural sector. In the description of the applied methods (participatory and regional climate change scenarios) the participatory techniques are emphasized as means to bridge knowledge between researchers and farmers on observed climate changes and the current responses to it, but also to communicate possible climate changes in the future and to discuss the viability of the chosen adaptation measures.

The methods to generate regional climate change scenarios that were presented to farmers in both study sites are also described in this section. Even though communicating climate change scenarios is a difficult task, in our research we did not 'average' those scenarios or have tried to minimize the impor-

Figure 65.2: Map of the two study areas in Tlaxcala (Tlaxco county in black) and Veracruz (coffee regions are shaded; inside the box is the central region, that includes Coatepec, and that is the most productive region), Mexico. **Sources:** elaborated by the geographer Raquel Araujo, postgraduate student (unpublished).



tance of uncertainty associated with future climate change.

Finally, the results achieved in these two studies are discussed, showing that the perception of current climate change is shared by both types of peasants, that their adaptive actions are being reduced by the lack of agricultural policies that can support their adaptive choices. In both study sites, migration of young farmers is a source of current and future vulnerability that can jeopardize any adaptation strategy.

Migration of the rural population has occurred in both study sites for decades. Migration of young men and – more recently – also of young women to cities in Mexico or to the United States of America, is one of the non-climatic factors that have determined the current vulnerability in the agricultural practices in Mexico. In 2004, 10.23 million Mexican migrants – especially from rural areas – lived in the USA, a population that has grown at an annual rate of 4.2 per cent since 1994.[1] In the same year, 16,613 million US$ in remittances were sent by migrants to Mexico.[2] The remittances to Mexico represented the second largest source of foreign income, after oil exportations.

These factors have determined that the rural population is one of the oldest in Mexican history. In 2003, according to a study for the Minister of Agriculture (Gay/Conde/Gómez/Cortés/Monterroso/Rosales/Eakin/Paz/Echanove 2004: 2–3), the majority of those who received governmental support were more than 50 years old, and one third of the beneficiaries were women. Households are supported by older men and women who would require specific adaptation strategies to cope with climate variability and change.

65.2 Research on Climate Variability and Change in Mexico

Mexico occupies around 195 million hectares, 85 per cent of them have arid and sub-arid climates. Only 7 per cent of the territory (in the southeast) receives almost 40 per cent of the total annual rain of the country (Reyes-Castañeda 1981: 58). The Tropic of Cancer can be seen as the division between the arid and semiarid with the humid and sub-humid climates (Rzedowski 1978: 33).

The climate in Mexico is mainly established by the interaction of tropical systems in summer and the middle latitude systems during winter (Magaña 1999: 23). Other meteorological phenomenon that also influence the rainy season in Mexico are: the position

1 CONAPO, 2004: "Población nacida en México que reside en Estados Unidos. 1990 a 2004"; at: <www.conapo.org.mx> (20 July 2005).

2 Banco de Mexico, 2004: *Informe Anual 2004*; at: <www.banxico.org.mx> (20 July 2005).

of the *Intertropical Convergence Zone* (ITCZ), the North American Monsoon, and the hurricane activity. Regardless of those generalizations, there are differences in regional climate determined by latitudinal and orographic conditions.

These climatic circumstances are fundamental for the agricultural activities, which are developed mainly in rain fed conditions during the spring – summer season. Climate variability – particularly extreme events – can then severely impact production and the well-being of the rural population.

Climate variability in Mexico has been highly associated with El Niño/Southern Oscillation (ENSO). In Mexico during strong El Niño events (Magaña 1999: 29), generally summer droughts, followed by spring droughts, are expected. These droughts are coupled with high temperatures in both seasons, conditions that have affected agricultural production all over the country (Conde/Ferrer/Gay/Magaña/Pérez/Morales/Orozco/ 1999: 109). In contrast, floods and landslides have occurred during strong La Niña events, because over than normal precipitations usually occurs during those events.

Other climatic extreme events, such as unexpected frosts, or strong winds, are also part of the most worrisome climatic events for farmers. Therefore, the possible enhancement in frequency or intensity with climate change of ENSO or other climatic extreme events are of more concern to peasants in Mexico than the changes in the climatological values usually shown in the climate change scenarios.

Working Group I of the *Intergovernmental Panel on Climate Change* (IPCC, WGI 2007: 5) states that the warming of the climatic system is unequivocal, and that at continental, regional and ocean basin scales, numerous long-term changes in climate have been observed. Studies for Mexico have shown that the country's averaged summer temperature and precipitation have increased (i.e. Conde 2003: 2–38), but regional differences were found. For both study sites of this chapter, and considering a 90 year period, summer temperatures have indeed increased, but precipitation has decreased.

WG1 of the IPCC (IPCC, WGI 2007: 7) also stated that there have been "changes in the precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones". Regional studies related to the change in the intensity, frequency or duration of extreme climatic conditions are being developed (López 2009: 3; Lozano 2009: 1), but some indication of those changes were pointed out by Conde (2003: 2–42). Climate change studies have been developed in Mexico for more than a decade (box 65.1). High resolution scenarios have been developed, new methods for impact assessments are applied, and projects focused on capacity building and the enhancement of adaptive capacity are now being performed.

The Mexican government has supported many of the studies that are listed in box 65.1. The *National Strategy for Climate Change* (2007) and the *Special Programmes for Climate Change* (2009) – although they are centred mainly on mitigation options - have included important analyses of the possible impacts and adaptation options for productive sectors and regions: biodiversity, agriculture, hydrological resources, fisheries, livestock, coastal zones, human health, and human settlements. Goals and activities that will be supported are also included in those documents.

However, more in depth studies are needed to assess the viability of listed adaptation measures, and current vulnerability and adaptation assessments should sustain the analysis of future adaptation options, since current policies, practices or processes may be barriers for adaptation or even the source of increasing vulnerability.[3] Without these analyses, adaptation measures suggested by researchers or even by key stakeholders involved in the study might be frustrated.

65.2.1 Tlaxcala Case Study

Rain fed agriculture is predominant in Mexico, and the main crop is maize. Subsistence of poor peasants is based on the year to year production, an activity that is constantly threatened by drought, and that usually renders low yields of maize. In the Mexican history (Florescano/Swan 1995: 55–56; chap. 51 by Arredondo/Huber Sannwald), drought events have produced severe social and economical stresses, particularly in the years previous to the independence of Mexico (1810) and previous to the Mexican Revolution (1910–1917). Some of those severe droughts were associated with strong El Niño events (Jáuregui 1995: 41). At the national level (Gay/Conde/Gómez/Cortés/Monterroso/Rosales/Eakin/Paz/Echanove 2004: 5–7) drought is still the source of most agricultural losses. The intensity and duration of recent drought

3 See Adger, Agrawala, Mirza, Monirul, Qader, Conde, O'Brien, Pulhin, Pulwarty, Smit, Takahashi 2007; Carter, Jones, Lu, Bahdwal, Conde, Mearns, O'Neill, Rounsevell and Zurek (2007: 721).

Box 65.1: Overview of Research on Climate Change in Mexico. **Source**: The author.

Initial studies related to climate change were developed in the Center of Atmospheric Sciences (i.e. Adem/Garduño 1984: 55; Conde 1996: 2), mostly based on simulated atmospheric responses to the increases of CO_2 and other greenhouse gases. Other studies focused on historical trends of climatic variables and extreme events (i.e. Jauregui 1995: 96, 1997: 39–40; Gay/Estrada/Sánchez 2009: 148). Recently, regional climate change scenarios were generated for Mexico and for Central America with a resolution of 5' x 5' (≈ 10 km x 10 km). Also a guide to generate those scenarios for different regions and at different scales.[a)]

Studies that generated climate change scenarios and the possible potential impacts on relevant sectors or regions in Mexico were initially developed in the U.S. co-sponsored Country Study Project.[b)] The organization of that project followed a similar structure of the IPCC, creating the critical nucleus for future investigations.

The Mexican Government has strongly supported the research on climate change issues, involving most of the researchers that participated in the Country Study Project. Since then, Mexico has delivered its Third National Communication (SEMARNAT/INE 2006)[c)], to the *United Nations Framework Convention on Climate Change* (UNFCCC), and in 2009 it is finishing its fourth. The Mexican government has also launched a *National Strategy for Climate Change* (ENAC)[d)] that was presented by the President of Mexico in 2007 and *Special Programmes of Climate Change* (PECC) has been announced to support that Strategy.[e)]

Initial studies of the impacts of climate change on rain fed agriculture in Mexico[f)], showed that Mexican agriculture is highly vulnerable to climate variability and change. Current studies related to potential impacts of climate change were developed recently for the *Fourth National Communication*. Results concerning human settlements, fisheries, livestock, hydrological resources, forestry, and guides for generating scenarios and developing regional Action Plans can be found at the web page of the Center of Atmospheric Sciences.[g)] Regardless of these advances, few projects have involved key stakeholders in the design of adaptive measures. Some examples can be found in the results reported in the project: *Integrated Assessment of Social Vulnerability and Adaptation to Climate Variability and Change Among Farmers in Mexico and Argentina* that integrated interdisciplinary research groups and focus more on vulnerability and adaptation. This project was developed in the context of the project *Assessments of Impacts and Adaptations to Climate Change (AIACC) in Multiple Regions and Sectors that* supported 24 regional studies in 46 countries.[h)] In the project *Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico and Cuba,* whose results were presented to the *United Nations Development Programme* (UNDP) by 2006–2007, the methods to involve stakeholders described in the Adaptation Policy Frameworks (Lim/Burton/Huq 2005: 1; Conde/Lonsdale 2005: 52) were applied, and the goal in the Mexican study case for the agricultural sector (Conde/Ferrer/Orozco 2006: 186) was the application of several adaptation measures.

a) Conde, Gay, Estrada, Fernández, López, Lozano, Magaña, Martínez, Sánchez, Ramírez, Zavala and Zermeño (2008); at: <www.atmosfera.unam.mx/gcclimatico/documentos/reportes_cuarta_comunicacion/Escenarios/Guia_escenarios.pdf>.

b) See at: <www.atmosfera.unam.mx/cambio/libro.html>; Gay (2000); Conde, Liverman, Flores, Ferrer, Araujo, Betancourt, Villarreal and Gay (1997); Magaña, Conde, Sánchez and Gay (1997); Mendoza, Villanueva and Adem (1997); Villers and Trejo (1997).

c) See at: <www.ine.gob.mx/publicaciones/consultaPublicacion.html?id_pub=489>.

d) See at: <www.semarnat.gob.mx/queessemarnat/politica_ambiental/cambioclimatico/Pages/estrategia.aspx>.

e) See at: <www.semarnat.gob.mx/queessemarnat/politica_ambiental/cambioclimatico/Pages/pecc.aspx>.

f) See i.e. Liverman and O'Brien 1991: 351; Liverman, Dilley, O'Brien and Menchaca (1994); Appendini/Liverman (1994: 159); Conde, Liverman, Flores, Ferrer, Araujo, Betancourt, Villarreal and Gay (1997: 20).

g) See at: <www.atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=144&Itemid=81>.

f) For final reports, see at: <http://www.aiaccproject.org/Final%20Reports/final_reports.html>, and Gay, Conde, Eakin, Seiler, Vinocur and Wehbe (2006).

events is highly correlated with El Niño events (Conde/Ferrer/Gay/Magaña/Pérez/Morales/Orozco 1999), particularly during the strong events of 1982–1983 and 1997–1998, when the summer droughts during the first year of El Niño (1982 and 1997), and the spring droughts during the second year (1983 and 1998), severely impacted rain fed maize production in the country.

Economic policies have lead to a dramatic drop of maize prices, being in 2005 about 45 per cent below those in 1988. In contrast, the *tortilla* price (basic nutritional staple in Mexico) increased in the same period by almost 279 per cent (Nadal 1999: 145; Zier-

vogel/Nyong/Osman/Conde/Cortés/Downing 2006: 17), accelerating the mal-nutrition conditions and poverty of the rural and urban population. Even though yields have then decreased, the Mexican production of maize has been more or less stable since 1988, except for 1998, when corn production was affected by a severe drought (Nadal 2000: 32; Conde/Vinocur/Gay/Seiler/Estrada 2008: 13).

Tlaxcala is the smallest state in the country, with the highest soil erosion in Mexico[4]: 82 per cent of the surface dedicated to agriculture in the state has severe erosion for wind processes, and 57 per cent has been eroded by hydrological processes. More than 80 per cent of the surface dedicated to rain fed agriculture[5], and at least half of it is dedicated to maize production, with averaged yields of 2.4 ton/hectare. Maize peasants are mainly smallholder producers (with less than 10 hectares), and most do not have insurances nor do they receive any credits. Another environment problem in the region are various pests, which are treated with agrochemical pesticides that also affect the quality of soils and water.

Its agriculture is mainly oriented at maize, with averaged yields of around 2.4 ton per hectare. Even though governmental programmes are oriented to convince farmers to switch from maize to wheat, barley or oats, peasants still preferred to plant maize. Primarily, because it is the main source of their food and that of their families. Also, because they know and control all agricultural conditions that surround this cultivar (Conde/Eakin 2003: 11).

From 2004 to 2006, a project supported by UNDP was developed: *Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico and Cuba*. For the case study in Mexico, the state of Tlaxcala was chosen, mainly because organized producers have asked for specific climatic studies during the 1997–1998 strong El Niño event. That first contact gave us the advantage of having previous studies and relationship with farmers and decision-makers. Because of that previous research, adaptive measures could be more readily discussed and applied.

In-depth studies of climate variability and climate change were presented to key stakeholders (producers' organizations, policy makers, peasants involved in the project) that were involved since the beginning of the project. Several studies showed that drought conditions in Tlaxcala during strong El Niño events (Conde/Ferrer/1998: 31; Conde/Eakin 2003: 11; Conde/Ferrer/Orozco 2006: 188) render very low yields or even total losses for maize producers. A maize simulation model (Ceres Maize model; Jones/Kiriny 1986) was used to assess the possible impacts under strong El Niño events, and also to project the impacts of climate change under several scenarios.

65.2.2 Veracruz Case Study

Veracruz borders the coast of the Gulf of Mexico. The climate in the state is mainly warm, humid or subhumid. However, the altitudinal variations (from sea level to almost 3,000 m) produce high climatic variations. Its central region is considered a region with high biodiversity (Gordon/Manson/Sundberg/Cruz-Angón 2007: 261–262; Manson,/Sosa/Contreras 2008: 283), which is threatened by land use change. Coffee plantations are imbedded in the rainforests, so they can be seen as a source for biodiversity conservation.

Coffee production occupies more than 152,000 hectares in Veracruz, and in the central regions concentrates 90.2 per cent of all the coffee producers in the state. This production was developed in Veracruz as an option to achieve greater incomes for small farmers (mostly, less than 5 hectares). Veracruz ranks as Mexico's second largest coffee producer although coffee plantations in that state are relatively recent, becoming an important agricultural activity since the 1950's, particularly due to the good prices after the Second World War.[6] This activity was the source of a major income until the 1990's, when agricultural policies changed and subsidies and technical support was extremely reduced and market prices dropped drastically. Organic coffee production was a response to lower prices, and new markets emerged for a small group of coffee producers. Coffee producers are currently struggling with pests (Castillo/Contreras/Zamarripa/Méndez/Vázquez/Holguín/Fernández 1997: 53) such as 'broca' (*Hypothenemus hampei, Ferr*) which apparently is reaching higher altitudes with increasing temperatures.

In the project *Integrated Assessment of Social Vulnerability and Adaptation to Climate Variability and*

4 SEMARNAT [Secretaría del Medio Ambiente y Recursos Naturales], 1996: "Estadísticas Selectas. Agua. Balance de agua superficial y subterránea"; at: <http://www. semarnap.gob.mx/naturaleza/estadística-am/> (6 July 2006).

5 See at: <http://www.tlaxcala.gob.mx/portal/indicadores/index.html>.

6 Bartra, Armando, "El aroma de la historia social del café", in: *La Jornada. La Jornada Del Campo*, 28 July 1999: 1–4.

Change Among Farmers in Mexico and Argentina (Gay/Conde/Eakin/Seiler/Vinocur/Wehbe 2006: 8), one of the chosen study sites for the case of Mexico was the central region of Veracruz, where coffee has been produced for the last decades.

An important outcome of that project was the generation of an econometric model (Gay/Estrada/Conde/Eakin/Villers 2006: 264), that showed that in the central region of Veracruz (where Coatepec is situated), the temperature and precipitation conditions are ideal to produce coffee (mainly *Coffea arabica* L). Other biophysical studies (Villers/Arizpe/Orellana/Conde/Hernández 2009: 323) agreed with those results. Nevertheless, drought, frosts, heavy rains and strong winds can affect the quantity and quality of coffee. As in the Tlaxala study, old peasants and women are the major population in most of coffee properties (known as *fincas*), since a huge number of young men have migrated to the USA.

65.3 Methods

65.3.1 Participatory Techniques

Given the climate variability and change studies, and the assessments of potential impacts on maize and coffee, one should expect that adaptation options could be chosen and readily applied by policy makers or peasants. Nevertheless, the results must be communicated to the stakeholders in the region in such a way that they can use them for decision making. Awareness of current and future threats can be generated during workshops, in focus groups, in-depth interviews, and with the support of local experts and policy makers.

Participatory methods are relatively new in climate change studies. They are being adopted and adapted from other disciplines, such as sociological, psychological and anthropological research, and from studies related to development, poverty, and political issues (i.e. Ruggieri-Laderichi 2001: 5; Geurts/Joldersma 2001: 302). These methods have rendered important results and have motivated high expectations for developing integrated assessments (Kloprogge/Van der Sluijs 2006: 364). In agricultural studies (Pretty 1995: 1253), *participatory rural appraisal* (PRA; i.e. Chambers 1994) methods have been applied and developed for at the least two decades.

Participatory techniques (Conde/Lonsdale 2005: 954) were developed with farmers in two study sites (in Tlaxcala and in Veracruz), and the results obtained allowed the development of an assessment that considered the climatic and the non-climatic factors that determined adaptive capacity (O'Brien/Leichenko 2000: 221; Brooks/Adger 2005: 168; Gay/Conde/Eakin/ Seiler/Vinocur/Wehbe 2006: 173). Current climate threats, current practices and past and current environmental, economic and household problems were analysed with the farmers involved in the study (Conde/Ferrer/Orozco 2006: 186).

Several meetings with farmers were arranged before developing the focus groups, which were the basis of the two studies. A minimum of five and a maximum of ten farmers participated in each focus group (figure 65.3). In some occasions, five of those groups worked simultaneously, and the results were later compared by the research team.

In the case of Tlaxcala, since the first workshop it was recognized that the most worrisome environmental problem was the loss of soil fertility. Also, those maize producers were highly concerned with frosts, drought, changes in the precipitation patterns, and strong winds. Farmers also found interesting that during El Niño events most of those climatic events could be magnified. In those focus groups a shared knowledge was assembled on the regional climate, on critical climatic years were identified, on those regions that are more at risk, and on the observed impacts of extreme climatic events.

The activities developed during those meetings with focus groups were mainly: 1) presentation of the theme; 2) explanation of the map of natural resources and land use; 3) transect of an altitudinal diagram and of soil classification; 4) development of a calendar on the cultivation of maize and coffee; and 5) analysis and prioritization of problems.

Except for the first one, each of these activities consumed at least one hour, so the research team provided soft drinks, coffee and food to all participants. One member of the research group acted as a facilitator, while the other members took notes, sometimes photographs, and only asked questions (such as 'what is your opinion?'), when they perceived that some farmers were set aside of the activity (for example women).

The initial presentation was one of the main activities. Several techniques could be applied, but in these studies the 'spider web' (figure 65.3) was the most frequent activity performed to 'break the ice'. Mainly, the facilitator of the focus group used a skein or piece of rope to start the presentation of all participants. The facilitator gave his or her name, briefly explained what he or she wants to learn by this focus group

Figure 65.3: Focus Group in Coatepec, Veracruz. Presentation on climate impacts. **Source:** photo by Beatriz Palma (2008).

Figure 65.4: Focus Group in Coatepec, Veracruz. Review of the map of natural resources and land use. **Source:** Photo by Beatriz Palma (2008).

(such as 'I study climate, but I do not know well the climate of your region or locality, nor how extreme events have affected your activity, or what has or could be done in those circumstances'). Then one end of the rope is tossed to any member of the group, which will also give his or her name and his or her purposes or expectations. Finally, all participants are part of a web, seeing the importance of the bond that could be formed if all members of the group are willing to participate, with respect and attention for the others' opinions. The facilitator could also pull or drop the cord, to demonstrate how easily the web could be broken if only one participant's opinions prevails, or if one member of the group does not participate.

The research group shows then a map (satellite or aerial images) that helps the participants to locate their community (figure 65.4). The facilitator can give those images as a gift to the participants. After the localization of the main features of the study site, a cardboard is placed, and with the use of colour markers, the members of the group constructed their own map, describing their natural resources and land use (such as forests, sources of water, working fields, houses, roads, etc.).

The activity of 'transecting the altitudinal diagram and of soils classification', helped to deepen the previous one, since farmers described the differences of natural resources or agricultural activities depending on soil types and the natural resources at different altitudes. In this activity a brief description of the spatial distribution of the climatic conditions can be achieved, situating in the map those regions were climatic hazards have occurred more frequently or have been more intense.

With the 'calendar of cultivars' (maize and coffee); temporal – usually monthly – crop requirements of temperature and precipitation were described, correlating those with the crop management developed by farmers. The purpose was to relate climate with the fenological stages of the crop, and to establish in which stage specific climatic events are more dangerous for agricultural activities. With this activity, the costs of the inputs (seeds, fertilizers, labour, etc) and the expected production and economical benefits can also be assessed.

Finally, with the 'analysis and prioritization of problems', the most worrisome climatic events were described and prioritized. This activity helped to establish which climatic aspects must be investigated with more detail, projecting – if possible – their changes in the context of climate change.

65.3.2 Climate Change Scenarios

Climate change scenarios were generated (Conde/Estrada/Martínez/Sánchez/Gay 2009: 16) using the outputs of several *general circulation models* (GCMs). Even though there is no consensus on how to manage the uncertainty associated with those multiple outputs (Estrada/Gay/Conde 2008: 514; Schneider 2001: 18; Jones 2000: 403), these scenarios were developed using the criteria suggested by the *Task Group on Data and Scenario Support for Impact and Climate Assessment* (TGICA) of the *Intergovernmental Panel of Climate Change* (IPCC-TGICA 2007: 26). These criteria are: *vintage* (the more recent GCMs outputs); *resolution* (the must higher resolution available, with more spatial details), *validity* (simulation of present-day climate faithfully); and *representativeness*

Figure 65.5: Example of the base scenario for mean temperature (in July). **Source**: See at: <http://www.atmos-fera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=77&Itemid=74> (1 September 2009).

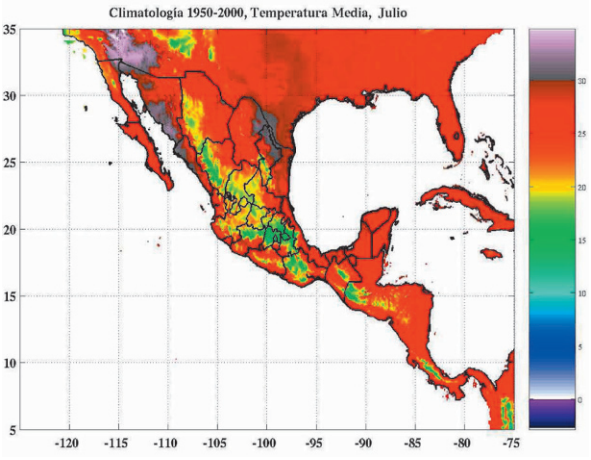
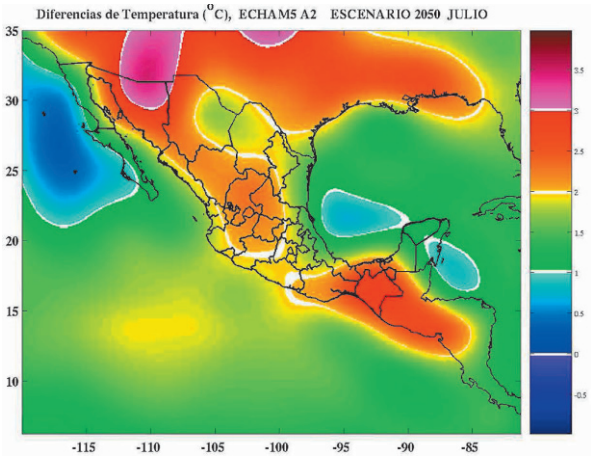


Figure 65.6: Example of climate change scenario, EHCAM5 model, A2 emission scenario, and horizon 205. Mean temperature (in July). **Source**: <http://www. atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=77&Itemid=74> (1 September 2009).



of the results (range or outputs that represent the uncertainty related to climate change). Another important criterion applied, was that those regional scenarios must satisfy the needs of impact modellers. They must be tailor-made instead of thinking that any scenario can be useful *per se*.

Using those criteria, scenarios were recently generated using the outputs of three General Circulation Models (GCMs: *GFDL CM2.0* (Geophysical Fluid Dynamics Laboratory), *ECHAM5* (Max Planck Institut für Meteorologie) and *HADGEM1* (Hadley Centre for Climate Prediction and Research)). These GCMs were evaluated, using some statistical conditions that their performance should accomplish (globally and for Mexico): the pattern correlation, the mean squared root error, the bias, and, the mean squared root error corrected by the bias (Wigley 2008). Also, following the criteria of *representativeness*, the output of the chosen GCMs should have no similar range of changes in temperature, and even different signs (positive and negative) for the changes in precipitation. The basis of this procedure is to establish that decision making in the context of uncertainty must be considered in climate change studies.

For the two study cases, previous versions of the GCMs were used, but for the project in Veracruz the new GCMs' outputs (since the Fourth Assessment Report [AR4] of the IPCC) and the criteria described above, are being used. Two emission scenarios were chosen (A2 and B2),[7] and two time slices were selected to project future climate: for the 2020's (for the period 2010–2039 centred in 2020) and the 2050's (2040–2069, centred in 2050). The outputs of those GCMs were obtained using the Model for the Assessment of Greenhouse Gas-Induced Climate Change and a Scenario Generator (Magicc/Scengen Model; version 4.1; Wigley 2003), and the more recent outputs obtained from the Canadian Climate Impact Scenarios that can be also useful when specific localities are under study.[8]

For Veracruz, regional climate change scenarios were generated using the methods described above.[9] Those scenarios were used in the Climatic Action Plan for Veracruz. These regional climate change scenarios were generated with a resolution of 5' x 5' (≈ 10 km x 10 km). The base scenario (1950–2000) includes extreme temperatures and precipitation, with the stated resolution (Hijmans/Cameron/Parra/Jones/Jarvis 2005: 1967). In the guide that was delivered for potential impacts assessments,[10] the multiple methods that could be applied are described. The intention of

7 See IPCC, WGIII (2007b: 7).

8 See at: <http://www.pacificclimate.org/tools/select>.

9 See at: <http://www.atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=77&Itemid= 74> (1 September 2009).

10 See Conde, Gay, Estrada, Fernández, López, Lozano, Magaña, Martínez, Sánchez, Ramírez, Zavala and Zermeño (2008).

the guide was to be user friendly, but also, to adjust to different users.[11]

65.4 Results

The participatory techniques described above showed that peasants have a great knowledge of the natural resources in their region. Spatial description of the rivers and underground water resources, forests, flora and fauna, were described in detail by farmers. Comparing the current with past conditions, a great concern was detected with regard to the loss or decline of those resources associated with land use changes, combined with intensive agricultural activities, such as low yields and extreme climatic events.

65.4.1 Tlaxcala Case Study

Using the results obtained from the Ceres – Maize model (Conde/Ferrer/Orozco 2006: 190), and the focus groups, it was found that the most vulnerable group of the agricultural sector in the state are the rain fed maize producers. The most worrisome climatic events are frosts, droughts, heavy rains and strong winds. During strong El Niño years, those events can be strengthened. Given the observed trends (Conde/Ferrer 1998: 29; López 2009: 138), minimum temperature is increasing, so it is possible to expect a larger planting season, free from frosts, which will benefit the maize production in the state.

There is no adaptation measure among maize peasants for unexpected frosts. Planting dates usually are established with the beginning of the rainy season (preferable in April: "April rains, thousand grains", peasants use to say) and harvesting labours must be developed by the end of August or September, before the frost events began. Farmers have a great knowledge of maize varieties, using seeds with shorter growing season (called *violentas*: violent) when the rainy season is delayed. Strong El Niño events usually last from the summer of the first year (i.e. 1982, 1997) to the spring of the second year (i.e. 1983, 1998), and drought conditions are expected during both seasons.

No adaptive measure can be applied during the summer of the first year. Since peasants planted usually in April, maize plants have developed to a stage were a drought will cause that all production will be lost. Only those who have water reservoirs (called *jagüeyes*) can rescue part of their production, the one that they planted in the most protected areas of their property (depressions or dips). During the spring drought, farmers can wait until May for the beginning of the rainy season, when they can plant 'violentas' varieties. If the rain delays more, then changing to another crop is one possible solution for farmers (oats for forage purposes was planted during 1998, for example). In this case, they will select seeds with shorter development cycle: barley, wheat or oats.

Strong winds and heavy rains affect the maize plants and also soil fertility. The measures that farmers have adopted in the past to cope with those events are constructing ditches or tree barriers. Nevertheless, these activities cannot be easily performed by old peasants and women, which also do not have the economic capacity to hire workers for these tasks.

The main coping measure that peasants have applied to assure their subsistence is to extend the planting area. This has been documented previously (Nadal 2000: 68), and is a measure that threatens the other elements of regional biodiversity (particularly forests, soils, and water reservoirs). In the short term, it can be seen as a zero cost measure for peasants, but this is an environmental aggressive strategy, that can be called a mal-adaptive measure. In contrast, usually peasants practice policultivars, since they include other crops in their maize planting area (such as some varieties of bean). This practice has demonstrated to preserve soil fertility (Altieri/Trujillo 1987: 198), and assures the maize peasants a broader food supply.

In synthesis, maize peasants have coping strategies that depend on the season, and on their human and economical resources. There are measures that can be applied with zero or minimum costs (Parry/Rosenzweig/Livermore/Fischer 2005: 2128), such as shifting planting dates, changing maize varieties (both tested with the Ceres – Maize model); extended the planting surface, or using part of their water reservoirs. Other adaptation measures, with higher costs, could be changed to other cultivars, increased fertilizer application, or pay for irrigation or labour force.

Besides these crop management measures, most of the rural families have developed outside-farm strategies (Saldaña 2008: 587). These can include incomes from a second job, governmental support after an extreme climatic event, remittances of relatives living in the cities or in the USA (Gay/Conde/Gómez/Cortés/Monterroso/Rosales/Eakin/Paz/Echanove 2004: 2–20), or, finally, the abandonment of the activity,

11 See at: <www.atmosfera.unam.mx/gcclimatico/index.php?option=com_content&view=article&id=144&Itemid=81>.

caused by migration to urban areas or to another country.

The described extreme climatic events, but also the reduced household capacities, and environmental and economic factors, show that the coping capacities of maize peasants have diminished (Ziervogel/Nyong/Osman/Conde/Cortés/Downing 2006: 32).

65.4.2 Veracruz Case Study

A brochure that synthesizes the results of the first year of the project (Rosales/Conde/Palma/Ferrer, Rosa/Monterroso 2009: 12) was delivered to the *Consejo Regional del Café de Coatepec, A.C.* (Regional Coffee Council), the organization that coordinates the actions taken by coffee producers in the region. Forty three peasants participated in the focus groups, and all their names were included in the brochure.

Peasants in the region classify climate depending on the altitude. In Coatepec County, three climatic zones were identified and described during the focus groups. In the higher zone, low temperatures are usual, and the rainy season is expected to start by 15 May (called San Isidro day), and last until September, with a regular distribution during those months. In the last years, there is uncertainty when the rainy season will begin, and heavy rains have occurred more frequently. At middle altitudes, the climate was temperate, but higher temperatures are now more frequent, which have increased evaporation. In a similar way, the temperatures have risen on the plain zone, were hail events have decreased.

The climatic events that could affect more the coffee production are heavy rains, particularly during the beginning of the spring season (April), frosts and high temperatures. Also, cold northern winds (called *Nortes*), and hot southern winds (called *Surada*) could impact on the coffee production if they intensify in the future.

Peasants use to say 'the flower might turn into leaves', since with heavy rains during spring, even if the coffee plant might survive, flowers could drop, diminishing that year's production. It has been documented that this relative drought in the spring is needed for the flowering stage of coffee.[12] Nevertheless, regular rains are needed during spring, because coffee plants do not flourish in drought conditions, such as those that occurred in 1983 and 1998 (El Niño years).

During the focus groups, peasants also highlighted that frost events are critical during the spring season. This was also found in previous studies and newspaper sources.[13] High temperatures and heavy rain events during summer could affect the quality of coffee, and also increase pests and plant diseases. This information matched also with other sources, which showed that the high temperatures and floods during 1970, 1973, 1996, 1997 and 1981 reduced the coffee production in those years.[14] Producers also recalled that during the El Niño event of 1982, farmers also struggled with the increase of broca (*Hypothenemus hampei, Ferr*) and nematode pests. The econometric model (Gay/Estrada/Conde/Eakin/Villers 2006: 262) showed that the winter and summer temperatures, and the spring precipitation, were indeed the climatic variables that had high correlation with coffee production in the region.

Coffee producers identify also other constrains to their agricultural activities. The lack of labour force (young producers) limits management and harvest activities. Low prices, and the lack of financial support (subsidies, insurance, or no access to loans) limits also their coping capacities. On the other hand, the coffee plants are immersed in forests, which provide coffee producers with alternative income sources, and can be seen as the basis for their coping capacities.

With coffee, peasants cultivate fruits such as oranges, lemons, bananas, passion fruits, chiles, and, in some cases, maize. Forests also provide farmers with medicinal plants, such as Piocha (used as an insect repellent), Chicha (used for diabetes), and other plants used for hypertension and to heel insects bites or stings. Forests micro-climates sustain also the birds and mammals diversity, which are also a nutritional source for farmers and their families (Rosales/Conde/Palma/Ferrer/Rosa/Monterroso 2009: 10). Coffee producers then envision the possible current and future adaptation strategies with forests' care and preservation.

65.4.3 Climate Change and Coping Strategies

With the previous information, the potential impacts of climate change and the possible strategies could be assessed. The climate change scenarios are synthe-

12 See Nolasco (1985: 95); Conde, Vinocur, Gay, Seiler, Estrada (2008: 284).

13 La Red (2004): Social Studies Network for Disaster Prevention in Latin America; at: <http://www.desinventar.org/desinventar.html> (20 November 2004).

14 La Red (2004); at: <http://www.desinventar. org/desinventar.html>.

Figure 65.7: Projected changes in temperature (A) and precipitation (B), for Tlaxcala (2020 and 2050), using 3 GCM (G: GFDL; H: Hadley; E: ECHAM) outputs and two SRES scenarios (A2 and B2). **Source:** Conde, Ferrer and Orozco (2006).

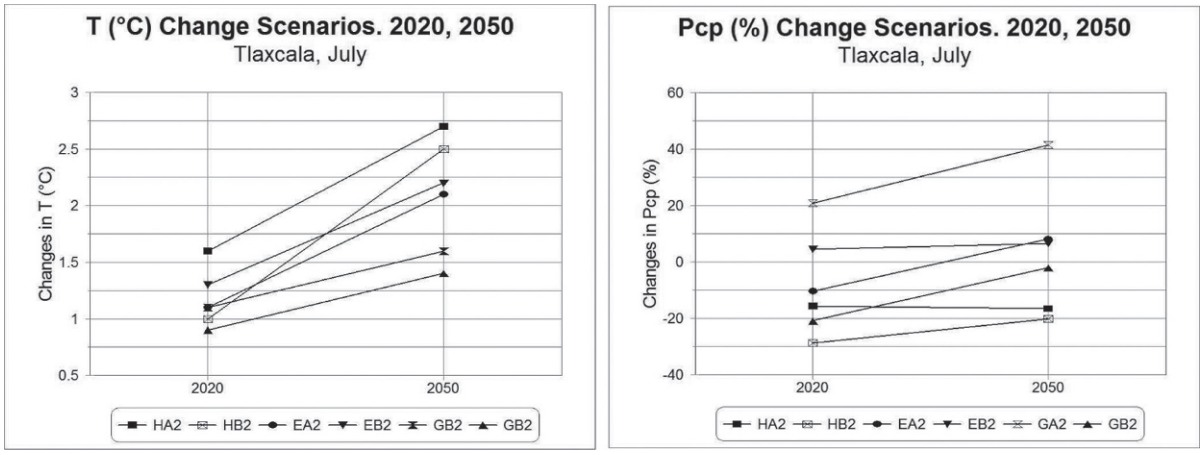
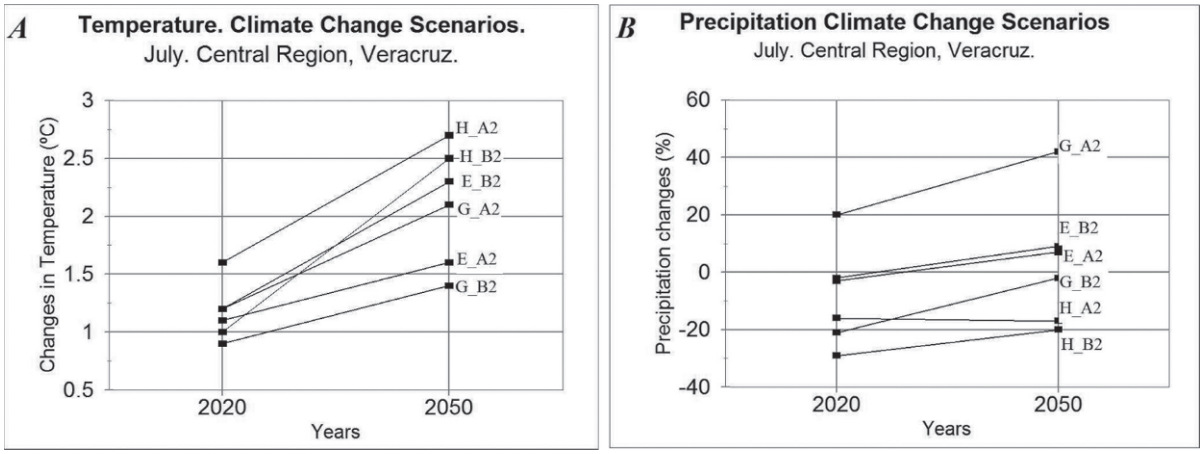


Figure 65.8: Projected changes in temperature (A) and precipitation (B), for Veracruz (2020 and 2050), using 3 GCM (G: GFDL; H: Hadley; E: ECHAM) outputs and two SRES scenarios (A2 and B2). **Source:** Conde, Vinocur, Gay, Seiler and Estrada (2008).



sized in figures 65.7 (for Tlaxco, Tlaxcala, see Conde/Ferrer/Orozco 2006: 190) and figure 65.8 (for Coatepec, Veracruz, see Conde/Vinocur/Gay/Seiler/Estrada 2008: 295), where summer (July) scenarios are shown as an example for both study cases.

In the first case, ranges of changes in temperature could vary from 1.3 °C to 2.8 °C (for the 2050 scenarios), and summer precipitation could vary from -20 per cent to +40 per cent; while for the second case study these ranges varied from 1.5 °C to 2.7 °C, and for precipitation, changes around -20 per cent to +40 per cent are also projected.

For Tlaxcala, frost risks could diminish, given the projected increase in minimum temperatures, but if climate change could also represent an increase of El Niño events, or of more intense or frequent heavy rains, then the possible opportunity for maize producers might be diminished.

In the case study on Tlaxcala it was possible to implement three actions (use of compost, small greenhouses, and drip irrigation) that were considered adaptation to a changing current climate and could have viability in the future. Given the high losses of fertile soils, compost was applied to cultivars (tomato and chile). To start the project: *Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico and Cuba*, the Autonomous University of Mexico (UNAM) donated 5 tons of compost. Greenhouses were considered ideal to deal with a variable climate, since temperature could be stabilized

inside them, and their dimensions (96 m^2) allowed them to be inside their house gardens. Tomatoes and chiles were chosen because of their prices in local markets and their great demand in Mexican food.

Four greenhouses were planned to be constructed, in 4 different localities in the state. Nevertheless, only two were finally constructed. One producer did not allow his wife to participate in the greenhouse activities (because his religion, he stated), and the other one found it too small, and had strong opinions on how it should be constructed. The failure of 50 per cent of our goals was quite frustrating for the research team, but finally it was clear that the basic adaptation measure was the interaction, decision-making, and activities developed between the researchers and farmers.

In the case study for Veracruz, reforestation, the increase of protected areas and more strict forests management regulations, are the key measures that coffee producers considered that could preserve the regional climate. In that context, the main objective of the ongoing project (Conde/Calderón/Castro 2008: 7) is to demonstrate that the payment of the environmental services can reduce the future vulnerability of coffee producers and that is a win-win measure for them and their communities. Measures have been made of the rates and amount of carbon dioxide sequestration by forests in the region, but the results are still not conclusive.

Thermometers have been placed inside and outside of a coffee plantation; these data will be introduced into the econometric model, showing that with climate change that difference of temperature can give coffee producers a lag of time before the worst projected impacts occurred. The list of local fauna and flora can support further studies of regional biodiversity, and activities such as ecotourism.

65.5 Conclusions

Current coping capacities are being diminished by the frequent and intense extreme climatic events and they could be more reduced under climate change conditions. These capacities are also currently being reduced by the agricultural policies (reflected in the lack of financial and technical support), the low prices and market changes. Given those circumstances, farmers expect an increase in their current vulnerability.

Stakeholders' involvement is fundamental in projects oriented to support adaptation measures, and force climate researchers to develop studies that are tailor-made for the peasants involved, and to seek for participative techniques that can facilitate the communication of their results to farmers.

The case studies showed that peasants are willing to apply adaptation measures to current the climate such as increasing soil fertility by compost techniques (Tlaxcala) or to promote the payment of environmental services (Veracruz). Farmers' participation is critical for the success of those measures, which are viable under climate change scenarios. On the other hand, the success of any adaptation measure depends on the farmers controlling the know-how of any of those measures.

Participatory techniques are an invaluable tool to assess current and future climate vulnerability and adaptive capacities, since climatic studies can focus on the most worrisome climatic events and their possible projection into the future.

Coping measures applied by farmers depend on the cultivar (maize or coffee). The coping capacities of maize producers highly depend on their traditional knowledge, acquired during centuries that allows them to change in planting date or to chose different varieties. They also can perform changes in crop management, such as changes in the amount of fertilizers or pesticides, but the increasing costs of those products might not be compensated with the incomes.

In the case study on Tlaxcala, the spring - summer droughts and early frost events have always been the worst climatic events, for which peasants have very low coping capacity. The construction of small greenhouses to produce tomatoes and chile, and the expectation to apply in those greenhouses drip irrigation and compost, highlights the urgency for those maize producers to change or combine cultivars and practices as a coping strategy. The abandonment of governmental support has critically reduced the coping capacity of maize producers.

In contrast, coffee producers have a permanent cultivar, embedded in highly diverse forests, that contribute in the preservation of microclimates, and from which they can acquire other products (i.e. fruits). In that study case, heavy rains and high temperatures are the most worrisome climatic events, for which also limited or no coping measures can be applied. The environmental services that the forest provides, opens a possibility for those farmers to adapt, since their incomes can also be diversified. As in the previous case, the lack of governmental support and the very low prices for coffee have also reduced these peasants' coping capacities.

In both cases, migration of young individuals can be seen as the extreme adaptive action for individuals, but not for the agricultural sector.

66 The Impact of AIDS on Women's Social Life in a Mexican Rural Community

Fátima Flores and Wolfgang Wagner

66.1 Introduction

66.1.1 The Setting

According to the United Nations official statistics for 2002, there were one billion poor people in the world, 70 per cent of whom were women, a figure that reflects a serious problem of gender inequity and a harsh social inequality. Some 40 million of the world's poor live in Mexico, 26 per cent of them in conditions of extreme poverty. Given this panorama, there is a clear and urgent need not only for actions designed to achieve an understanding of the multiplicity of the causes of poverty but, more importantly, to generate interventions by different sectors that will bring about a gradual transformation of this reality. This entails adopting a posture that orients discussion and exposes basic aspects of poverty. In particular, there is a need to analyse elements that affect women in particular.[1]

We intend to show how economic, social, and psychological vulnerability impacts on women's capability to cope with adverse health conditions, such as having acquired HIV. The lack of resources critically heightens the subjective feeling of insecurity and perceived lack of coping strategies in situations of threat. Vulnerability, in this sense, is subjectively perceived defenselessness and negatively affects social integration and personal well-being.

This research on women's health and their associated social life was conducted in a rural community, Coatlán del Río, a municipality in the state of Morelos that is characterized by high indices of migration[2] that have specific repercussions on the dynamics of everyday life and the social relations that develop among people (figure 66.1).

According to data from the population census (INEGI 2005), this town has 4,523 male and 4,833 female inhabitants. The average age is relatively low, as the largest cohort is the 1 to 15 years age group. In Morelos, 15 per cent of migrant women and 14 per cent of non-migrant women are heads of households (Chávez Galindo 2008: 52). The most common illnesses in this jurisdiction are infectious diseases and parasitic infections of the digestive tract, mainly intestinal amebiasis, caused by the lack of clean drinking water and sewer systems. These ailments affect mostly children and young people from 5 to 14 years of age. Communicable diseases such as hemorrhagic dengue and sexually-transmitted diseases, especially the *Human Papillomavirus* (HPV) and HIV, are also present. The most common non-transmissible, chronic-degenerative diseases are arterial hypertension, diabetes mellitus, rheumatoid arthritis and, especially, cervical-uterine cancer. The latter is detected in 30 per cent of cases analysed and is the most common cause of death there; indicating clearly that women's health suffers from a lack of preventive measures and medical attention.

The community's economic activity is based on agriculture because of its favourable climate. Though located in a region rich in natural resources with broad extensions of arable land, residents live in somewhat precarious conditions mostly due to a lack of orientation, support systems, and official resources for developing programmes. Given the lack of employment opportunities, slow emigration has become a 'naturalized' phenomenon, as men – mostly – have assimilated

1 A perspective much in vogue in public policies during the 1990's that emerged from denunciations of male/female inequities in different contexts fostered by the women's liberation movement in the 1970's.

2 Among the states with high levels of migration registered by CONAPO in the 2000 Census, we find: Aguascalientes, Colima, Guerrero, Hidalgo, Jalisco, Morelos and San Luís Potosí. Morelos showed a migratory flow of 10,495 people in that year.

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Figure 66.1: Location of the research: Coatlán del Río, Morelos, Mexico.

migratory processes and flows, leading to a consolidation of shared imaginaries and collective identities. Most of the women with whom the researchers had close contact have experienced the migration of their partners at some point in their relationship and assume that at any moment their family dynamics may have to be reoriented. This uncertainty propitiates a state of emotional alert related to their ambivalent feelings and this, in turn, generates tension as well as states of anxiety and contradiction.

Against this backdrop, our research represented an attempt to identify: 1) the psychosocial and gender indicators that are constructed through the subjective experiences of a group of women exposed to the migratory process in that setting; and, 2) how those women have come to signify HIV/AIDS in their condition.

66.1.2 Social Representations in the Community

The present research takes social representation theory as the starting point. The concept of social representation refers to socio-cognitive processes by which social actors render their reality comprehensible and endow it with sense and meaning. By providing an everyday epistemology, social representations are the prerequisites for constructing and maintaining systems of communication among the members of communities. This approach allows conceptualizations of everyday thinking and experience within the frame of community discourse and personal communication.

A community is the place where personal communication intersects with the wider social setting and mass-mediated communication. A village or a city block has a size that allows villagers and residents to meet on a regular basis and to engage in personal contact that involves exchange of private matters as well as of societal and political ones (Jovchelovitch 1995, 2001; Moscovici 1976). The wider public sphere enters via the representations entertained and transported by the mass media, which provide topics for conversation and dispute among the members of the community. In this sense the community settings are pivotal in the generation, elaboration, and change of social representations that always emerge when discourse unfolds about some new phenomenon and some preconditions are met (Wagner/Hayes 2005).

Illness appears to be first and foremost a matter of private interest. Maintaining and re-establishing one's personal physical well-being depends on lifestyle and personal preferences. However, what counts as well-being and what counts as an adequate and preferred lifestyle is defined in the deeply social fabric of cultural and societal discourse. There is no private desire or behaviour that is not directly and indirectly informed by, and directed towards, other actors as well as towards the collectivity. Each person's subjectivity is the historical product of collective processes that converge in an individual as a member in families, social groups, communities, nations, and cultures.

The illness of AIDS or HIV-positivity is a case in point. People are affected by HIV infections as patients, as family members of patients, and as members of societies that are struggling to contain the societal consequences of this virus. The appearance of AIDS/HIV a few decades ago was shocking and serious enough to give rise to a full-fledged representational system. The emergence and development of how the public collectively coped with this issue showed all attributes that social representation theory postulates. First, it was an issue that immediately gained high significance in the media, thus setting AIDS on the agenda of the wider public discourse. Second, in the course of this developing discourse a multitude of images, metaphors, and stories emerged that anchored thinking about the novel illness in existing systems of everyday knowledge. Third, once objectified, the images and metaphors condensed into an amalgam of practical and symbolic public knowledge that, to a certain degree, contains the symbolic frames as well as the practical means of avoiding the infection, for example by the use of condoms. This representation, hence, is the prerequisite of people's participation in public, media, and personal discourse (Joffe 1995; Marková/Wilkie 1987; Marková 2003; Wagner/Kronberger/Seifert 2002).

Besides providing an example of the symbolic realm representing AIDS and HIV, this chapter also contributes to a more theoretical understanding of how the social sphere and the individual experience interact in community discourse about other issues such as public health and the implementation of health programmes (Joffe 2002, 2003). The social and psychological processes in all these realms do not differ significantly from each other since they all require forms of public and symbolic coping as well as individual responses to novel developments. Normal societal innovations as well as personal hazards are a threat to the security that one feels while following an established way of life as recognized in several UN documents (cf. Brauch 2008a).

66.2 Method

Our starting point is the fact that certain personality characteristics and features of the individuation process universally differentiate between the sexes, and that these, in their representation of themselves, articulate multiple representations that become current as a function of the situation. At some point, one of those variants is established circumstantially as constitutive of the subject in the 'centre' of her/his consciousness (Flores 2001).

Our first approach to this town was through informational talks and workshops focused on HIV/AIDS and *sexually transmitted infections* (STIs). These activities allowed us to detect certain needs that called for an urgent intervention due to the conditions of vulnerability to which the population is exposed. The intervention was designed using the perspective of communitarian psychology[3] in a series of stages that were carried out from April to November 2006. Ethnographic methodology included survey visits, contacting key informants, and organizing focus groups.

66.3 Results and Discussion

66.3.1 First Stage: Approaching the Community

In this stage, survey visits were conducted and the search for key informants begun. We contacted individuals who exercise some degree of leadership in the community in order to facilitate access to the main features of local dynamics, though it also allowed us to publicize our planned activities. A talk called "Women, Health and Daily Life" was organized, dealing with some of the hardships associated with gender

3 In this approach, the community is not seen as bereft of power because it is excluded from many social benefits. Rather, it naturalizes a situation in which the dispossessed, poor, excluded and, in general, all social groups that do not enjoy statutory power or adequate socioeconomic conditions are seen as weak, incapable and deprived of any possibility of transforming their lives. In this view, community members participate actively in the search for solutions and transformations by potentializing their resources.

conditions and some aspects of STIs and HIV/AIDS in the context of migration.

The event was attended by 20 women and one man who were between 30 and 45 years old and had finished junior high school (*secundaria*). Seventeen had a life partner (married or common-law) and on average 3 minor children. Most were housewives. Family income, consisting mainly of remittances, was less than three minimum wages.[4] These data showed a somewhat higher economic income than those of a preliminary study, though perceptions were quite similar. This activity allowed us to enter the community in a favourable manner that paved the way for the next stage: a focus group designed to identifying people's needs.

66.3.2 Second Stage: Focus Group

The focus group employed 10 of the women from the first stage, all from the same municipality. We decided to use this technique because it is a productive tool in social psychology, especially in efforts to use group interaction to understand the meaning and attributions that people associate with their own existence. Also, it is an exploration method that focuses on culture (Marková 2003).

The focus group lasted three hours. Participants demonstrated their interest in being involved by signing an informed consent form. The following topics were explored: 1) the impact of migration on daily life; 2) health, HIV/AIDS and vulnerability; and 3) marital relations; themes chosen on the basis of women's contributions in the first stage.

The information obtained in this second phase was transcribed literally so it could be systematized using a 'content-type' analytical technique that makes it possible to draw valid, reliable inferences with respect to context (Bardin 1982; Krippendorf 1988). Given the nature of the study, this technique turned out to be pertinent as it combines the rigour of objectivity with the richness of subjectivity by generating revelations that precede the initial meanings.

66.3.3 Third Stage: Reinforcement

Eight women participated in this stage, all of whom had attended the other two sessions and stood out because of their great interest in the community and the leadership they exercised. This final stage of the intervention focused on the goals of reinforcing and consolidating the other two phases through a specific activity based on thematic guides taken from the women's own discourse. Once again, these women deliberated over the issue for three hours, speaking freely about their personal processes and meanings, and their life experiences in the town. Then, we presented all the information that had been systematized up to that point. The group's psychological contention was observed, several dynamics[5] were conducted, and the need to set up support networks among them was reinforced.

It must be noted that in this activity special attention was paid to reinforcement[6] as a strategy for developing and transforming communities through the members' own active participation. This potentializes their capacities and abilities so that they can achieve positive change that will improve their quality of life. Community-based support networks propitiate reinforcement in certain ways, as they constitute alternatives for political action and, at the same time, demonstrate their capacity to transform, to provide social support, and to exercise solidarity and power, as well as their reinforcing character. Finally, they are a source of leaders for the community (Montero 2003).

The results of this intervention revealed various aspects of women's life experience and that constitutes the specific meanings developed in the face of the particular adversity they confront.

4 The daily minimum wage in the state of Morelos, which came into effect 1 January 2007, is $47.60 pesos (about 2.8 €), established by the *Comisión Nacional de los Salarios Mínimos* [National Minimum Wage Commission] in a resolution published in: *Diario Oficial de la Federación*, 29 December 2006.

5 In the first dynamic, participants were asked to complete a series of incomplete phrases alluding to their feelings and what they needed to fulfill their different roles (as women, partners, housewives, mothers, friends). The second was an exercise on imaginaries, the main objective of which was to have them reflect on how they cared for themselves (enjoyment, appropriation of their bodies, self-esteem). The third dynamic consisted in symbolizing a support network among participants as a means of creating an atmosphere of trust and mutual support.

6 This is the Spanish term for "empowerment", a neologism that appeared in the USA as a homologous word. However, as Montero (2003: 61–63) notes, the Spanish words for "strengthening" (*fortalecimiento*) and "potentialization" (*potenciación*) have been used in Latin America since the late 1970's.

One of the first elements that caught our attention in the town were references to HIV/AIDS, mainly due to an increase in contagion in the November-January period, the time of year when male migrants to the USA return home to take part in Christmas festivities. During the first stages, it became clear that the system of social beliefs and representations regarding the origins of HIV were strongly based on the stigmas that attribute the causes of this pandemic to groups such as homosexuals, sex-trade workers, and people who have casual, unprotected sex.

Women also judged that adolescent boys and girls were especially vulnerable and, therefore, required information to avoid transmitting the virus. This shows how women shift their concern towards their adolescent children who could become infected; but this is a representational shift that impedes them to some degree from recognizing their own susceptibility to infection or from seeing themselves as potential victims of AIDS. This situation has been established as part of a social imaginary that holds that "the disease is present but doesn't affect us", a discourse similar to those found by other groups of researchers (Flores/ Leyva 2004).

Another observation was that though some women were aware of the importance of condoms as a form of protection and prevention, this did not necessarily translate into their use during sexual relations. This was attributed mainly to factors that might affect or impugn their spouses, as they specifically mentioned elements such as faithfulness and trust; however, in these negotiations, gender status puts women at a disadvantage.

In the focus group, we found that the impact of migration on women's everyday life was strongly marked by emotional states that reflected how gender conditioning operates through their daily activities.

The first significant element to emerge was that women often expressed a fear of dying, though they related this fear to how their absence would affect others, seeing it as a 'failure' on their part. This attitude indicates their feelings of total responsibility and devotion to the family that places them in a permanent state of anxiety, as the following extract shows: "... what really worries me is that I might leave this world and my children would be left alone with relatives..."

Here, the perspective of the social construction of feminine subjectivity suggests it would be extremely difficult to find a suitable substitute for a mother's care, much less someone who could take her place, a situation that has constituted a contradiction throughout history:

> "...I also worry about my children because I have a boy who's 16, one who's 10 and a baby of 11 months; so yes I worry that something might happen to me, like getting sick, because I'm their right arm, what worries me is getting sick ... or dying ..."

In the third stage, this anguished thinking about death led to discussions about the emotional links women have established with their children and how those links lead them to stop thinking about themselves and to live their lives through those children. Together with them, costs and benefits of this kind of relationship were analysed:

> ...and what if I die? What if I'm not around? That's the question day after day, every night... oh God, dear God, I don't want to die because my children need me. ... I think that's what worries us as mothers because whether you have a husband or not, death is the biggest worry, if we were to leave our children on their own. ...

The women in this group also said that they experienced feelings of loneliness and of not being understood, that they were left alone and unprotected by their partners and by their close family members. One participant said that her father told her: "... you chose your life, now you deal with it. ..." Another said:

> ...men don't worry about anything, they never say 'hey son, how'd things go at school today' or 'how're you doing', they do their part just by working; ... they get home and say 'come on, rub my feet and get me something to eat'... It's us, the women and mothers who worry, the father's job is just to work, bring home the money and, well, that's it...

The loneliness and lack of comprehension that mark these women's lives lead to poor self-esteem and to the idea that their feelings are of little importance in the conditions of poverty and migration in which they live. In the face of adversity, their feelings are relegated to 'second-place' and this contributes to the development of gender-related maladies that have repercussions for their mental health. Vulnerability that women in this group expressed with respect to HIV is intimately associated with their gender status, especially in view of their partners' activities and their own fear of contracting the virus due to men's behaviour, whether as migrants or living in the town:

> ... for example, in my case [my partner] lives with another woman in the United States. I'm careful not to have any other partner here, but it would be impossible anyway because [you know] he might come back tomorrow or maybe next year, and I'm his wife. I don't know

> how many other relationships or partners he may have had, but if he'd use condoms...

As this extract shows, it is considered natural and is widely tolerated for men to have relations with other partners. Thus any negotiations on the use of condoms that involved these women – who see themselves as distinct due to their identity as wives – centre on the danger of contracting the HIV virus and not on the condom as a naturalized practice in the exercise of their sexuality. It is assumed that *he* can be with other women but that *she* cannot be with other men, and it stamps the husband-wife relationship with an assumed inequality that clearly contributes to feelings of malaise.

Some of the participants in this group agreed that because of the sexual behaviour and absences – short or prolonged – of their men, it is the women who are in greater danger of exposure to HIV, as the following testimony from an interviewee reflects:

> ...we run a greater risk, because if a husband goes to bars, drinks and has relations with *individuals* who don't always get checked or who pay the doctors not to check them ... it's really dangerous, I knew of a case of one *individual* who worked there and never had any supervision or didn't go where she was supposed to; she just kept hanging around the bars... then he comes home to me and he's not going to use a condom, I mean if he doesn't use one with that *individual*, there's no way he's going to use one with me, so that's why we need to be more careful than other people. ...

As mentioned above, in this community the stigma against sex-workers is deeply-rooted and it is an element that differentiates among social groups. Also, it is a central aspect of the social representation that people have of AIDS as a disease. Paradoxically, this centrality actually promotes preventative actions in the non-stigmatized population, as in the case of these women, though what they really need is more information, more means of prevention, and a change of attitude on the part of both men and women in relation to AIDS.

Another finding was that although these women spend long periods alone and assume complete responsibility for their households, which they resolve through a diverse repertoire of survival strategies that includes selling food and consumer products, this is not sufficient to counteract a certain imaginary subjection or to give them a greater sense of self-worth. One woman, for example, said:

> ...the place of my children's father is respected, though he's not around, we know he'll be back... but meanwhile I have to work and make sure my children can get ahead.

During our observation period another feeling of contradiction in the exercise of this dual role as mother *and* father became clear. On the one hand, this was due to satisfaction women feel when they are recognized by their families and society for their strength, and on the other, due to the emotional malaise they are never quite able to explain but is reflected in the physical weariness caused by daily tensions. This often leads them to turn to self-medication as a way of reducing their suffering and keeping up with their daily activities. Also, it helps them to avoid feeling that they may be losing control, a sentiment they expressed constantly.

On another topic, participants also referred to problems of violence and expressed feelings of vulnerability and loneliness in a world full of hostility towards them because of their condition as women. They said they had been victims of sexual harassment by men in their hometowns, as this extract shows:

> ... often when I have to go out alone on some errand, men's looks and comments really bother me [but] because I'm a woman I never say anything ... but they just have the right to annoy [us]. ...

In addition, they mentioned feelings of insecurity and a lack of protection, especially when they spoke of the situation of their daughters in the town, another important source of latent fears that women and daughters discuss and share with each other because of their common condition as women.

This aspect is central to the analysis of the construction of subjectivities characterized by situations that are reflected among mothers and daughters because of their gender status. They may be a constitutive element of a certain social and psychological defencelessness that will be very difficult to change in their lifetime. As Chodorow writes (2003), while subjectivities are being constructed they are anchored in lived processes of gender.

As mentioned above, self-medicating is a common practice among women in taking care of their own physical and mental health. Almost all of them, at some point in their lives, have taken non-prescribed anti-depressants or anxiety-reducing drugs; a finding that supports data from the National Psychiatric Epidemiology Survey (*Encuesta Nacional de Epidemiología Psiquiátrica*).[7] When we asked them about the reasons for self-medication in our study, women said that while they knew it was not advisable to take such

7 See: Medina-Mora/Borges/Lara/Benjet/Blanco/Fleiz/Villatoro/Rojas/Zambrano/Casanova/Aguilar (2003).

drugs, it was one of the few alternatives they have to make themselves feel better and keep up with their heavy daily workload. They also reflected unease with respect to the future, as one said: "...there's no good medical service here, so you just have to take whatever you can. ..."

Once again, here it remains clear that women do not consider their own health as a matter of high priority. In fact, their prime concern is their responsibility to care for others; hence, they tend to trivialize their feelings of malaise and symptoms or illnesses that may manifest themselves.

For most women in the group the meaning of their bodies has basically been annulled: i.e., the body does not exist to feel pleasure or to be cared for. A defence mechanism operates here that leads them to somaticize their tensions and therefore turn their bodies into recipients for their emotional states.

The symptomatology of depression in the group was also connected to their role as caregivers and the person responsible for their households. This immerses them in a condition of personal and social vulnerability arising mostly from their obligation to confront life's travails practically bereft of support, a burden that tends to leave them physically and emotionally spent, as one interviewee described: "... I often get depressed, I feel a sadness invading me, the only thing that keeps me going is ... my children."

This situation of abandonment, perceived loneliness, the absence of their partners, and the minimal personal compensating resources they have at hand, all combine to keep these women in a tension-filled state that often leads them to commit acts of violence against their children. Of course, such incidents almost immediately engulf women in feelings of guilt, a recurrent situation that turns into a form of family coexistence that is recursive and accepted as a result of abandonment. In this situation, their sexuality is obviously forgotten and enjoyment or pleasure does not exist in their immediate subjective register, a fact that also contributes to the gender-related maladies they suffer, which with time can become illnesses.

In addition, we observed that though these women share the common experience of being migrants' wives, they have been unable to build support networks, a fact they explain by referring to the difficulty of trusting people, their isolation, and their almost non-existent mutual recognition. Here, the intervention group emphasized the importance of several elements: 1) consolidating support networks; 2) recognizing and accepting themselves *and* their peers as women, in spite of their individual differences; and, 3), the importance for their subjectivity of having their actions and desires validated as strategies of change oriented to a process of reconstruction that would valorize them as people and offer new representations that support their capacity to exercise power and thus raise their self-esteem.

In the final stage of the intervention –'reinforcement'– we sought to conduct a process in which the women would deconstruct-reconstruct the gender-based systems of representation that have psychosocial referents in the subjective constitution of the group. Our hope was that this analysis of their practices would allow us to extract highly significant nonverbalized symbolic elements related to the signification of a representation (Flores 2001).

In that phase of our work, we conducted an analysis of their discourse and narratives using certain group dynamics and techniques designed to isolate significant elements that reflected some of the tensions identified in the previous stages. This analysis centred on the relation between the meanings women attribute to their surroundings and their personal experiences. It revealed emotional ambivalences related to their double role as female heads of households and as women. What stood out was their need to feel loved, protected, and cared for by a masculine figure, a finding that agrees with González (1993: 78), who reported that "throughout their lifetime women do not obtain the amorous nourishment that they provide [to others]." As one participant said: "...when he calls me from the US, he never asks me how I'm doing ... instead he's surprised to hear I'm working and says I'll probably get fired before long."

When asked about their life projects, these women reached the conclusion that no such thing existed or, if it did, that it was centred exclusively on the family, a situation causing feelings of frustration. They feel insecure about undertaking any other project outside the family context, and this attitude limits their search for new possibilities and contributes to their low self-esteem. It proved very difficult for them to identify with the ability to carry out a life project of their own; one that would benefit them and proffer them some degree of comfort. The following comments illustrate this: "... I always wanted to study, but didn't have the chance, I've always had to work ...", and "... I'd really like to be someone, to study, but I don't know how."

Upon becoming conscious of their role as caregivers, they began to critically question the survival strategies they had constructed, which also centred on others. Eventually, they came to realize that this process *is* reversible and constrains their personal growth

Table 66.1: Summary of the results by objective factors and subjective expression. **Source**: The authors.

Objective factors	Subjective expression	Discourse
Migration	Fear due to the spouse's absence and the lack of his social support	"When he went ... I was left completely alone."
HIV, AIDS	Fear of dying and leaving the children	"What disturbs me most is that my kids remain alone."
	Loneliness and depression	"When I can't continue anymore I take a pill."
Community	Low self-esteem	"I am nobody."
	Continuing dependency on spouse	"Even though he is not here, his space is being respected."
	Helplessness, lack of recognition and power	"Nobody understands me. I am alone with my kids."

to a considerable degree. Malaise, pain, and sadness were expressed time and time again as the feelings they associate with the context of migration and, clearly, with their poverty, low self-esteem, feelings of guilt, self-censorship and feelings of dependence.

Recognizing and revalidating these feelings, necessities, and thoughts supported the process of becoming more sensible that led to an analysis of the dynamics of visual imagery related to their death. The pain they manifested in this context – one that all of us must face sooner or later – oriented them more towards the 'here and now' when they spoke of the things they needed for their physical and emotional well-being: taking control of their bodies, recovering lost pleasures and their sexuality, generating a life project that will strengthen and give them a new dimension as women.

Table 66.1 summarizes the overall results in a grid contrasting the objective situational factors, the subjective expression of the stressors and examples of the women's discourse as illustration.

66.4 Conclusion

The results obtained in this research allowed us to see subjective processes, social representations, and the sense and meaning that these women give to their existence in a context of migration and conditions of poverty and vulnerability. The women's statements and contributions to the focus group and intervention reveal a deep emotional undercurrent in subjectivity and sense making that colour all discursive production. We think that most realms of life, including general health-related behaviour as well as behaviour implied by the lack of critical resources show a similar structure. Also in these areas of everyday life and coping with the novel, affective underpinnings have a crucial effect upon cognition, action, and language use.

Besides, the present study on women and HIV reveals how public knowledge is displayed in the conversations of people affected and their family members. It illustrates the finding that the stable core of social representations comprises primarily affective and emotional elements (Wagner/Valencia/Elejabarrieta 1996). In this study, we find concern for the well-being of one's beloved children, fear of the unknown future of living with HIV, distress about the husbands' absence for work in a foreign country and their extramarital relationships there, and the desire for community support. All these are 'hot' ideas linking the general societal discourse about AIDS to one's private subjectivity. The subjective weight of women's own experience of HIV in the light of their dialogues is also reflected by the fact that they do not hesitate to openly talk about deeply sexual issues in their private lives, while sexuality usually falls prey to rules of decency and prudishness in most other conversations.

On a more general level, the research highlights that "to be secure is to feel free from threats, anxiety or danger. Security is (...) a state of the mind in which an individual (...) feels safe from harm by others" as stated in the Report of the UN Secretary-General's High Level Panel on Threats Challenges and Change, 2 December 2004. Such a subjective state of security, however, does not only depend on identifiable others, but also on structural characteristics of a social system. These characteristics have to do with the social status of their gender and the associated lack of power which are central constituents of the women's subjectivity. Consequently, the risks entailed by migration and HIV become overwhelming for a single person.

The study also illustrates that the pillars of human security, particularly the 'freedom of want' and the

'freedom of hazard impact' as defined in United Nations documents (Brauch 2008a), are crucially interconnected. The ability to cope with the impact of potentially lethal health hazards depends on a nation's public health infrastructure as well as on the economic and, even more so, on the social resources available to the individual. The stories of the women recounted in the focus groups vividly illustrate the plight of HIV positives to realign their life in the community under their changed condition. Even though purely existential fears in the face of a serious disease can never be completely alleviated, a general feeling of security can very well be achieved through community resources backed by a nation's social and gender policy.

67 Integrated Assessment of Vulnerability to Heat Stress in Urban Areas

Tanja Wolf, Glenn McGregor and Anna Paldy

67.1 Introduction: Global Environmental Change

Throughout human history societies have changed their environment by developing agriculture, settlements, practicing commerce and conquest and becoming increasingly industrialized and urbanized (McMichael 2002: 1145). Today we are in a historically unprecedented situation: the aggregate environmental impact of humankind has begun to alter aspects of the Earth system. The human-induced changes in the large-scale biosphere and atmosphere are called *Global Environmental Change* (GEC). They include stratospheric ozone depletion, biodiversity loss, land degradation, coral reef degradation, depletion of freshwater supplies, spread of invasive species, the disruption of nutrient cycles (e.g. nitrogen, sulphur, and phosphorus) and the dispersal of persistent organic pollutants. Furthermore, the increased concentration of human related atmospheric trace gases has lead to one of the most widely discussed of these environmental changes, namely climate change (Martens/Mc Michael 2002).

Four assessment reports of the *Intergovernmental Panel on Climate Change* (IPCC) have summarized the knowledge on climate change and increasingly attribute this to human activities. Greenhouse gas emissions have now reached unprecedented concentrations and in parallel to continuous efforts to mitigate present and future greenhouse gas emissions, massive adaptation to unavoidable climate change and its impact is required. Climate change will particularly affect vulnerable countries and populations. Their vulnerability is a function of the hazard they are exposed to and their sensitivity. To understand and assess vulnerability to hazards has practical benefits for identifying 'hot spots' as targets for adaptation strategies. Accordingly an approach to assess vulnerability to heat stress using indicators for risk is presented here.

67.2 Assessment of Climate Change by the IPCC (1990-2007)

Over the past decade, the fact that the world's climate is changing has become clear. Initially the responsibility has been attributed to both, natural processes and numerous human activities that transfer gases into the atmosphere which enhance the natural greenhouse effect. The Third and Fourth Assessment Report of the IPCC stated that there is "new and stronger evidence" that most of the warming observed during the past 50 years is attributable to human activities (IPCC 2007; IPCC 2001). The IPCC describes that the global average surface temperature has increased since 1861 and that the increase in temperature throughout the last hundred years is the largest of any other century during the last 1000 years. The recent warming has taken place in a much shorter time span than similar changes in paleo-times. Over the past 100 years, the global mean temperature has increased by 0.6 °C and in Europe, the increase amounts to about 1.3 °C over the past 100 years. Ten of the 12 hottest years in the 20th century occurred after 1988. Climate models indicate a temperature increase by 2100 of 2.4–6.4 °C (IPCC 2007).

67.2.1 Projections Until 2100

Regional climate models for Europe forecast that in 2071 to 2100 compared to 1961 to 1990 there will be an increase in temperature and an increase in the variability of temperature (Schaer/Vidale/ Luthi/Frei/ Haberli/Liniger/Appenzeller 2004: 332). Cold winters are expected to nearly disappear during the next century and hot summers are expected to become much more frequent (Parry 2004: 1). Recent regional scenarios predict warming in central and south-western Europe to peak in summer, with very large temperature increases reaching 6–7 °C locally and perhaps even 10 °C (Räisänen/Hannson/Ullerstig/

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Doescher/Graham/Jones/Meier/Samuelsson/Willen 2004: 13).

Climate change has and will have effects on regional weather conditions[1], physical environment, ecosystems, economic environment and society (EEA 2003; IPCC 2007). One of the major consequences of climate change will be the increasing occurrence of extreme weather events and changes in temperature, precipitation, wind and especially an increased climate variability that will make heat-waves, drought, flooding and storms more probable. In combination with other recent processes of global environmental change (urbanization, stratospheric ozone depletion, biodiversity loss, land degradation, depletion of freshwater supplies) and demographic and epidemiologic transitions, the potential health effects are grave.

Climate change will affect human health in many ways but mostly adversely. Epidemiological evidence of how climate variations and trends affect various health outcomes has been assessed and estimates of future health effects of climate change over coming decades have been published (Campbell-Lendrum/Pruess-Uestun/Corvalan 2003). Kovats, Campbell-Lendrum and Matthies (2005: 1409) have estimated avoidable deaths and disease from climate change due to heat stress, air pollution, weather disasters, mosquito, tick and other vector borne diseases, water- and food-borne diseases and under nutrition. Evidence and anticipation of adverse health effects will strengthen the case for pre-emptive policies, and will also guide priorities for planned adaptive strategies (McMichael/ Woodruff/Hales 2006: 859).

67.3 Heat Stress as a Health Risk

For the direct health impact of heat, the summer of 2003 provides strong evidence. First estimates suggested approximately 22,000–35,000 heat-related deaths across Europe during the first two weeks of August 2003 (IFRC 2004; Kovats/Wolf/Menne 2004). Later the Centre for Research on the Epidemiology of Disasters updated the estimated deaths from the heatwave in fourteen European countries to 72,210 deaths (CRED 2007: 1). Other studies looked at the mortality in small administrative units during the exceptionally hot summer compared to other summers without taking temperature into account, resulting in estimates of 74,483 deaths (Robine/Cheung/LeRoy/VanOyen/Griffith/Michel/Herrmann 2008: 177). Although the 2003 heatwave was unique in many ways, heat-related health outcomes have been and continue to be a problem in Europe (Kovats/Koppe 2004) and the rest of the world (CRED 2007). The fact that many heat-related deaths could be avoided if single and ill people were better looked after should be an imperative for health systems and society.

The adverse health effects of heat are most evident in urban areas. Often cities are built in a way that temperatures are several degrees higher compared to the surroundings and considering the trend in increasing urban sprawl, this certainly does not help future situations under climate change (Patz 2005: A84). The urban heat island effect (the ambient air temperature within cities is higher than in rural surroundings) poses a risk to urban inhabitants' health (McMichael 2001). The heat island in summer is due to the heat-retaining characteristics of the built environment, the treeless expanses of inner cities and the physical obstruction of cooling breezes (Kim 1992: 2319; Oke/Johnson/Steyn/Watson 1991: 339). In summer, the symptoms of diurnal heating begin to appear by mid-morning when temperatures can be about 10 °C warmer than nearby woodlands. Furthermore, the health of urban inhabitants may in addition be impaired due to urban air pollution from industry and traffic (Sartor/Snacken/Demuth/Walckiers 1995: 105; Smoyer/Kalkstein/Greene/Ye 2000: 881).

The identification of high-risk patients and taking appropriate measures to avoid hypothermia is essential for decreasing mortality during heatwaves. Outreach to populations at risk can be improved when it is known where they are and where the heat stress is greatest (Wilhelmi 2004: 147). Part of the risk management of heat stress in urban areas is therefore the identification of high risk areas. The challenge to manage the health risks related to heat stress in urban areas is becoming even more relevant under conditions of a changing climate and an increase in climate variability and the frequency of heatwaves (Confalonieri/Menne/Ebi/Haugengue/Kovats/Revich/Woodward 2007). To provide decision support on how and where vulnerability to heat stress occurs and where it can be reduced requires risk assessment and prioritization, understanding of vulnerability of the population and identifying geographic 'hot spots'.

1 By definition, climate is the average state of the atmosphere, while weather is the day-to-day manifestation of climate.

67.4 Sustainable Prevention of Adverse Health Outcomes from Heat Stress: The Challenge

67.4.1 Response and Lessons learnt from the 2003 European Heatwave

In response to the 2003 heatwave several countries in Europe implemented heat health plans. Besides national plans in Italy, France, Spain, Portugal and the United Kingdom, some regions and cities have also developed mechanisms to be able to better respond to future heatwaves. These plans include mainly four strategies to reduce adverse effects of hot weather: changes in long-term urban planning towards creating a benign urban climate, adaptation in buildings and housing, education, information and preparation of people as well as heat health warning systems which trigger an alarm when a specific threshold condition (temperature) is forecast to be exceeded (Kirch/Menne/Bertollini 2005: 277).

67.4.2 Long-term Changes in Urban Planning

Long-term urban planning can achieve climate rehabilitation of the environment. Adjusting the layout of cities to the climate in which they are located, changing the traditional skyline of the city (straight lines of high rise buildings with open spaces in between instead of bell type skylines) and using urban underground space for underground building (doubling of the urban area without changing the urban climate) are examples of some of the long-term measures that can be implemented on the city scale. At the building and neighbourhood scale, reduction in the use of artificial air-conditioning, heating and lighting, urban shading projects, greening of the urban environment through parks and public gardens or green roofs and the use of alternative sustainable energy like solar, wind, water, biomass and waste are examples of adaptation strategies (Koppe/Jendritzky/Kovats/Menne 2004; Keatinge 2003: 512).

67.4.3 Adaptation in Building Requirements

Buildings designed following guidelines for high energy-performance may in the medium term reduce the exposure to heat load indoors (Bitan 2003). While in many areas building codes require the possibility to warm a rented dwelling in winter, similar requirements for cooling in summer are rare (Eliasson 2000: 31; Kilbourne 2002: 328). Air-conditioning is a common approach to cooling indoor environments in developed countries with high summer temperatures. However, besides the high energy consumption, which if not produced from renewable energy contributes to further greenhouse gas emission and climate change, air-conditioning systems produce heat which may enhance the urban heat island effect.

67.4.4 Education, Information and Preparation

The general population, health professionals and staff in institutions need to be informed and made aware of what to and what not to do when confronted with heat. Raising awareness of a range of simple measures to combat the effects of heat can be achieved through public education programmes. Measures include wearing light and loose fitting rather than excessive clothing, to avoid prolonged sun exposure, avoid acute alcohol intoxication, continue to eat regular meals and drink enough water, open windows, to use fans wisely, avoid unnecessary exertion, sprinkle water on clothing and check that windows can be opened and that a fan is available in advance (Basu/Samet 2002: 190; Ebi/Teisberg/Kalkstein/Robinson/Weihe 2004: 1067; Keatinge 2003: 512).

67.4.5 Implementation of Heat Health Warning Systems

In the short term *Heat Health Warning Systems* (HHWS), run by or in cooperation with national weather services, can be used to trigger warnings to the population and health care providers. The success of HHWS depends on availabitiy of effective intervention strategies. These may include a 'buddy system', a 'hotline' telephone service, heat advisories via mass media, organization of transport to air-conditioned areas and extra health and social services staffing during heat events (Kalkstein 2000: 650). Ebi, Teisberg, Kalkstein, Robinson and Weihe (2004: 1067) calculated, based on a number of assumptions, that for the HHWS in Philadelphia an individual warning lowered the daily mortality by about 2.6 lives on average and that the benefits in terms of lives saved far outweighs the operational costs of such systems.

67.5 Risk Management and Vulnerability Mapping

To analyse risk means to understand and measure the probability of the occurrence of a damaging event. For each risk, its likelihood or probability to occur and the extent of the impact or consequences are required to assess the risk. Risk management is a systematic approach to setting a course of action under uncertainty by identifying, assessing, understanding, acting on and communicating risk issues. The final aim of understanding risks is, to help to anticipate dangers and mitigate them. To understand and assess vulnerability to hazards has shown to be directly relevant and applicable to a number of risks as it can be useful for identifying 'hot spots' as targets for adaptation strategies.

Mapping of vulnerability to heat stress is just starting to make its way onto risk assessment agendas. For example mapping of the impact of heat has been done by the *Institut de Veille Sanitaire* (INVS 2004) after the 2003 heatwave, the health risks due to high temperatures have been assessed in Canada (Dolney/ Sheridan 2006: 94; Vescovi/ Rebetez/Rong 2005: 71) and in the US vulnerability to heat stress in relation to microclimate has been studied (Harlan/Brazel/ Prashed/Stefanov/Larsen 2006: 2862).

One way of assessing vulnerability is to build an index, composed of the factors influencing vulnerability to heat stress. Criteria of a vulnerability index for identification of hot spots of vulnerability with the aim of supporting decision makers where to target vulnerability reduction measures are:

- *Significance*: the index needs to be able to identify hotspots of vulnerability where evidence indicates an elevated vulnerability compared to the surrounding area
- *Stability*: the index needs to be able to identify hot spots of vulnerability that are stable for some time (or show repeating patterns in dynamics) in order to allow vulnerability reducing measures.
- *Relevance*: the hotspots of vulnerability need to match with hotspots of hazard-related mortality and morbidity
- *Feasibility*: the data fed into the index need to be cheap, reliable, recent, routine and at a sufficient spatial resolution
- *Transferability*: the index should – in its fundamentals – be applicable to several European cities

A vulnerability index is presented here to describe and assess the dimension of vulnerability within cities. Vulnerability is defined as a function of hazard, exposure and sensitivity (IPCC 2001). The composition of the index is based on experiences with risk and vulnerability assessment through the application of indices in other disciplines (INVS 2004). Vulnerability depends on various factors which have been identified in epidemiologic studies and which have often been reviewed, for example in Kovats (2007). To assess the vulnerability and the factors determining the vulnerability to heat, the following aspects have to be evaluated:

- the hazard in form of heat load
- the exposure to the hazard[2]
- the sensitivity of the population[3]
- the degree of adaptation to and prevention of the hazard

In this study, because of the need for generalization and a lack of specific data, sensitivity and adaptation capacity are regarded together, since both are influenced by similar factors. To assess population vulnerability, reliable, recent and readily available routine data is necessary.

The spatial overlay of several vulnerability indicators can help to identify hotspots of vulnerability. Based on the findings of epidemiologic studies, vulnerable areas in cities are characterized firstly by a high 'outside' heat load due to the heat island effect, the city morphology and the lack of vegetation or ventilation. Secondly, residences with high 'inside' heat load due to building height, quality of thermo-isolation and ventilation and exposure certainly carry a higher risk of adverse health effects from hot weather. Thirdly is a concentration of people lacking resilience due to age or impaired health and fourthly, a lack of adaptation capacity. Together these make an area and its population sensitive. Where more than one of the determinants of vulnerability appears, the vulnerability is even higher. To assist with identification of 'hot spots' heat risk factors can be mapped as a vulnerability index. The mapped vulnerability index, composed of individual or combined risk factors, can then be validated with spatial health data, such as mortality, for hot weather events.

2 Adaptation may be defined as adjustment to a new or changing environment, see next chapter

3 Vulnerability to health effects of heat may be high due to age, impaired health, medication and other risk factors

67.6 Example Budapest

Budapest has a continental climate with cool winters and hot summers. Hungary has defined heatwaves as periods when the daily mean temperature exceeds 26.6 °Celsius for three consecutive days, which corresponds to the 98th percentile for the period 1992–2000. From 1992 to 2003 11 heatwaves occurred, with 5 between 2001 to 2003 (table 67.1). The average mortality in summer has been reported as about 61 deaths per day, while the maximum number of excess deaths during heatwaves was about 100 per day. This trend shows that there is a need to assess vulnerability to heat stress in Budapest. In order to identify hotspots of vulnerability, the vulnerability index – as described above – was applied to Budapest.

Table 67.1: Number and period of the heatwaves in Budapest (1996-2003). **Source**: Páldy/Bobvos/Vámos/Kishonti (2006); Páldy/Bobvos/Kovats (2005).

Year	from	to	No of days	total
1994	28.06.1994	01.07.1994	4	14
	30.07.1994	08.08.1994	10	
1998	22.07.1998	25.07.1998	4	7
	03.08.1998	05.08.1998	3	
2000	13.06.2000	15.06.2000	3	6
	20.08.2000	22.08.2000	3	
2001	14.07.2001	16.07.2001	3	3
2002	21.06.2002	24.06.2002	4	9
	09.07.2002	13.07.2002	5	
2003	07.06.2003	14.06.2003	8	18
	04.08.2003	06.08.2003	3	
	13.08.2003	20.08.2009	7	

To assess the outdoor heat load in a city, satellite images of thermal emission (Terra ASTER) for a warm summer day can be used. The potential of satellite imagery for heat detection is described in detail by Voogt and Oke (2003: 370). Important urban climate-related variables can be obtained from the *Moderate Resolution Imaging Spectroradiometer* (MODIS). The value of using satellite imagery lies in the instantaneous observation, the global coverage and the promising quality of MODIS products such as Landsat and ASTER (Lo/Faber 1997: 143; Menglin/Shepherd 2005: 681). Spatial temperature patterns in Budapest have been analysed via remote sensing by Pongracz, Bartholy and Dezso (2006). They also analysed the urban heat island intensity. They found that the warmest part of the city is the downtown area (administrative and commercial centre) on the left bank of the Danube River whereas the western part of the city is hilly, covered by forests and relatively cool. However, satellite images only give information on surface temperatures. With regard to housing, the roof top temperature is revealed by satellite images. How far this can be an indicator for temperatures within buildings is not yet known sufficiently. Besides this, no cheap data on heat load at a sufficient spatial resolution and temporal stability is available. Therefore, heat load is not included in the index presented here.

The best source for indicators of vulnerability is census data. This data is available for 2001 for Budapest from the Central Statistical Office and contains demographic, socio-economic and housing data for 23 city districts of relevance as vulnerability indicators. According to expert opinion, information on the level of education is an important vulnerability indicator in Budapest. Therefore the variables indicating high population vulnerability and used to construct the vulnerability index are:

- High age: Percentage of population over 65–75
- Very high age: Percentage of population over 75 (separate variable to account for very high age)
- Living alone: Percentage of single households
- High population density: Percentage of more than 11 flats per block
- High indoor temperature due to poor insulation: Percentage of buildings with a low housing quality
- Percentage of people with low level of education (maximum of 8 years of school visited)

For each indicator the range of the percentage values is divided into 5 equal intervals and a value of 1 to 5 is attributed to each class with respect to the extent to which it indicates higher or lower vulnerability. In this way, the expression of an indicator is normalized by the values occurring to each indicator (see table 67.2 for some basic statistics of the variables).

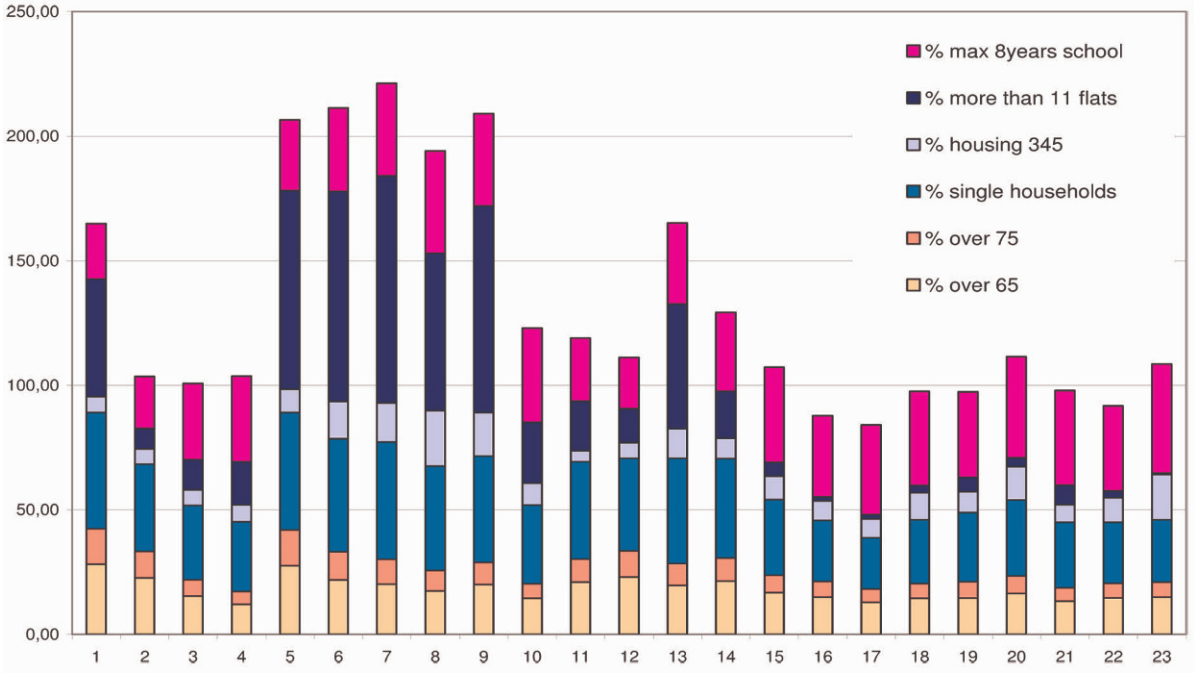
Figure 67.1 shows the share for each variable by district. It is clear that some districts accumulate high shares in more than one of the risk variables. In those districts (1, 5, 6, 7, 8, 9, 13) where the threshold of 150 per cent is exceeded, it is obvious, that many people are characterized by a double burden of vulnerability.

The index, which is the sum of the values from the classification (1–5) for the various indicators for every spatial unit (district) gives an estimate of the overall vulnerability in the district. The results have been

Table 67.2: Descriptive statistics of the variables. **Source:** Central Statistical Office Budapest.

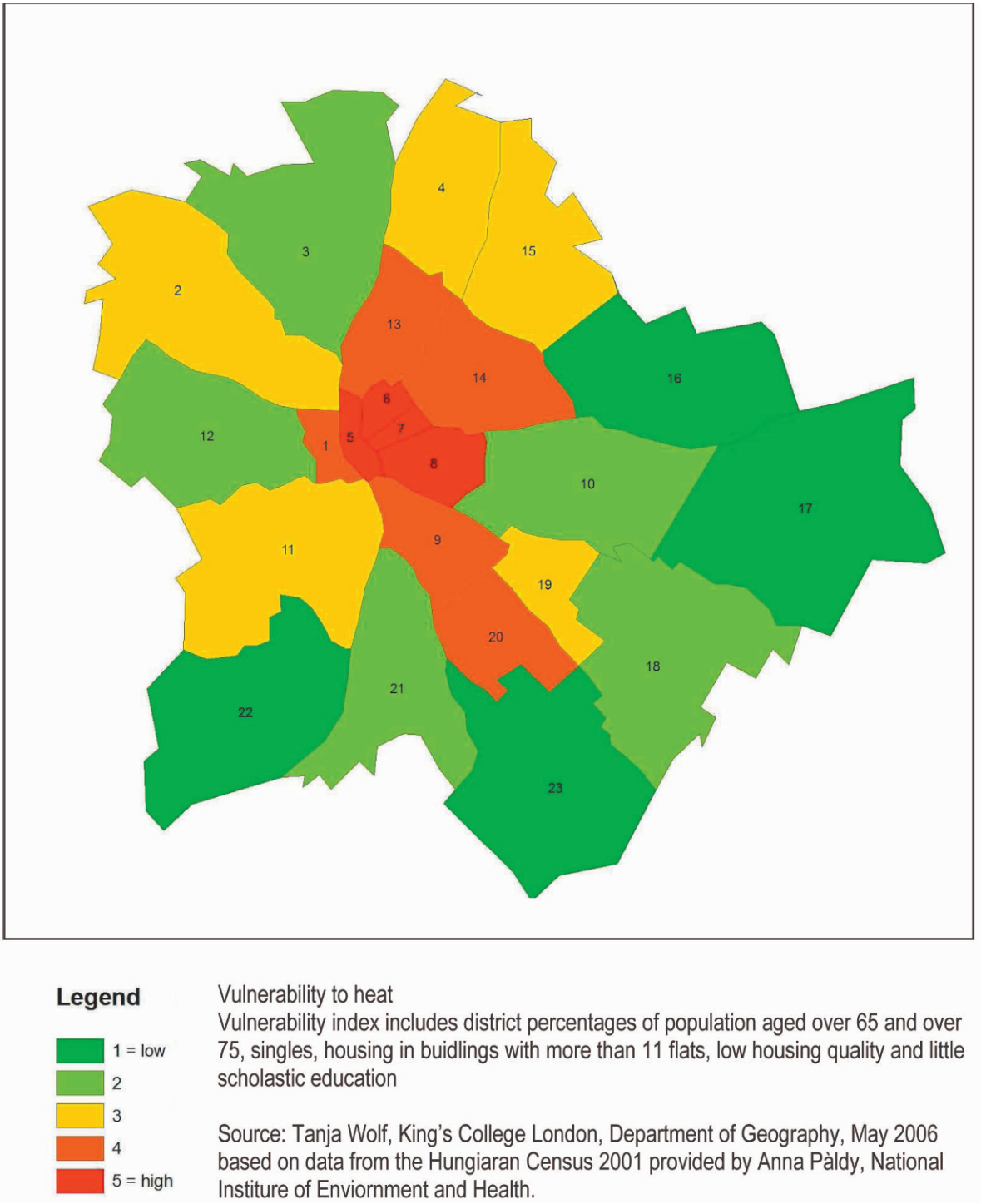
	Descriptive Statistics (N = districts)								
	N	Range	Maximum	Minimum	Mean	Std. (?)	Variance	Skewness	Std. Error
Population density/ km²	23	30180.10	507.50	30687.60	6407.09	6738.77	45411026.47	2.52	0.48
km²	23	5274.00	209.00	5483.00	2283.30	1503.16	2259504.31	0.17	0.48
Per cent over 65	23	16.03	12.04	28.07	18.12	4.51	20.32	0.75	0.48
Per cent over 75	23	9.24	5.08	14.33	8.20	2.71	7.36	0.95	0.48
Per cent of single households	23	26.52	20.59	47.11	34.32	8.52	72.65	0.17	0.48
Per cent of housing 345	23	17.83	4.44	22.28	10.33	4.60	21.14	1.13	0.48
Per cent of more than 11 flats	23	90.57	0.63	91.19	28.05	31.26	976.93	1.05	0.48
Per cent of a maximum of 8 years in school	23	23.19	20.53	43.73	33.41	6.33	40.09	-0.73	0.48

Figure 67.1: Shares of populations with characteristics attributable to vulnerability indicators by district. **Source**: Central Statistical Office Budapest.



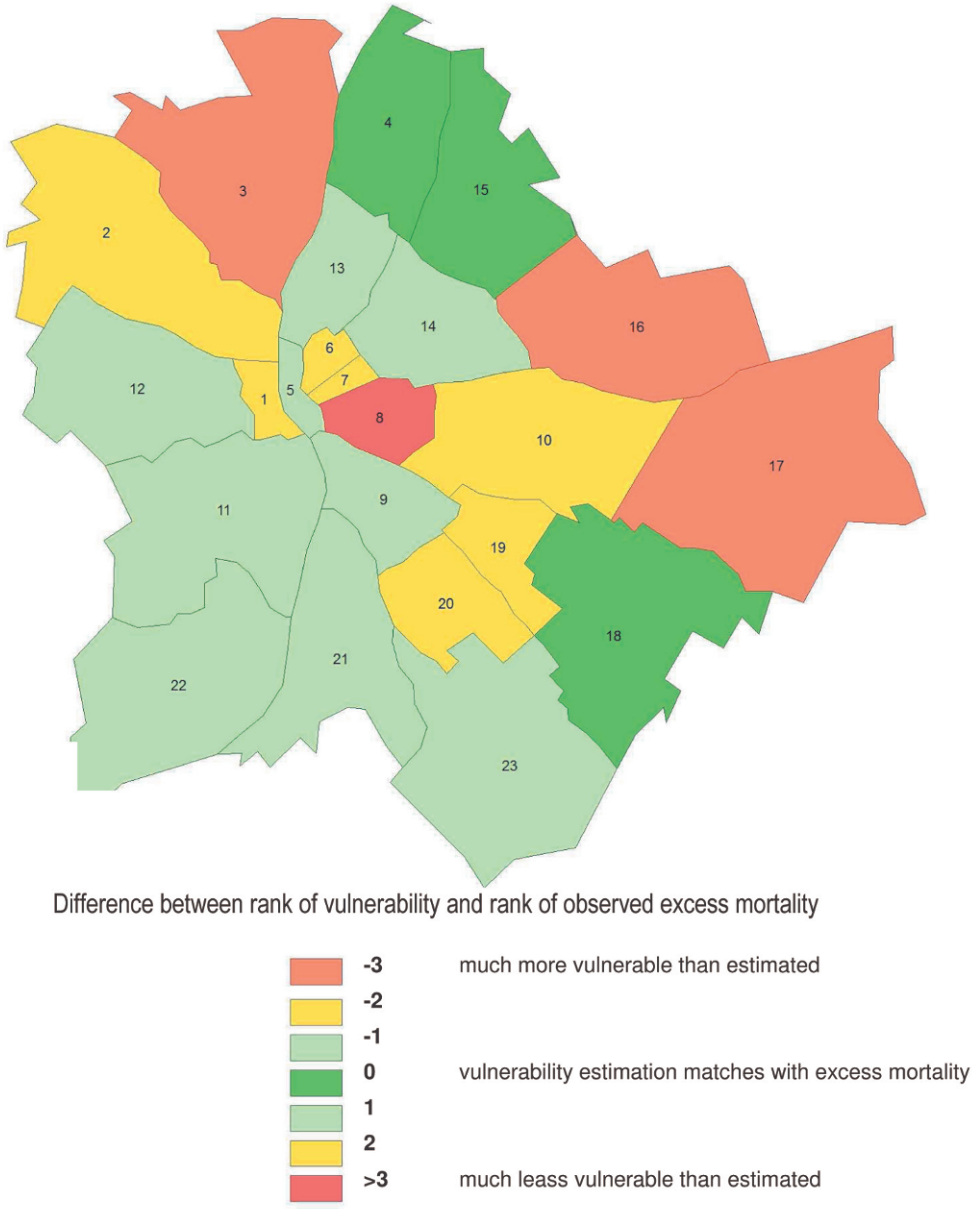
mapped in figure 67.2. Taking into account the nature of a hotspot as being of high interest because of the severity of the threat and the number of the people affected in relation to the size of the district, the index calculation based on percentages of the population are adjusted by the population density in the district. Finally, class 1 has the lowest value of being a hotspot of vulnerability, class 5 the highest. Following this approach, the districts with the highest vulnerability are number 5, 6, 7 and 8, in the centre of the city, then district 1, 13, 14, 9, and 20 as the second highest class (figure 67.2).

Figure 67.2: Vulnerability Map. **Source:** Wolf (2006).



As a last step the results of the vulnerability assessment have to be compared with the observed spatial distribution of summer heat-related mortality. For such a bottom up approach data on the location (address, district) of individual deaths during a hot period is necessary. A comparison of hotspots of vulnerability with the observed distribution of heat-related mortality will show whether a spatially inhomogeneous distribution of mortality correlates with the patterns of the physical and socio-economic landscape.

Figure 67.3: Test result: Difference between vulnerability index and observed excess mortality. **Source**: Wolf (2006).



In order to compare the vulnerability map based on the information on population vulnerability and population density with the spatial distribution of the heatwave mortality, daily mortality data is used. The cases from 1996 to 2003 have been made available by NIEHS. This data identifies total mortality for male and female as well as by age group (15 to 46, 47 to 65, 66 to 74, 75 to 84 and over 84). Mortality of under 15 year olds is negligible in Budapest during a heatwave so this age group is not considered.

From 1.1.1996 to 31.12.2003 a total number of 206,130 deaths were registered. During those seven years, in total and in all districts there is a trend of decreasing numbers of deaths, except for a marked winter influenza peak in 1999. Throughout the year, more deaths occur in winter. The share of deaths by district is fairly equally distributed, the differences

occur constantly through the years and the months. The weekly and daily distribution of mortality has not been assessed; few deaths occur in each district daily and the fluctuation on this level may be just by chance.

In order to assess if the hotspots of vulnerability match with observed locations of excess mortality during heat events, the excess mortality was mapped. To reach a level of significance, some aggregation of the cases is necessary. Since the spatial resolution (23 districts) is quite low, further spatial aggregation has to be avoided. Instead, the number of deaths that occurred during those days which have been defined as heatwave days (43 days) has been calculated. During the 43 heatwave days, 3251 people died in Budapest. A comparison with the average number of deaths during summer shows that the mortality during heatwave days is always and in every district, except in district 8, higher than the average of the seven year study period.

As a next step, the range of excess mortality in each district has been classified into quintiles and has been compared with the vulnerability classes for every district. Figure 67.3 shows, that there is some matching, but in some districts high mortality does not coincide with high estimated vulnerability.

The only district which did not show excess mortality during heatwave days compared to average summer mortality (district 8) is also the one which shows much less sensitivity to heat than expected from the assessment. This district had an outstanding low housing quality. Perhaps in this district the low housing quality is not linked with high vulnerability. In contrast, for districts 3, 16 and 17 the excess mortality was instead high, while the vulnerability was estimated to be low. Here, some factors influencing vulnerability seem to be not captured by the variables comprising the vulnerability index.

67.7 Conclusion

In this chapter a new method for identifying hotspots of vulnerability to heat stress in urban areas has been presented. Many caveats, such as the lack of freely available spatial data concerning exposure, but also the rather low spatial resolution of data on the vulnerability side have been shown. In the near future, technical progress might make thermal remote sensing and the analysis of urban heat islands more sophisticated and cheaper. But the information on roof-top temperatures does still not give evidence on the exposure of populations to heat inside buildings. Furthermore, to increase the spatial resolution of census data is probably an even bigger challenge.

The vulnerability mapping tool presented here should provide evidence on hotspots and where action is most urgently needed. However it would appear that the tool needs to be more precise. Of the 23 districts vulnerability matched the observed excess mortality for 12. For the remaining 11 it was either under- or overestimated.

Notwithstanding methodological constraints, the potential of this tool as part of an adaptation policy framework, even if able to predict the health impact of heat events to a high degree, is still an open question. This is because moving from scientific knowledge to policy and action is a difficult process. Also, to incorporate insights from vulnerability analysis into policy and practice is a challenge and a lack of correspondence between vulnerability theory and action indicates weak links between analyses and decision-making. Pertinent questions in this context include how successful and precise does risk assessment need to be in order to really lead to policy and action? How much uncertainty on the one side and how much precaution on the other side allows for inaction? And importantly, when hotspots of vulnerability reflect patterns of social inequality or environmental injustice, will action be taken?

Part VI Coping with Hazards and Strategies for Coping with Social Vulnerability and Resilience Building

Chapter 68 **Regulation and Coupling of Society and Nature in the Context of Natural Hazards**
Jörn Birkmann

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68 Regulation and Coupling of Society and Nature in the Context of Natural Hazards

Jörn Birkmann

68.1 Introduction

Disasters are often viewed as sudden onset events triggered by external shocks impacting on societies and causing major harm and losses. However, most disasters linked to hazards of natural origin – such as the Cyclone Nargis (May 2008) which devastated the Irrawady-Delta in Burma with more than 100,000 fatalities, the Hurricane Katrina (August 2005) that caused major losses and harm particularly in New Orleans, and the Indian Ocean Tsunami (December 2004) that left more than 230,000 dead behind – are characterized by a major crisis and partial collapse of communities and socio-ecological systems as well as by important changes and feedback processes during and after the disaster. To achieve a better understanding of disasters and to derive lessons learned for future risk reduction endeavours, a more comprehensive perspective on these regulation and coupling processes is needed.

Adger, Hughes, Folke, Carpenter and Rockström (2005: 1036) argue that social and ecological vulnerability to coastal hazards – as in the Indian Ocean Tsunami – is influenced by building-up or erosion processes of resilience both prior to and after the disaster. Furthermore, Bohle (2006a: 4) underlines that research on social vulnerability and risk must emphasize social science theories to understand and explain disasters. Disaster studies and management strategies have often paid little attention to theories and conceptual frameworks.

This chapter introduces concepts of socio-ecological crises and examines different theoretical notions currently applied for describing interactions, coupling and regulation processes between society and nature, as well as socio-ecological crises and catastrophes. Particular emphasis will be given to concepts and theories regarding regulation based on economic regulation theory and the newer concept of the regulation of societal relationships with nature by Görg (2003) on the one hand (68.2), and the theories and concepts of general systems theory and cybernetics (68.3), including newer applications of these concepts in the Syndrome approach of the WBGU and the Archetype approach of UNEP's Global Environmental Outlook. Additionally, the concepts of Ecosystem Services and Human Well-Being developed within *the Millennium Ecosystem Assessment* (MA 2005) will be analysed in terms of their explanatory value for explaining coupling processes between society and nature. It will be explored whether and to what extent different concepts and frameworks focusing on socio-ecological interactions (systems) as well as on socio-ecological crises phenomena can offer a first theoretical and conceptual background for explaining key terms such as coupling and regulation as well as different response processes like coping, adaptation, stabilization, and change. Based on this theoretical and conceptual review, a critical analysis of pre-analytic visions of disasters is conducted in order to explore different problem views and perceptions on how disasters and crises are generated and what kind of phases are linked to these conceptualizations of disasters (68.4). Furthermore, regulation theory and the newer concept of Görg (2003) underline the importance of change and transformation due to larger crises. In this context, the author also examines how change and transformation can be linked to key terms in the disaster risk research such as coping and adaptation. This differentiation provides also an important basis to better understand – from a conceptual perspective – how to account for change within the context of crises and disasters linked to natural hazards (68.5).

These theoretical and conceptual sections will be juxtaposed against the practical research and experience of regulation and coupling processes of socio-ecological systems in Sri Lanka after the Tsunami 2004 (68.6). Major emphasis is given to different views and problem definitions, key coupling processes between coastal communities and their natural

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resource base, post-disaster stabilization and destabilization processes, and different feedback and response processes that also reveal new arenas of conflict and different agendas of the various actors involved in the recovery and reconstruction process. The conclusions summarize key findings of the empirical case study work and also formulates a kind of synthesis in terms of key-questions for capturing coupling and regulation of socio-ecological systems within crises and disasters linked to natural hazards (68.7). These questions are based on both the conceptual framework discussion in the first part of the chapter (68.2 to 68.5) and the empirical case study work in the second part of the chapter (68.6).

68.2 Regulation

Coupling and regulation are key terms when dealing with the interactions of human-environmental systems or so-called coupled socio-ecological systems (see e.g. Turner/Kasperson/Matson/McCarthy/Corell/Christensen/Eckley/Kasperson/Luers/Martello/Polsky/Pulsipher/Schiller 2003). Although there is a general consensus that coupling processes between society and nature are key for understanding coupled socio-ecological systems, there is yet a large gap regarding a sound conceptual and theoretical approach that can explain coupling and regulation processes within these coupled systems linked to crises and disasters due to hazards of natural origin. Therefore, the following chapter will examine different theoretical and conceptual approaches that have attempted to explain the nature of coupling and regulation.

68.2.1 Introduction to Regulation Theory

Increasingly, regulation theory has been applied within the concept of societal relationships with nature and in the framework of global change research. In the context of the discourse on crises and disasters linked to hazards of natural origin – regulation theory, based on newer concepts of societal relations with nature – may offer a theoretical framework to explain why certain crises and disasters lead to change while others do not. It might also help in examining the different interests and strategies prior to and after disasters. On the other hand, its limitations to the analysis of socio-ecological crises phenomena must also be better understood (Görg 2003, Görg/Brand 2008; Becker/Jahn 2006).

The term 'regulation' plays an important role in different disciplines and scientific fields, such as political economy and cybernetics. During the 1970's, regulation theory was developed by Michael Aglietta (1979) to improve our understanding of socio-economic change. Regulation theory aims to explain the economic and extra-economic mechanisms that can stabilize capitalist societies despite their fundamental contradictions generating crisis and disintegration (Danielzyk/Ossenbrügge 2001). Regulation theory discusses fundamental historical changes and respective stabilization and destabilization mechanisms in societies as well as the interplay between continuity and discontinuity using two central concepts, namely the 'regimes of accumulation' and the 'modes of regulation' (Aglietta 1979). In this context, regulation is based on the assumption that capitalist societies are inherently linked to and influenced by contradictions, which permanently endanger their own societal reproduction. Therefore, action and production patterns, economic development models, and other principles that structure and shape society (modes of accumulation and modes of regulation) are seen as core factors questioning the reproduction and further existence of society. 'Regulation'[1] within this context is not understood as an authoritative steering or governing process of the economy, but rather as a self-regulating process that conceptualizes the evolution and temporary stability of a crisis-driven capitalist society in which major conflicts and contradictions remain (Lipietz 1985; Görg 2003: 121; Danielzyk/Ossenbrügge 2001). However, this self-regulating process is based on the interests of different stakeholders that do act intentionally whereby the consequences of their actions are contingent and not always match the original intent.

From the perspective of social ecology and newer work done by the Institute for Social-Ecological Re-

1 An example of a regime of accumulation was 'fordism' which was characterized, among other features, by large automatization processes, mass production and mass consumption in industrialized countries. The historic change to post-fordism – often linked with terms such as flexibility, decentralized production units and new technologies etc. as the dominant economic model – was a fundamental change which is explained and discussed by regulation theory. In this perspective, the term regulation refers to the stabilization of structures and processes within societies and between society and the economy while major contradictions among different social groups and the economic development model remain.

search in Frankfurt (Germany), Wissen (2004: 45) points out that regulation realizes itself through different institutions, forms, and norms that structure and frame individual and societal behaviour, which together constitute a mode of regulation. These institutional practices, forms, and norms often stabilize conflicts and contradictions within societies and between society and economic development models for a certain period of time (Wissen 2004; BMBF 2004).

Aglietta (1979) examined the specific relations and interplay between continuity and discontinuity within different phases of socio-economic development in capitalist societies. This school of thought defines regulation as a contingent result of an open process of social contest that can be based on stakeholders acting intentionally. Regulation does not mean steering or controlling as clearly intentional and planned behaviour. In its core meaning, regulation describes the processes and structures – as a result of intended and unintended consequences – which lead to a stabilization of societal structures and relations linked to a specific economic development model while major conflicts and contradictions remain. The term regulation and some of the theoretical aspects developed by the 'French School' (Aglietta 1979; Lipietz 1988) are further developed and transformed in order to explain societal relationships with nature.

68.2.2 Regulation of Societal Relationships with Nature

Görg and Brand modified and transferred regulation theory which had originally been used to explain stability and crises within capitalist societies to the field of societal relationships with nature (Görg 2003; Brand/Görg 2008; Becker/Jahn 2006). The original meanings of both modes of regulation and modes of accumulation seem to disappear. The concept of 'modes of regulation' is used as a core element to explain the stabilization of specific ways on how societies view and use nature and natural resources (Görg 2003, Becker/Jahn 2006). Regulation in the new concept of societal relationships with nature tries to explain why contradictions and destabilization processes in societal relationships with nature do not lead to a collapse of societies or the corresponding societal relationships with nature.

The concept of the regulation of *societal relationships with nature* (Görg 2003) defines the institutional practices that determine the modes of regulation as key factors within the stabilization of societal development and societal relationships with nature. Furthermore, the concept of Görg (2003) distinguishes between small and large crises[2]. While a small crisis is seen as a process which can be managed and dealt with by existing institutions and organizations and does not exceed the problem-solving capacity of important stakeholders, large crises imply a major disruption, transformation, and change within existing institutions, modes of regulation and organizations. Görg (2003) underlines that his new approach of societal relationships with nature can help understand the social context in which crises occur. Thus, the general conditions of economic production and reproduction as well as the structures and approaches that configure societal development and the fundamental norms and values are embedded in and linked to this societal development (Görg 2003). That means that the term regulation is used for societal relationships with nature to describe the stabilization of societal structures and reproduction patterns, – while major contradictions in society (for example class, income, gender, etc.) as well as between the specific economic development patterns (logic of production, distribution, and consumption) and the natural resource base (ecosystem requirements) often remain.

According to Görg (2003), the concept of societal relations with nature has at least four major implications: *firstly*, the metabolism between production and reproduction is embedded in nature and has to be examined in the context of social values and norms. *Secondly*, he argues that knowledge and interpretation patterns must be taken into consideration as discursive representations of societal relationships with nature. *Thirdly*, he shows that norms and interpretations are the result of societal contest. *Fourthly*, the different phases of development in societies are also characterized by structural constraints (Görg 2003: 121–122).

Furthermore, strategies regarding societal relationships with nature and environmental problems do not start with the discussion about alternative solutions, but with the identification and definition of the problem itself. Thus, to acknowledge that a certain process, development, or structure can lead to crises or has already become a problem is often a disputed subject between major stakeholders. This issue is particularly important since the problem identification and definition themselves already determine the corridors in which solutions will be developed.

2 This distinction of small and large crises and their consequence is similar to the regulation theory of the French School see Aglietta (1979) and (Lipietz 1985).

68.2.3 Critique and Limitations

Regulation theory, as used in the context of the regulation of societal relationships with nature (Görg 2003), has undergone an enormous differentiation during the last decades, i.e. various concepts and variations of regulation theories were generated. In this context, Danielzyk and Ossenbrügge (2001) concluded that the thematic diffusion of regulation theory has dissolved into a broad stream of critical social science.

Thus, when trying to examine the value of the theory for analysing socio-ecological crises with a clear geographical perspective and a local and sub-national research focus, several limitations become visible. The original work by the 'French school' (Aglietta 1979; Lipietz (1985) focuses on the explanation of fundamental changes within societies, for example the change from 'fordism' to 'post-fordism'. The examples used within regulation theory clearly encompass changes which are taking place at the international level, such as transformation and change related to the industrial paradigm, accumulation regime, and mode of regulation as well as the overall model of development. For an analysis of socio-ecological crises linked to natural hazards at the local and sub-national level, regulation theory overemphasizes macro-structures, macro-economic forces, and large-scale institutional mediations and changes, while issues of local feedback and response processes, scale interactions, governance and social learning – which become more important in order to understand change and transformations at local scales – are underrepresented. The concept of the regulation of societal relationships with nature by Görg (2003) also focuses on international crises phenomena, especially the contested terrain of the use of biological resources, instead of investigating change on local scales.

The second limiting factor of the approach is the vagueness of some of its terms. Within the description of the change from fordism to post-fordism, the term 'post-fordism' remains fuzzy not only in original regulation theory but also in its application to societal relationships with nature. Critical reviewers argue that within regulation theory it remains unclear whether the term 'post-fordism' can be a guiding concept for a new development model at the end of the 20th century or whether it is rather an overloaded catchword showing the inability of regulation theory to deliver a coherent explanation of change (Danielzyk/Ossenbrügge 2001). They point out that also other key terms within regulation theory also remain vague, such as the key concept of 'regulation', which is defined either as a process or a result of intended and unintended consequences of social practices or as a contingent combination that might operate to support accumulation. According to Danielzyk and Ossenbrügge (2001), these terms are too broad for a coherent theoretical framework.

The third limitation is that most approaches in regulation theory have paid little attention to ecological and environmental questions. Although Lipietz (1985) argued that the Western mode of production has neglected the environmental resources and carrying capacity of the earth system, most approaches ignored the environmental aspects or society-nature relations as key factors that might determine future economic and social changes. Thus, by addressing the societal relationships with nature Görg (2003) made an important extension of the concept of regulation to society-nature interactions. Nevertheless, his understanding of what exactly nature means and includes also remains quite open. The analysis of stabilization and destabilization processes is too much centred on a societal perspective, while a better understanding of socio-ecological systems and crises phenomena would require a better theoretical understanding of coupling and feedback processes as well as destabilization and stabilization processes from the social and environmental perspective.

In summary, it seems promising to use at least parts of Görg's theoretical approach in order to explain changes in socio-ecological crises linked to natural hazards, especially regarding stabilization versus destabilization processes. However, regulation theory in general and his concept of regulation theory are too broad and in some parts too deterministic to explain the various characteristics that shape socio-ecological crises. The reason might be his focus on major societal transformations on the macro-level that neglects a detailed analysis of local level changes. Thus, additional theories and concepts must be reviewed for an improved theoretical understanding of socio-ecological crises phenomena linked to natural hazards. From the perspective of geographical and spatial science, theories from the social and natural sciences should be linked and combined to enhance our understanding of 'disasters of natural origin' (Rauch 2008: 204). The development of more integrative theoretical concepts and theories to capture socio-ecological interdependencies remains a challenge and faces many difficulties and obstacles, particularly when considering the different epistemologies applied (see e.g. Egner 2008; Wardenga/Weichhart 2006). But for

geography and planning – as interdisciplinary sciences – this challenge may result in new theoretical concepts that are needed to better explain socio-ecological crises linked to natural hazards.

This chapter reviews approaches linked to general systems theory and cybernetics that try to explain socio-ecological systems and socio-ecological interactions. Within this context, applied concepts such as the syndrome approach of the WBGU and the concept of the ecosystem services and human well-being within the Millennium Ecosystem Assessment will be discussed.

68.3 Approaches Related to Systems Theories

The discourses on resilience and coupled socio-ecological systems, on syndromes of global change and archetypes of vulnerability (Folke 2006; Berkes/Colding/Folke 2003a; WBGU 1996; UNEP 2007), as well as on societal relationships with nature (Görg 2003, Becker/Jahn 2006; Brand/Görg 2008) have existed mainly in parallel. However, during the past decades, several authors have at least tried to combine natural science and social science perspectives (Berkes/Colding/Folke 2003b: 9–13). But most of the approaches described by Berkes, Colding and Folke (2003) often prioritize either the social or the ecological/environmental perspective as the limiting condition. Although important links have emerged out of both schools, particularly within the Resilience Alliance, core elements in this research field – such as the coupling processes between social and ecological components of socio-ecological systems – still need a better understanding. Several case studies and examples use processes in ecosystems to explain coupling processes in coupled socio-ecological systems rather than societal or institutional changes. Changes, however, often reveal important insights into the functioning and hence the coupling of socio-ecological systems. The central conceptual frameworks for the analysis of coupled socio-ecological systems (Berkes/Colding/Folke 2003b: 22) as well as for the building of resilience (Folke/Colding/Berkes 2003: 359), such as the adaptive cycle, offer an important basis for progress in socio-ecological research. Nevertheless, it must be better explained how coupling and regulation processes work during normal times and in crises and how (generic) responses to a crisis develop prior to, during, and after a disaster. The dominant view that societal responses occur only after environmental shocks and crises may become questionable in the context of climate change. In this context, predictions about future changes in climate conditions already trigger societal responses (e.g. regarding insurance regimes or land management) – although bio-physical changes in environmental conditions have not yet occurred.

Against the background of resilience research (e.g. Holling 2003; Berkes/Colding/Folke 2003a) and the analysis of the concept of the societal relationships with nature (Görg 2003), the following analysis focuses on the description of coupling and regulation within the discourse on socio-ecological interactions in general systems theory and cybernetics (von Bertalanffy 1972, and newer applications by Vester 1990), within network theory and within the newer discussion of Society-Human-Environment-Interactions (Egner 2008) that are linked to the theoretical discourse in geography. These schools of thought should contribute to a better understanding of socio-ecological interactions and socio-ecological crises phenomena. The chapter cannot give an in-depth overview of the various schools of thought and sub-research fields. Rather, it will outline the use and meaning of coupling and regulation within the selected approaches described above. Furthermore, conceptual frameworks of coupled socio-ecological systems described within the syndrome concept of the German Advisory Council on Global Change (WBGU) (1996) and the archetype approach (UNEP 2007) as well as the concept of ecosystem services and human well-being introduced by the *Millennium Ecosystem Assessment* (MA 2005; Leemans 2009) are briefly reviewed, since they represent the school of thought on applied systems theory approaches with a strong emphasis on the environmental component.

68.3.1 Society Nature Interactions under the Perspective of General Systems Theory and Cybernetics

General systems theory (von Bertalanffy 1972), Cybernetics (Wiener 1948; Ashby 1985; Vester 1990, 2002, 2007), as well as complex systems theory (Lewin 1996) are used in different research fields including sustainability science, resilience research (Berkes/Colding/ Folke 2003b: 5), urban development and traffic system analysis (Vester 2007). All these research fields focus on the structure of complex systems, interdependencies, communication and interaction processes and, particularly, positive and negative feedback processes as well as control and regulation mechanisms within and between the different ele-

ments of a system. Moreover, it is important to note that the different contributions mentioned above also encompass specific historic context components.[3]

In geography and spatial planning, general systems theory and cybernetics play(ed) an important role for example in human-environmental systems research, in environmental assessment and in traffic and mobility research (see e.g. Vester 1990; 2007; e.g. the research on environmental *Life Cycle Assessment* (LCA) linked to cybernetics). Additionally, the work on social systems theory by Luhmann (e.g. 1990) received an increasing recognition within the social science oriented risk and systems theory research (see e.g. Egner 2008).

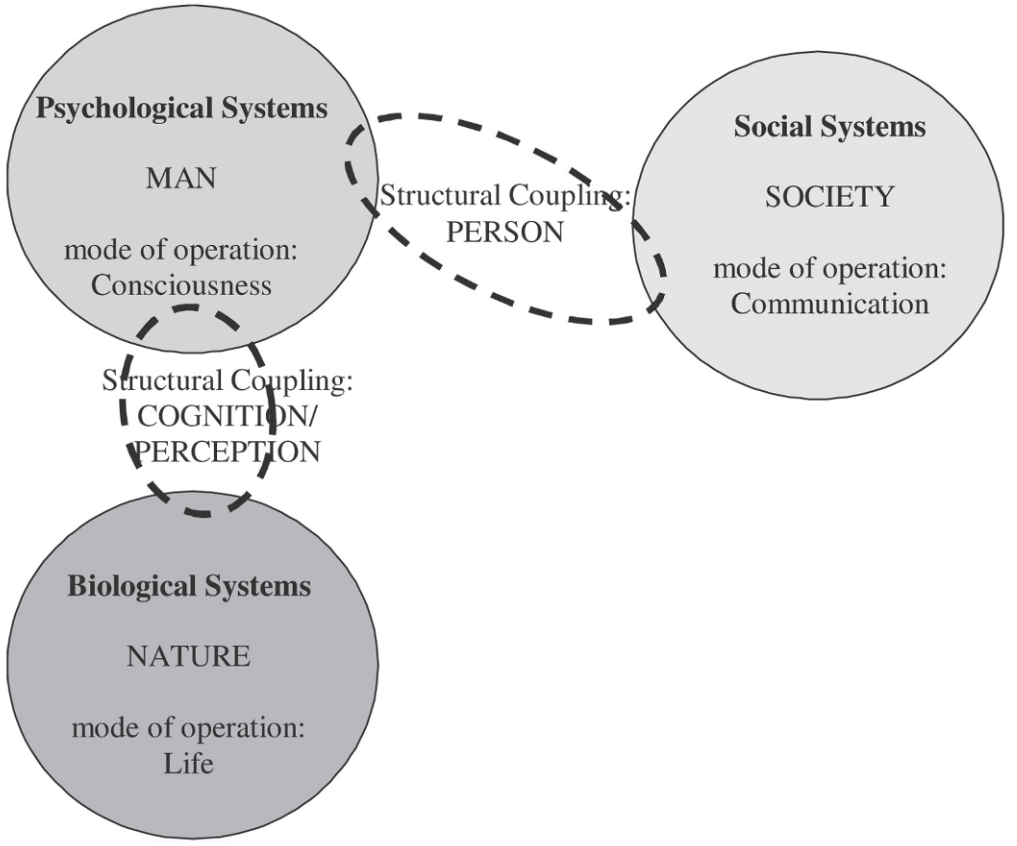
Important influences of network thinking and cybernetics in the field of planning and applied geography stem for example from Frederic Vester (1990, 2002), who applied these concepts to urban development as well as traffic problems. This school of thought within cybernetics views coupling and regulation as linked mainly to the process of interaction between different variables of a system; key in this understanding of coupling and regulation are feedback processes within feedback loop systems. Vester distinguished between more technically understood cybernetics – often practised in economics - on the one hand and bio-cybernetics of living systems on the other hand. Particularly the concept of feedback loop systems in bio-cybernetics has close links to and overlaps with newer concepts of coupled socio-ecological systems and resilience (Davidson-Hunt/Berkes 2003: 75). The resilience community extended these basic concepts by putting more emphasis on areas such as: adaptation, uncertainty, and surprise, as well as issues of centralization, flexibility, and resilience within the systems analysis (Davidson-Hunt/Berkes 2003: 75; Berkes/Colding/Folke 2003a). Today, cybernetics as a research area is seen as a key component of systems theory thinking, although both research fields had developed separately in the beginning (Egner 2008: 56).

The terms coupling and regulation within cybernetic models are often mixed and used simultaneously to explain key processes between interdependent subcomponents of the system as well as to describe the ability of a system to absorb, compensate for and deal with external shocks within the system's own capacity (self-regulation). Thus, key aspects of this understanding of coupling and regulation within cybernetics are negative feedback processes that limit the impact and buffer the consequences of external shocks to the overall system as well as processes that move the systems from the actual status to the targeted status (Vester 2007: 43). Furthermore, Egner (2008) underlines that this field of science is also based on the assumption that the transfer of information (communication) between individual components of the complex system constitutes the system as a system (Egner 2008: 57). Further extensions of cybernetics and general systems theory were made by adding and linking these theories with concepts and theoretical elements of chaos-research and complexity theory, including concepts such as self-organization and non-linearity – for example within the context of resilience research (Egner 2008: 37ff., 56ff.; Davidson-Hunt/Berkes 2003: 76.). Egner (2008) points out that the principles of self-organization extended the idea of the regulation of systems regarding the fact that systems are not solely technically viewed as steered from outside, but rather encompass a component of autonomy – that manifests itself in principles of self-organization (Egner 2008: 59). Additionally, the extension of cybernetics – within the framework of social systems theory – towards self-referenced systems was another milestone within the further development of newer systems theory. The theory of self-referenced systems refers mainly to work done by von Foerster (1987) and further developed by Luhmann (1988), who underlined that the separation and distinction of a system is generated by the system itself. This implies that research not only needs to examine the observed system, but should also analyse the observer as a part of the description and explanation of the system (concept of first and second order observations; see Luhmann 1992: 98; Egner 2008: 60–64).

While concepts that stem from general systems theory and cybernetics often just distinguish systems according to a "more natural" and a "more anthropogenic or human/social sphere" (WBGU 1996), Egner (2008) differentiates – based on social systems theory concepts of Luhmann – three systems, namely a) *Soci-*

3 While Wiener (1948: 133) focused his work on key elements of cybernetics using examples from medicine and technical instruments linked for example to issues of the precision of anti-aircraft fire control (using mathematical equations for their description) (context second world war), von Bertalanffy (1972: 17–21) stressed that general systems theory and cybernetics do not necessarily have to be linked to mathematical equations and technical systems; rather, systems theory aims to identify similarities within the operational mode of very different systems and can also be linked to philosophy. For the role of system thinking in security research and in economics see Mesjasz (2008, 2008a, 2009b).

Figure 68.1: The basic concept of human ecology and the relationship between Society, Man and Environment (nature) through the lens of a differential theory perspective. **Source:** Egner (2008: 135) based on Luhmann (1988).



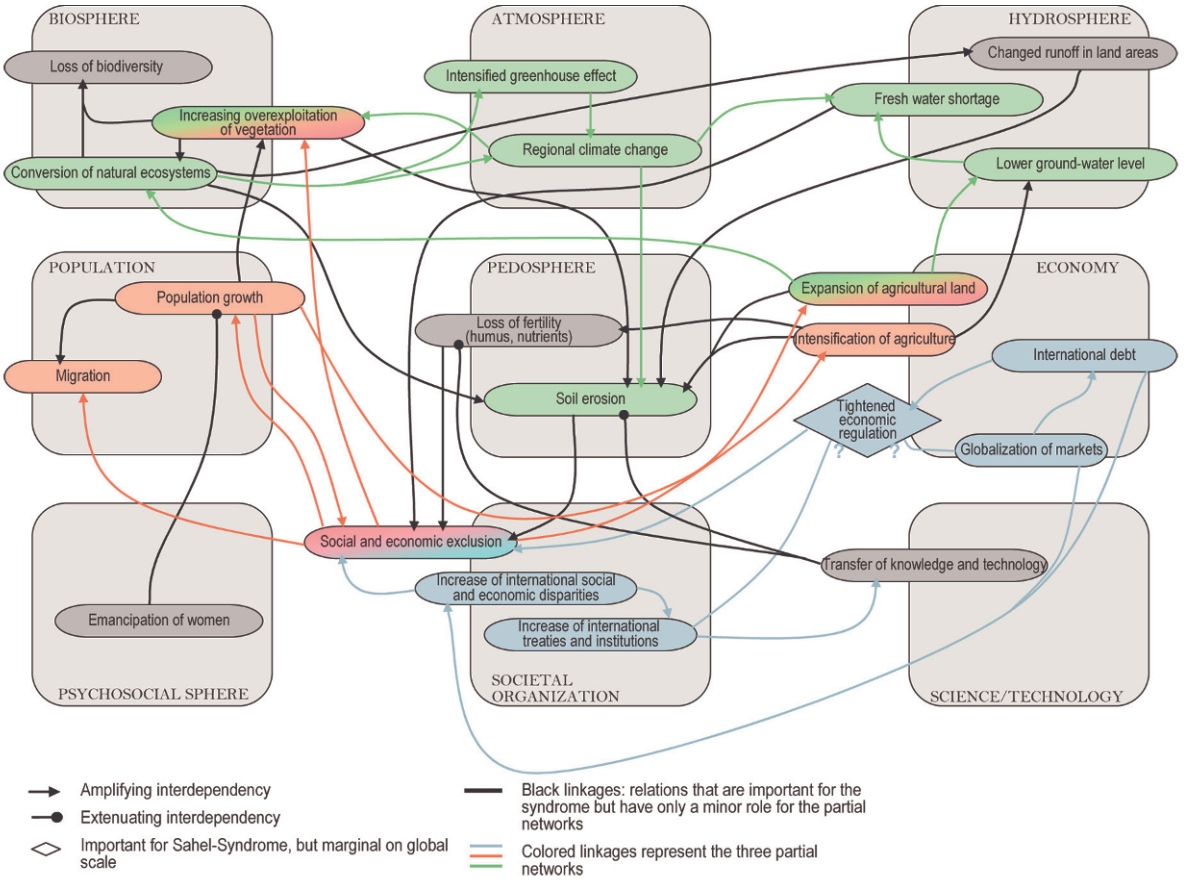
ety, b) *Humans* and c) *Nature* (figure 68.1). According to this differentiation, society has no direct access and link to biological systems (nature), but rather needs the consciousness or a state of awareness that allows for the observation and interpretation of biological processes within the 'nature' system. The 'human' system itself can be separated into two components: one dealing with consciousness (a), and another dealing with the body (b). The system logic of consciousness implies that the human system is a kind of transmitter that selects stimuli and information of the system 'nature' through system internal capacities and processes. Through its consciousness the human system is closely linked and structurally connected to the social system (society) (figure 68.1). The framework underlines that 'structural coupling' might need to be differentiated from other forms of coupling when dealing with the analysis and framing of socio-ecological crises phenomena.

Based on the discussion of different schools of thought within the heterogeneous group of systems theories and the analysis of key terms, the following chapter will review applied frameworks of coupled socio-ecological systems within global environmental change research with a particular emphasis on the syndrome approach of the WBGU (1996), the approaches used within the GEO-4 report (Jäger/Kok 2007), and the *Millennium Ecosystem Assessment* (MA 2005).

68.3.2 Syndrome Concept and Archetype Approach

The syndrome approach of the *German Advisory Council on Global Change* (WBGU) – based on the notion of cybernetics and complex systems theory – examines various global phenomena that indicate unsustainable developments within the natural and anthropogenic components of the syndrome. Thus syndromes as functional patterns illustrate undesirable effects and constellations of natural and anthropogenic trends and interactions (WBGU 1996: 4–7). A key thesis of the WBGU is that the variety of characteristics of the complex nexus of environmental and develop-

Figure 68.2: The Sahel-Syndrome. **Source:** WBGU (1996: 141). Permission was granted by WBGU.

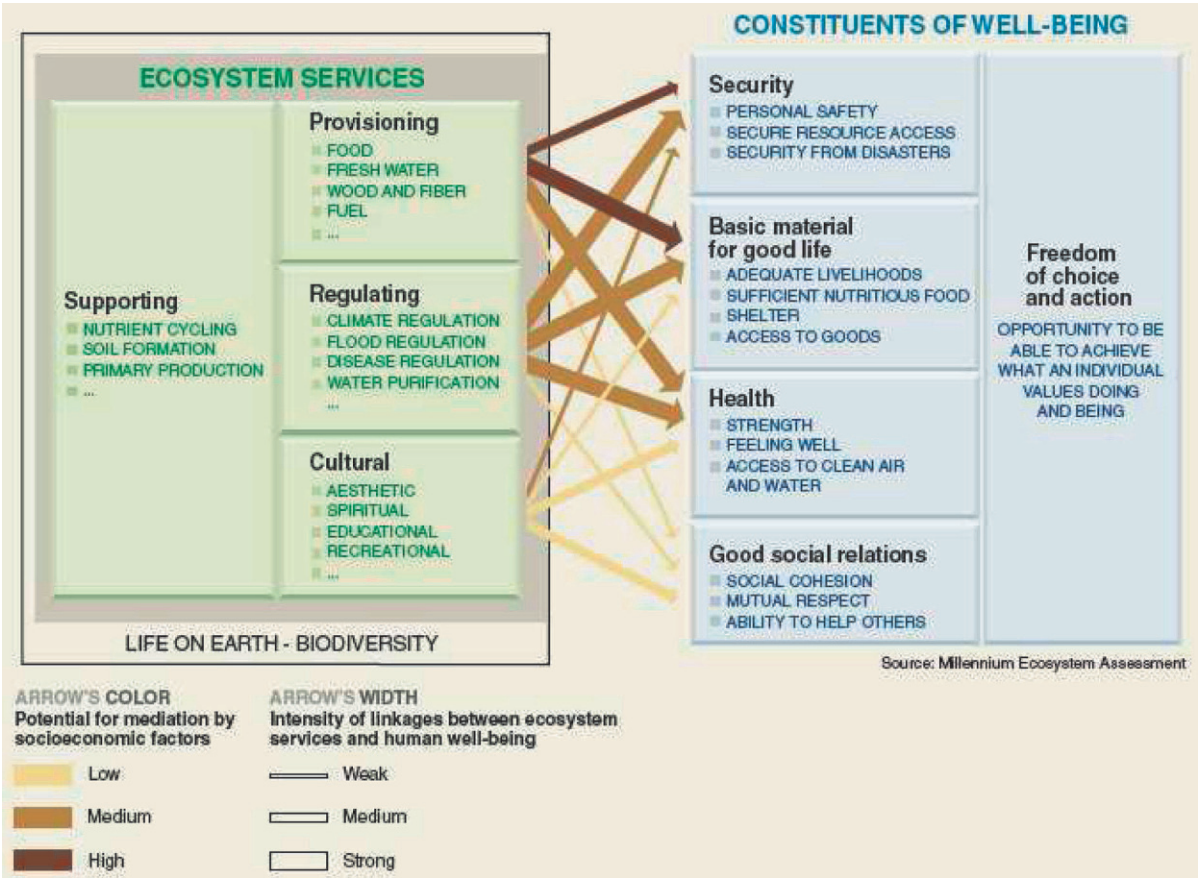


ment problems can be reduced to a manageable amount of syndromes representing key patterns of environmental degradation (WBGU 1996: 4). In contrast to disciplinary and sectoral approaches, the syndrome concept aims to explain and capture the interrelations between civilization and environment based on the identification of typical interaction and key degradation patterns in a transdisciplinary way. 16 syndromes have been identified by the WBGU to describe global change and respective degradation patterns, classified into three syndrome groups: a) utilization, b) development, and c) sinks (WBGU 1996: 5). Syndrome approaches range from the Dust Bowl-Syndrome regarding land degradation to the Katanga-Syndrome which focuses on environmental degradation due to the use of non-renewable energies (WBGU 1996). Figure 68.2 offers an illustration of such a syndrome that focuses on the core components and the key interacting variables or trends which are also linked to the concept of the 'vicious circle'.

Compared to earlier applications of the vicious circle, the syndrome approach also accounts for the broader interactions between the vicious circle and other trends that determine global change. Although the concept shown in figure 68.2 is rather descriptive, the WBGU underlines that also action-oriented research questions such as the analysis of the options for action of affected societies, regional climate change, and surrounding economic conditions are taken into consideration in the system analysis of the Sahel-Syndrome (WBGU 1996: 150).[4] Coupling and

4 This approach – particularly the Sahel-Syndrome – has also been applied to regions outside the Sahel, such as the *Middle East and North African* (MENA) region, in terms of projected regional climate change (Brauch 2003a: 935). Additionally, the Syndrome-Approach of the WBGU has also informed other research areas and frameworks, particularly aiming at developing mitigation strategies for the identified syndromes of global change. This is for example the case within larger North-South Research Partnerships between Swiss universities, the Swiss Development Cooperation, and countries in the South (see overview in Brauch 2003b: 108).

Figure 68.3: Linkages between Ecosystem Services and Human Well-Being. **Source:** MA (2005: VI) and Leemans (2009: 56).



regulation in this framework is understood as the operation mode, particularly the causal linkages between different components of the syndrome and their interdependencies. Furthermore, the framework aims to identify general rules determining how syndromes operate independent of space and time specific differentiations.

The syndrome approach was an important basis for newer applications such as the 'archetype' concept in UNEP's (2007) *Global Environmental Outlook* (GEO 4). This approach is used to address patterns of vulnerability to environmental and socio-economic changes (Jäger/Kok 2007: 301). Archetypes of vulnerability are – according to their conceptual bases - linked to the syndrome approach. The seven archetypes of vulnerability show specific, representative patterns of the interactions between environmental change and human well-being. The 'archetype' approaches are broader than the syndrome concept of the WBGU (Jäger/Kok 2007: 317). Overall, the notion of the feedback loop system and the intensive discussion about the interplay of socio-economic and natural conditions as well as regarding responses at various scales and from various actors underlines the strong linkages with concepts of general systems theory and cybernetics (e.g. feedback processes, principles of self-organization).

68.3.3 Millennium Ecosystem Assessment

A third approach of global research on socio-ecological systems and linkages between nature and societies was offered by the *Millennium Ecosystem Assessment* (MA 2005). Contrary to the syndrome and archetypes of vulnerability, this approach outlines the importance of ecosystem services for human well-being (figure 68.3).

While the syndrome and archetype approaches have used a negative definition to describe socio-ecological phenomena and sustainability, the MA examines the different phenomena using a positive definition for the connections between ecosystem services

and human-well-being. This differs widely from an overall conceptual strategy. Furthermore, interaction processes are rather one-dimensional[5], which means that the different ecosystem services are linked to human well-being rather than connecting to them through larger feedback and response processes. The term regulation is explicitly mentioned and used to describe interventions or management options relating to, for example, climate or ecosystem services (MA 2005: 20).

68.3.4 Critique and Limitations

The selected approaches presented above underline that from the natural and environmental science perspective, coupling and regulation of society and nature are much broader defined and dominated by a perspective originating from general systems theory and environmental impact assessment. For example in the *Millennium Ecosystem Assessment*, major emphasis is given to the characterization on how human well-being depends on environmental resources and services. Less and very limited attention is given to the conceptualization on how these environmental services are redistributed and accessed within society. Additionally, the framework does not give any information on how societies and communities respond to potential or actual degradation processes and changes of ecosystem services. These questions regarding the societal responses are neglected, while they are key in Görg's concept of societal relationships with nature – in order to capture and understand regulation processes. Likewise, the coupling effects – understood as the positive and negative feedback processes within systems (cybernetics) – are not sufficiently acknowledged.[6]

Compared to the MA approach, the 'syndrome' (WBGU 1996) and 'archetype' approaches (UNEP 2007) offer a broader view and emphasize the interrelations, i.e. positive and negative feedback processes, within a larger system or problem phenomena. The understanding of the syndromes and archetypes is therefore linked to the examination of how the different components and parts operate together. Regulation – if the term is used at all – is often linked to feedback loop processes and the description of drivers within socio-ecological systems. In this regard, regulation is primarily understood as a kind of self-regulation. Self-regulation is used to describe the processes and capacities of a system to deal with external shocks through negative feedback loops. Thus, self-regulation mechanisms within the syndrome approach of the WBGU are processes that ensure that external impacts may be absorbed so that they do not lead to a direct collapse or restructuring of the system. Both concepts seem to imply that most processes and feedback loops are known. But complex systems theory applied in resilience research (Berkes/Colding/Folke 2003a) underlines that complexity originates from the problem that dynamic interactions are often characterized by non-linearity, uncertainty and emergence, scale interactions and self-organization (Berkes/Colding/Folke 2003b: 5). In this respect, the self-organized interaction of the components of a system might lead to the emergence of new, unpredictable structures and processes (non-linearity). Therefore, a new challenge for these approaches will be the modification and integration of aspects such as uncertainty, surprise, and self-organized criticality (Bak 1997; Berkes/Colding/Folke 2003a).

Additionally, the syndrome approach is criticized due to the fact that it encompasses mainly a macro-perspective that might exclude important features and differences at the micro-level. This is particularly true for example for the dualistic nature of some of the processes and system components, such as it is the case for the issue of migration in the above mentioned Sahel-Syndrome. Krings (2002) and Müller-Mahn (2008: 400–402) outline that migration for drought-affected communities can have either negative or positive implications – thus it can be both a negative coping process or a type of adaptation which allows to sustain certain income generating activities even in times of droughts.

Furthermore, it becomes evident that these three approaches give too little attention to social concepts and theories. Although the livelihood framework as a social science concept is noted in the work of the MA and the GEO 4 report, the integration of natural science and social science concepts and theories is still underdeveloped.

Questions of different types and intensities of coupling - between society/humans on the one hand and natural/biological components/resources and processes on the other – as well as regulation processes – here understood as unintended and intended forma-

5 Ashby (1957: 48–51) explains coupling with a one directional technical process between machines.

6 Overall, the 'MA approach' is closely linked to the discussion and conceptualization of environmental impact assessment which also encompasses protection assets such as the environmental media (air, water, and soil), health, humans, and their interrelations.

tion and organization processes of societal interactions with 'nature' (encompassing material and energy flows as well as non-material flows and components) have to be better understood. Moreover, issues of similar or different thresholds and tipping points - for social and ecological components of socio-ecological systems or within socio-ecological crises phenomena are just being discussed (Renaud/Birkmann/Damm/Gallopín 2009) and should also be incorporated into the further development of these approaches.

While the theoretical concept of social relationships with nature (Görg 2003) examines the environmental problems and the use of environmental resources and nature in the broader context of societal development, institutions, market processes, and political frameworks to explain and understand socio-ecological crises, the syndrome and archetype approaches tend to outline mainly the different natural and human components that characterize the different interactions within a specific phenomenon (syndrome). The interplay of different actors, the role of institutions and power structures are often neglected or underrepresented. The term regulation within cybernetics and the syndrome or archetype approaches are used primarily to describe self-regulation and feedback processes that buffer the impacts of external shocks, which is different to the understanding of the term in regulation theory.

Although the interpretation and the use of the term regulation differs among the various schools and approaches outlined above, a certain added value could be seen in a combination of the more social science oriented perspective on the one hand, and the environmental science perspective on the other. While the school of thought represented by Görg (2003) emphasizes the stabilization of conflicting and contradicting processes and strategies in societies and different societal occupation strategies of nature – including power relations - the concept of regulation in the context of the socio-ecological system debate also refers to a kind of stabilization linked to self-organization within and between the direct interactions of society and nature. Thus the potential application of both the concept of societal relationships with nature (Görg 2003) and the understanding of socio-ecological crises from a more environmental perspective could be beneficial if both the coupling process in the social and in the environmental sphere could be better understood and further explained by different elements and forms of regulation, including, e.g., direct forms of regulation that occur in biophysical exchange processes (e.g. material and energy flows, emissions) and symbolic and cultural processes (e.g. risk perceptions, interpretation of nature). An improved understanding of these processes is a prerequisite for developing effective strategies to stabilize or change socio-ecological systems towards a more sustainable development.

Although a full integration is not desirable and presumably not possible (different epistemologies), the added value for both streams can clearly be seen in a better understanding of the so-called coupling effect between society and nature – from a social science and natural science perspective. Furthermore, the analysis of newer developments in general systems theory and cybernetics also showed (Egner 2008) that additional theoretical concepts, such as complexity theory, might be necessary to account for non-linearity, surprise, and sudden changes, which are observable phenomena within coupling processes of socio-ecological systems in crisis and disaster situations.

Against the background of the different theories and conceptual approaches discussed, developed within the social and natural science field to capture coupling and regulation within socio-ecological systems and within the context of socio-ecological crises, the following sections will deal with the different views and conceptualizations of disasters and crises processes linked to natural hazards. Additionally, a differentiation of coping and adaptation is presented that helps to better understand change and transformation (link to regulation theory) within the context of disasters. Thereafter, the conceptual sections are juxtaposed against the empirical analysis of actual coupling and regulation processes of socio-ecological systems in Sri Lanka after the Tsunami 2004. In this context, different feedback and response processes by various actors are outlined as well as different arenas of conflict which indicate the contradictions between different response strategies and respective stabilization and destabilization processes.

68.4 Contested Views of Disasters and Crises

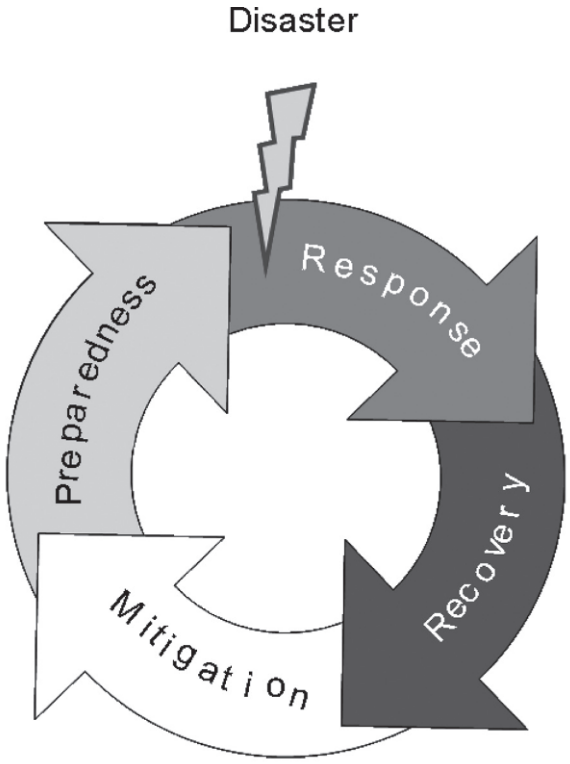
For socio-ecological crises linked to natural hazards it is a challenging task to review prevailing views and problem definitions. 'Socio-ecological crises' refer to the fact that the crises and disaster can not be sufficiently explained by social or natural factors only, thus emphasis has to be given to the critical interactions between society and nature that shape the crises. Furthermore, these crises encompass different stages,

where parts or components of the socio-ecological system might be disrupted or destroyed. This term may also encompass temporal tipping points like disaster which do not imply an irreversible breakdown of a society, but rather a peak of un-sustainable developments that is often followed by coping, recovery, and reconstruction processes.

From a process perspective, most politicians, a large majority of society and also most disaster management agencies worldwide view disasters linked to natural hazards mainly as a catastrophe triggered by an external shock impacting on societies. The external shock causes major or minor harm and disruptions within a society. Within the 'disaster cycle' it is assumed that societies respond, recover and mitigate before a potential new hazard occurs. These actions are followed by phases of risk reduction, prevention, and preparedness (figure 68.4). This cycle is a widely accepted pre-analytic vision in disaster and emergency management. According to the US *Federal Emergency Management Agency* (FEMA)[7], this cycle describes processes through which managers prepare for emergencies and disasters, respond to them when they occur, help people and institutions to recover and mitigate their effects, and reduce the risk of loss and prevent new disasters. Although preparedness and prevention are taken into consideration, the dominant view defines disasters as events caused by external forces such as floods or earthquakes. FEMA points out that "a major disaster could result from a hurricane, flood, tornado or major fire which implies that the President determines warrants supplementing federal aid" (FEMA 2007). Thus disasters are characterized as events which go beyond state capacity to deal with them effectively, and they are viewed as a result of a hazard event which is external to the society (figure 68.4).

Its underlying pre-analytic vision emphasizes the external stressor. But in reality disasters are observed as a result of parallel developments – of problematic land use, urbanization processes, lack of preparedness, a hazard event, of limited knowledge, a lack of appropriate warning procedures and surprises – which sometimes reach a tipping point where a hazard event triggers a disaster. Thus, a disaster is often caused by vulnerable conditions manifesting themselves in urbanization trends, social segregation, lack of hazard awareness, or degradation of local knowledge on socio-ecological dependencies (Wisner/Blaikie/Cannon/Davis 2004).

Figure 68.4: The Disaster Risk Cycle. **Source:** Cutter/Gall (2008: 356) based on FEMA (2007, see footnote no. 7).



Rather than viewing disasters as a single event caused by an external shock, socio-ecological crises, including disasters – understood as a broader spectrum of sudden-onset and creeping processes which might lead to a disruption or degradation of coupled socio-ecological systems – are more appropriately viewed as processes which emerge within coupled socio-ecological systems. Recent disasters, such as Cyclone Nargis (May 2008), Hurricane Katrina (August 2005), and the Indian Ocean Tsunami (December 2004) show that various past and present human-induced development trends have created a context where a hazard event could trigger a disaster. Furthermore, under the perspective of the regulation of societal relationships with nature (Görg 2003), it is important to examine intended forms of regulation to prevent or mitigate the effects of a disaster, in other words, interventions of society in socio-ecological processes prior to the occurrence of adverse events.

In the context of Hurricane Katrina for example, Kates, Colten, Laska and Leatherman (2006: 14653)

7 FEMA, 2007: "Disaster Life Cycle", at: <http://www.fema.gov/about/what.shtm>; former version at: <http://www.4uth.gov.ua/usa/english/politics/agencies/fema.html> (17 May 2008).

argue that the 'levee-effect' – i.e. levees that induced additional developments leading to much larger losses when they collapsed – was a major (negative) development chain that caused the disaster. They conclude that the US political culture often rewarded patronage at the expense of safety and efficiency. Thus, the completion of an effective hurricane protection system suffered from misplaced priorities particularly since the early 1920's (Kates/Colten/Laska/Leatherman 2006). Furthermore, misperceptions of the magnitude of the hurricane by people staying in New Orleans as well as the institutional vulnerabilities revealed after the flooding, e.g. in terms of insufficient disaster management strategies and operations, must be viewed as inherent components of the crises.

Alternative views on disasters were published since the 1980's (Hewitt 1983; Watts/Bohle 1993; Cardona 1993). The *pressure and release* (PAR) framework of Wisner, Blaikie, Cannon, and Davis (2004) also documents an alternative pre-analytic vision of disasters. The pressure and release framework underlines the development of vulnerability from general or macro-economic root causes that cause dynamic pressures and lead to unsafe conditions (Wisner/Blaikie/Cannon/Davis 2004: 50ff.). In contrast to the 'disaster cycle' or 'disaster life cycle', these frameworks view disasters as a result of different development patterns. Watts and Bohle (1993) underline the step-wise intensification of a crises process which starts with a trigger, leading for instance to a food crisis which in turn may cause a hunger crisis, along with the related consequences and potential stabilization and coping processes (Watts/Bohle 1993). Although this framework focuses primarily on a social science perspective, it can generate an added value for the discussion on socio-ecological crises by discussing those processes that stabilize or further intensify crises (figure 68.5).

While the standard disaster cycle views a catastrophe or disaster as a single major event, the framework for hunger-famine vulnerability of Watts and Bohle (1993) underlines that between the triggering event or various stressors on the one hand and the famine crisis as the most severe phase in hunger crises, additional steps and phases can be observed such as food crises. This view points out that crises and disasters are often characterized by different development steps and that the capacity to cope and deal with the different forms of destabilization as well as the baseline vulnerability are key factors that determine whether the external stressors or triggers will ultimately lead to a crisis that ends up in a disaster (figure 68.5).

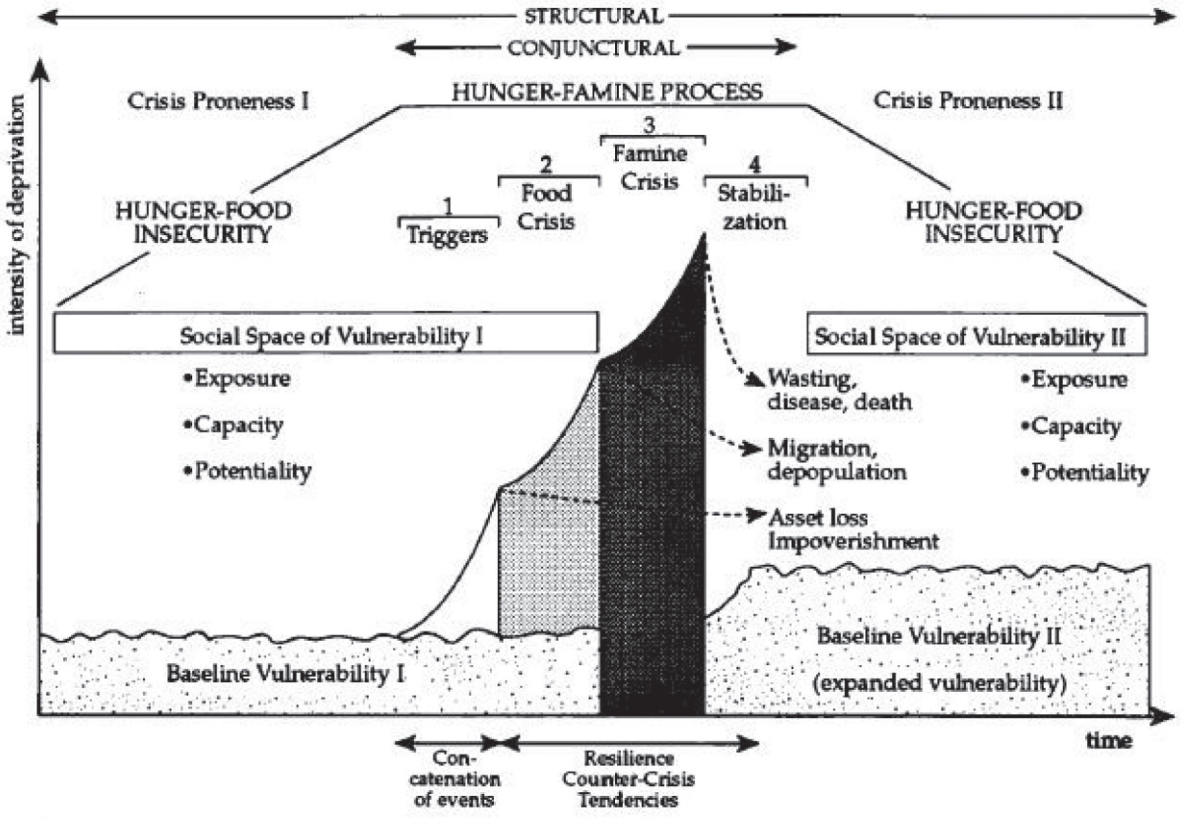
Overall, it is important to acknowledge the existence of different phases of crises and disasters due to hazards of natural origin and to examine how feedback processes, such as 'coping' or 'adaptation' as major terms in risk and disaster research, can be linked to 'stabilization', 'change', and 'transformation' that are used within the field of the regulation of societal relationships with nature (Görg 2003). These terms are discussed in the following section taking into account the theoretical and conceptual discussion of regulation and coupling reviewed above (68.2).

68.5 Coping and Adaptation – Change and Transformation

For an analysis of socio-ecological crises in the context of different concepts and theoretical approaches of regulation and self-organization, Görg's (2003) approach of societal relationships with nature distinguishes large and small crises for their influence on change and transformation. Large crises and disasters reveal the inadequacy as well as lack of capacities of institutions and organizations. Thus large disasters challenge existing structures and can trigger transformation and subsequent change. In the disaster and natural hazard literature, transformation and change due to disasters are rather new topics, since disasters used to be viewed predominantly as solely negative events which need to be prevented. However, recent studies underline that disasters might function as an important catalyst of change and social learning (Birkmann/Buckle/Jäger/Pelling/Setiadi/Garschagen/Fernando/Kropp 2009). The importance of the ability to learn individually and institutionally from past disasters is also a key insight of the newer resilience discourse (Folke 2006; Berkes/Colding/Folke 2003a).

Issues of destabilization versus stabilization as well as the notion of transformation can indirectly be linked to 'coping' and 'adaptation' (figure 68.6) in the natural hazard and vulnerability literature. If coping and adaptation are used as key feedback processes prior to, during, or after disasters to prevent harm, to bounce back or to reorganize the system at risk, more rigour is needed in the use and differentiation of terms. Do these concepts or terms differ according to their time dimension – short versus long-term actions? Or do the qualities for coping and adaptation differ? Further, in the light of cybernetics and the concept of self-regulation it is essential to understand whether and how coping and adaptation lead to stabilization or destabilization.

Figure 68.5: The hunger-famine process or chain. **Source:** Watts and Bohle (1993: 43ff.).



Different notions of coping and adaptation are used, e.g. by the *United Nations International Strategy for Disaster Reduction* (UN/ISDR) that defines coping' as:

> The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions (UN/ISDR 2004: 16).

The *United Nations Environmental Programme* (UNEP) defines 'coping and coping capacity' in its *Global Environmental Outlook* (GEO) 3 and 4 as:

> 'The ability to cope with threats includes the ability to absorb impacts by guarding against or adapting to them' (UNEP 2002: 426), and as 'The degree to which adjustments in practice, processes or structures can moderate the potential impact for damage, or take advantage of opportunities' (UNEP 2007: 517).

The first definition clearly underlines the time specific coping characteristic, thus the processes or resources that help to face the adverse consequences of a disaster in normal times and during crises, and is thus linked to the immediate consequences of a hazard event that might lead to a disaster. The GEO reports link 'coping' to the potential to limit the impact for damage and for the GEO 3 report, coping encompasses the ability to absorb impacts by adapting to them. While UN/ISDR defines coping primarily as the immediate response capacity to a hazard event, UNEP's GEO reports view coping as a broader concept which includes adaptation.

'Adaptation' has gained a high recognition mainly within the climate change discourse. Interestingly, UN/ISDR's (2004) *Living with Risk* did not refer to adaptation among its definition of key terms. In the GEO 4 report 'adaptation' is defined as:

> Adjustment in natural or human systems to a new or changing environment, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (UNEP 2007: 515).

The *Intergovernmental Panel on Climate Change* (IPCC 2001: 365) defines adaptation' as:

> Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their

effects, which moderates harm or exploits beneficial opportunities.[8]

These definitions document that 'adaptation' implies adjustment to changing conditions or a changing environment. The time dimension is kept relatively open, thus adaptation could encompass various actions and measures. However, when examining additional literature such as Vogel/O'Brien (2004) it is evident that coping and adaptation are different concepts. While coping encompasses immediate measures that might help to deal with an actual hazard event (impact), adaptation measures should allow for a longer-term adjustment (change). Thus 'adaptation' should allow for the maintenance of the 'standard of living' also during the time of shocks and stresses linked to natural hazards, while 'coping' is short term and might imply the selling of important assets for survival. Pelling (2008) points out that adaptation requires having the information necessary to identify a potential future hazard or cause of vulnerability and to identify an alternative mode of working or living. Birkmann and Fernando (2008: 82–104) argue that coping capacities in the tsunami of 2004 in Sri Lanka were those resources and measures that helped to overcome its primary and secondary impacts. Coastal communities had to cope with the tsunami itself but also with the secondary effects, including the lack of drinking water due to the salinization of wells.

'Adaptation' rather refers to a long-term process that allows communities exposed to natural hazards or climate change to live with the hazard impacts and changes in their environmental or social conditions. 'Coping' might imply the selling of important assets or eating less during a drought, while in contrast 'adaptation' means that people change or adjust their livelihoods to the altered conditions in order to maintain major activities during droughts without losing assets and capital. Major differences between 'coping' and 'adaptation' can also be shown by linking them to 'impact' and 'change' (figure 68.6) due to disasters. In this framework coping refers to a feedback process that is directly linked to hazard impacts, while adaptation is determined by medium- and long-term adjustments and reorganization processes that correspond with the notion of change. Furthermore, the link between adaptation and change constitute transformation, which is often a pre-condition for a phase and place specific stabilization of coupled socio-ecological systems.

68.6 Regulation and Coupling of Socio-ecological Systems in Sri Lanka after the Tsunami Disaster

On the background of the theoretical concept of the societal relationships with nature (Görg 2003) and of selected approaches linked to general systems theory and cybernetics (von Bertalanffy 1972; Wiener 1948; Ashby 1985; Vester 1990, 2002, 2007), as well as resilience research (Davidson-Hunt/Berkes 2003; Berkes/Colding/Folke 2003a), the Indian Ocean Tsunami disaster and particularly the post-tsunami process including formal and informal feedback processes will be analysed below with a focus on empirical research regarding regulation and coupling of society and nature in post-disaster and recovery processes in Sri Lanka – particularly based on research in the tsunami affected cities of Galle and Batticaloa. Several coastal disasters – such as the Indian Ocean Tsunami 2004 – underline the interrelatedness of social and ecological systems, of different capitals and their crucial contribution to human well-being (Constanza/Farley 2007: 252).

68.6.1 Views and Problem Definitions

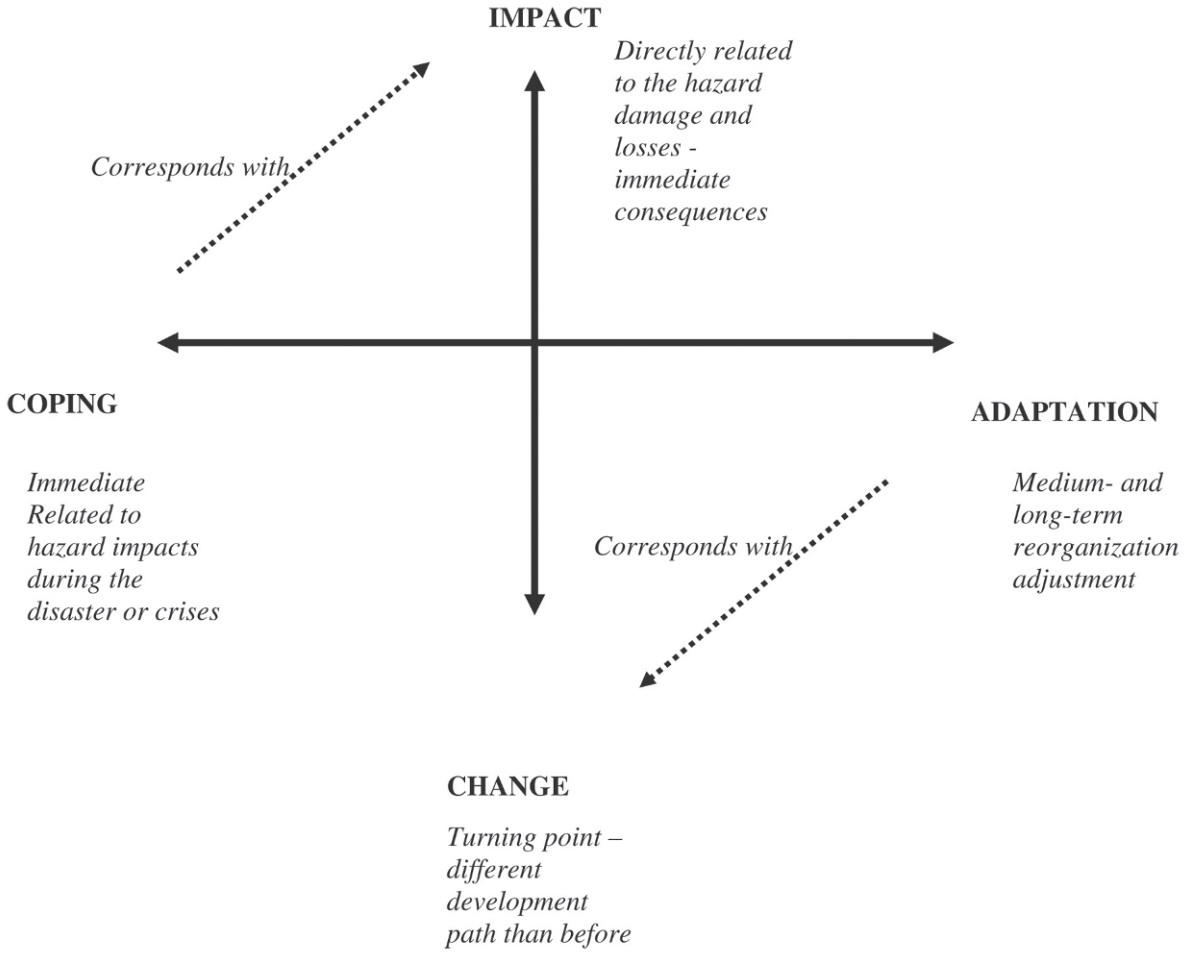
The Indian Ocean Tsunami of December 2004 with its 230,000 fatalities was a mega disaster (Birkmann 2007a). Thus, the problem identification was not controversial. But in the post-tsunami process the problem definition and respective solutions were contested, especially those factors that had contributed to the magnitude of the disaster. Many national and international organizations viewed the magnitude of the hazard event and the lack of effective hazard detection and early warning measures as the root causes which led to the disaster. Also the lack of awareness of tsunamis and the uncontrolled occupation and urbanization of the coastal belt were seen as key factors that allowed the tsunami wave to trigger this mega disaster.

Based on this assessment, various countries, including Sri Lanka, developed regional and national early warning systems in cooperation with the international community.[9] Also new organizations, such as

8 See: "Annex B. Glossary of Terms", in: IPCC (2001: 365)"; at: <http://www.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf> (16 June 2007).

9 IOC [Intergovernmental Oceanic Commission]/UNESCO at: <http://ioc.unesco.org/iocweb/index. php>. (14 May 2008).

Figure 68.6: Coping and adaptation as well as impact and change. **Source:** Own figure based on Birkmann, Buckle, Jäger, Pelling, Setiadi, Garschagen, Fernando and Kropp (2009: (i.p.).



disaster management centres were established. Thus, the prevailing view within national governments and organizations saw the lack of technical early warning capacities, insufficient disaster management, and uncontrolled urbanization as root causes which had led to the devastating consequences of the tsunami. Issues of inadequate land distribution, marginalization, and migration were not addressed in the first analyses made by these officials. Consequently, solutions for preventing future tsunami risks were dominated by a view that privileged technological and disaster management solutions in terms of the establishment of early warning systems as well as the strengthening of disaster management organizations (with primarily former and active military personnel) should be the underlying principles.

68.6.2 Coupling Processes

The analysis of coupling processes and of interdependencies between the coastal communities impacted by the tsunami and the tsunami itself has shown that this hazard was not generated by human actions. But its devastating impact has been directly linked to the strong dependence of affected communities on coastal livelihoods, land use changes, and the urbanization of the coastal belt. Therefore, coupling processes between social and ecological systems (see above e.g. MA or WBGU perspective) and the societal relationship with nature (Görg 2003) play a dominant role when disaster impacts and feedback processes are addressed. Thus, disaster impacts and feedback processes in the short- and medium-term, caused by different actors, must be analysed in light of the various interlinkages between coastal environmen-

tal resources and the respective social and economic structures.

In Sri Lanka, about 95 per cent of the affected communities depend on fishing or tourism as major sources of income (IPS 2005). Historic development trends and past patterns also had an important influence on the specific socio-ecological crises phenomena observed during and after the tsunami. Urbanization trends and a rapidly growing hotel sector characterize and influence the present societal relationship with nature in the south of Sri Lanka, as well as in Indonesia and the Maldives. Another important societal feature of the socio-ecological crises has been the migration of poor households to the public coastal belt during the past decades, which encompasses the immediate land by the sea which had not been occupied or sold so far. In general, in the area of the first 300 meters from the seashore, the construction of buildings is limited and requires approval of the Coastal Conservation Department (Coast Conservation Regulations, No. I of 1982).[10] While the development of the hotel industry in the coastal belt had been clearly planned, the occupation and migration of the rural poor into the coastal belt was largely influenced by the lack of alternative locations and in some cases the patron-client relationship with the politicians in that specific area (governmental land). Thus, many of these people did not choose to live close to the sea due to its attractiveness, but rather as the only place they could migrate to (Birkmann/Fernando 2008). Along the coastal strip in Galle in Sri Lanka, encroachers also settled next to the railway tracks as this is 'no-man's-land' and belongs to the state-owned railway department.

68.6.3 Key Coupling Processes of Coastal Communities in Sri Lanka

Important reciprocal interactions and coupling processes within socio-ecological systems (see e.g. general system theory and cybernetics discussed above) are determined by the strong reliance of people in coastal communities on livelihoods that are linked to coastal resources and the coastal landscape. The coupling of socio-ecological systems is especially strong for those people who are directly and indirectly working in the fishing and tourism sector. Both sectors depend directly on the access and quality of natural resources of the coastal landscape. Households working in the agricultural sector in coastal communities in Sri Lanka and Indonesia were also highly affected by the tsunami. The salinization of wells showed that for people engaged in agriculture, the tsunami and other coastal hazards can have severe consequences for the functioning of socio-ecological systems. The salinization of wells was a direct threat for humans as it disrupted the major sources of drinking water. Irrigated crops which survived the tsunami had to cope with higher degrees of salinity (Renaud 2006: 117–127).

The tsunami wave had several consequences particularly for the communities and households that were highly dependent on coastal resources, on the access to the sea, and on the environmental quality in coastal regions. Their lack of other income sources or the dependence on only one freshwater resource made households very vulnerable to direct and indirect tsunami impacts. As a consequence, unemployment was particularly high among fishermen and people who worked in the hotel sector during the first phase (first 6 months) after the tsunami (Birkmann/Fernando/Hettige 2006).

68.6.4 Post-Disaster Stabilization and Destabilization Processes

Changes of coupled socio-ecological systems after the disaster were diverse. Besides the total collapse of some coupling processes – for example for households of fishermen and their fishing activity (which was nearly absent in the direct aftermath of the disaster) - also fundamental changes in terms of the traumatization of people and the disruption of social and demographic structures could be examined.[11] The massive destabilization of a whole region due to the direct tsunami impact was rapidly followed by internal and external feedback processes that aimed to stabilize the situation. Based on research in Sri Lanka, at least six phases of stabilization and destabilization can be distinguished.

- The *first phase* is characterized by the destabilization due to the direct tsunami impact, causing death, disruption and loss of livelihoods, infrastructures and communities.

10 "Coast Conservation Regulations, No I of 1982", in: *Gazette of the Democratic Socialist Republic of Sri Lanka*, 2 September 1983.

11 See Birkmann, Fernando, Hettige, Amarasinghe, Jayasingam, Paranagama, Nandana, Naßl, Voigt, Grote, Engel, Schraven and Wolfertz (2007); Birkmann and Fernando (2008); Birkmann, Buckle, Jäger, Pelling, Setiadi, Garschagen, Fernando and Kropp (2009).

- The *second phase* was characterized by an enormous inflow of external aid and support. The analysis of the national and agency reports presented in the Relief Web[12] and by the RADA report (2005) show that Sri Lanka received (2005) financial donations and support of up to a total sum of 3.3–5 billion US$ during the first year after the tsunami (RADA 2005). Besides this enormous amount of external financial support, also various actors and aid agencies were entering the country after the disaster. Among other things, the direct disaster aid and relief included the provision of food, tents, mobile hospitals, water tanks and measures to clean drinking water within days. This rapid and massive external aid and international disaster response regimes (UN/OCHA; Flash Appeal etc.) prevented the outbreak of epidemics and – at least during the direct relief and recovery phase – functioned as an important stabilization factor. The unexpected magnitude of the tsunami donations (positive factor of surprise) and the international support received allowed the affected countries to be relatively generous on financial support for households in the most affected regions. But this stabilization also contributed to indirect destabilization processes, when local communities and affected people were receiving support without a stimulus for self-initiated action.
- The *third phase* of the stabilization and destabilization process can be separated from the direct disaster assistance in terms of the establishment of major interventions and feedback processes particularly through formal organizations at the national level. These interventions and rules comprised among other measures for example the establishment of a buffer zone and the strategy of relocation – intentionally introduced to support disaster resilient communities through a reduction of exposure to tsunamis. But these measures and interventions also induced major destabilization processes for some households – that are explained in detail below in chapter 68.6.5.
- The *fourth phase* can be linked to the reconstruction of houses and the replacement of destroyed fishing boats in the first and second year after the tsunami. The rapid reconstruction was relatively successful particularly in Aceh and South Sri Lanka, while in contrast the intensification of the civil war destroyed the progress achieved in north and east Sri Lanka.
- A *fifth phase* can be observed in some communities, such as in Galle in southern Sri Lanka, after the reconstruction of the houses and the rebuilding of the fishing fleet. Particularly in relocation sites far from the city centre and in parts of the buffer zone, social and physical infrastructure is (still) missing or insufficient. In our surveys, particularly the access to schools, the lack of appropriate transportation, and the limited access to hospitals were mentioned as problems especially in relocation sites located far from the city, such as in Walahanduwa and Kuruduwaththa in the region of Galle. This implies for some households that they have serious difficulties in sending their children to school or to commute to work on a daily basis. Thus, some of these people and relocated households – particularly those who are engaged in the fishing or tourism sector - were therefore exposed to additional problems in terms of finding a job and getting to work. Also, our household surveys revealed that the number of people shifted into another employment sectors was relatively low particularly among people engaged in fishing and tourism.
- In a *sixth phase*, re-migration from the relocation site to the buffer zone can be observed in some cases, particularly in those cases where the household owns a land plot in the buffer zone. This re-migration is a clear indicator of households aiming at a more stabilized situation, which has not been sufficiently secured in the respective relocation site.

68.6.5 Response Actions: Different Agendas, Demands and Interests

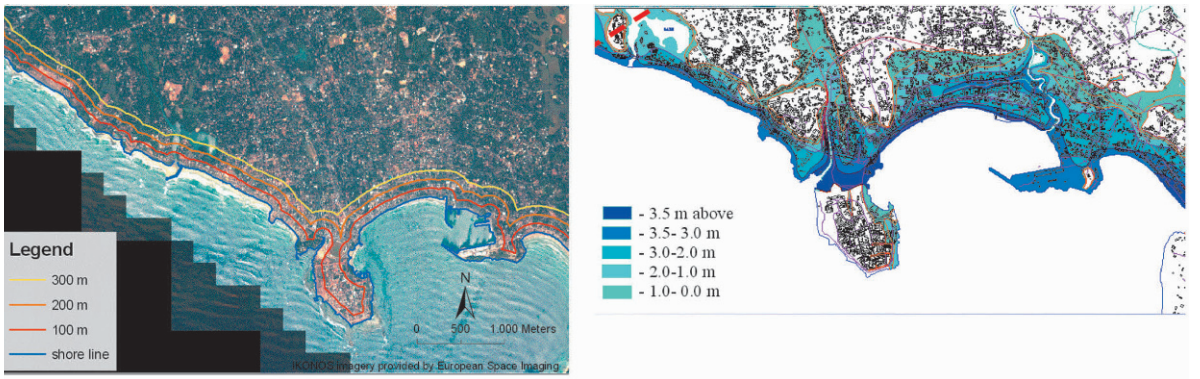
This section focuses on societal response processes where formal and informal response and feedback processes can be distinguished. Formal response actions and feedback processes included the establishment of an early warning system and the buffer zone. The latter not only posed various uncertainties for the population living in the area, but it was also a potentially positive trigger particularly for some encroachers (landless households) to overcome their chronic poverty by getting an official land title (Birkmann/Fernando 2008).

12 See at: <http://www.reliefweb.int/rw/db.nsf/doc100?OpenForm> (11 May 2008) and "Appeals & funding: Sri Lanka funding received 2005"; at: <http://www.reliefweb.int/rw/fts.nsf/doc105?OpenForm&rc=3&cc=lka&yr=2005> (11 May 2008).

Figure 68.7: The actual inundation in Galle and the 100 metre buffer-zone.

The proposed 100 Meter Buffer Zone (red line) based on own calculations. **Source**: Naßl/Voigt (2007).

Actual inundation due to the tsunami in Galle, Sri Lanka. **Source**: Hettiarachchi/Wijeratne (2008).



In Sri Lanka, according to the Coast Conservation Regulations (No. I of 1982)[13], the first 300 metres from the sea fall under the authority of the Coastal Conservation Department. Only with a special permission of the coastal conservation director is it permitted to construct or build houses for residential purposes, tourist hotels, commercial buildings, or any other structures in this area.[14] Generally, the construction of buildings without permission is illegal and the Coastal Conservation Department can order their demolition. After the tsunami, the government introduced a 'non-construction zone' which comprises a 100 meter zone from the sea in south Sri Lanka and a 200 meter zone from the sea in north and east Sri Lanka. This amendment of the Coast Conservation Act (No. 57 of 1981)[15] implies that no permission is given to build a house or other constructions for residential purposes in this buffer zone. Exceptions can be made for development activities that encompass special projects of national interest as well as for buildings and infrastructures regarding fishery or tourism (Coastal Conservation Department, no year)[16]. The leaflet of the Coastal Conservation Department states that the rules are enforced until new regulations are adopted.

The introduction of the buffer zone rule was justified with the high fatalities from the tsunami 2004 in the first 100 and 200 meters (Birkmann//Fernando/Hettige/Amarasinghe/Jayasingam/ Paranagama/Nandana/Naßl/Voigt/Grote/Engel/Schraven/Wolfertz 2007). But the buffer zone also created many problems. In particular, it generated destabilization processes with regard to recovery and the planning security of households who were affected and living in the buffer zone before the tsunami (Ingram/Franco/Rumbaitis-del Rio/Khazai 2006: 608–609). The exceptions that could and can be made for the hotel and fishery sector clearly outline the contradictory nature of the formal response (feedback processes) to the tsunami disaster. While normal residences were not allowed to return to the buffer zone, constructions and buildings for the hotel and fishing industry were allowed with special permissions. While some hotel buildings are more robust than houses of encroachers or poor households, the overall conflict between different occupation rights in the coastal belt intensified. Normal residents had to migrate out of the zone, while the hotel industry saw a chance of extending their influence and their access to land which was 'cleaned' from normal residents and encroachers after the tsunami (Klein 2007: 543). In light of the concept of societal relationships with nature (Görg 2003), the buffer zone was meant to be an instrument to promote disaster resilience against tsunamis, while it was

13 "Coast Conservation Regulations, No I of 1982", in: *Gazette of the Democratic Socialist Republic of Sri Lanka* (2 September 1983).

14 This Department can issue two kinds of permissions: a) a so-called *major permission* issued by the Coastal Conservation Department (CCD), and b) *minor (or primary) permissions* which are issued by the Divisional Secretary (DS), the equivalent of a local city district manager.

15 "Coast Conservation Act, No 57 of 1981", in: *Gazette of the Democratic Socialist Republic of Sri Lanka, Supplement to Part II* (11 September 1981): 1–21.

16 Coast Conservation Department (CCD) (n.y.): "Relevant Regulations and Permit Process for any development activity in the Coastal Conservation Zone", in: *Bulletin-CCD*, Colombo.

in reality a terrain and arena for different interest groups and stakeholders to compete against each other regarding the access to the beach and coastal belt. The actual formulation of the buffer zone rule – particularly of the exceptions made for the hotel and fishing sectors – clearly privileges the economically oriented use of the land. Thus, specific economic interests lay behind the introduction of restrictions for normal residents. The implementation of protective measures against future tsunamis and coastal hazards can therefore not be separated from the discussion about the access rights of different stakeholders to coastal resources. Formal interventions conducted after the tsunami were therefore selective and the consequence of different power structures. Additionally, the example shows that a coherent and integrative strategy was not developed; rather the example shows the temporal stabilization of the conflict structure through a formal intervention.

The large involvement of international donors and internationally operating NGOs as well as the interest of home owners generated a lot of critique with the consequence that the buffer zone was frequently amended and shortened. Paradoxically, however, the fuzziness of the actual regulation made the situation even worse, since people did not know whether they were allowed to rebuild in the same place or whether they should relocate. Hyndman (2007: 366) concludes that the buffer zones have created spaces of fear and mistrust and generated a climate of uncertainty and hopelessness regarding the reconstruction of permanent houses.

68.6.6 Arenas of Conflict

The dispute about the buffer zone regulation, but also about the general aid distribution mechanism, occurred at various levels, from the local municipality and community to the arena of international donor meetings. Although the government of Sri Lanka tried to centralize the disaster aid and recovery process at the national level within the newly created *Task Force for Rebuilding the Nation* (TAFREN), the international donors and INGOs were able to bypass these institutions by providing direct support to affected households (figure 68.8).

In some cases, this allowed for a faster and direct support for affected households, but some INGOs and donors also introduced their own procedures, agendas, and funding rules. For example in the case of the relocation site 'Salzburg', the respective manager checked and reviewed the list of selected households developed by the Divisional Secretary. In some cases the managers found that households seemed not to face major difficulties and severe losses, and therefore deleted those households from the official list for the specific relocation site 'Salzburg village'. This procedure generated confusion and difficulties, since the official list and the actual list of the specific relocation sites sometimes differed. Although the general idea of specific donors to evaluate the list of households provided by the official local government might be reasonable, the actual procedure increased the uncertainty and insecurities for people waiting for new houses in relocation sites.

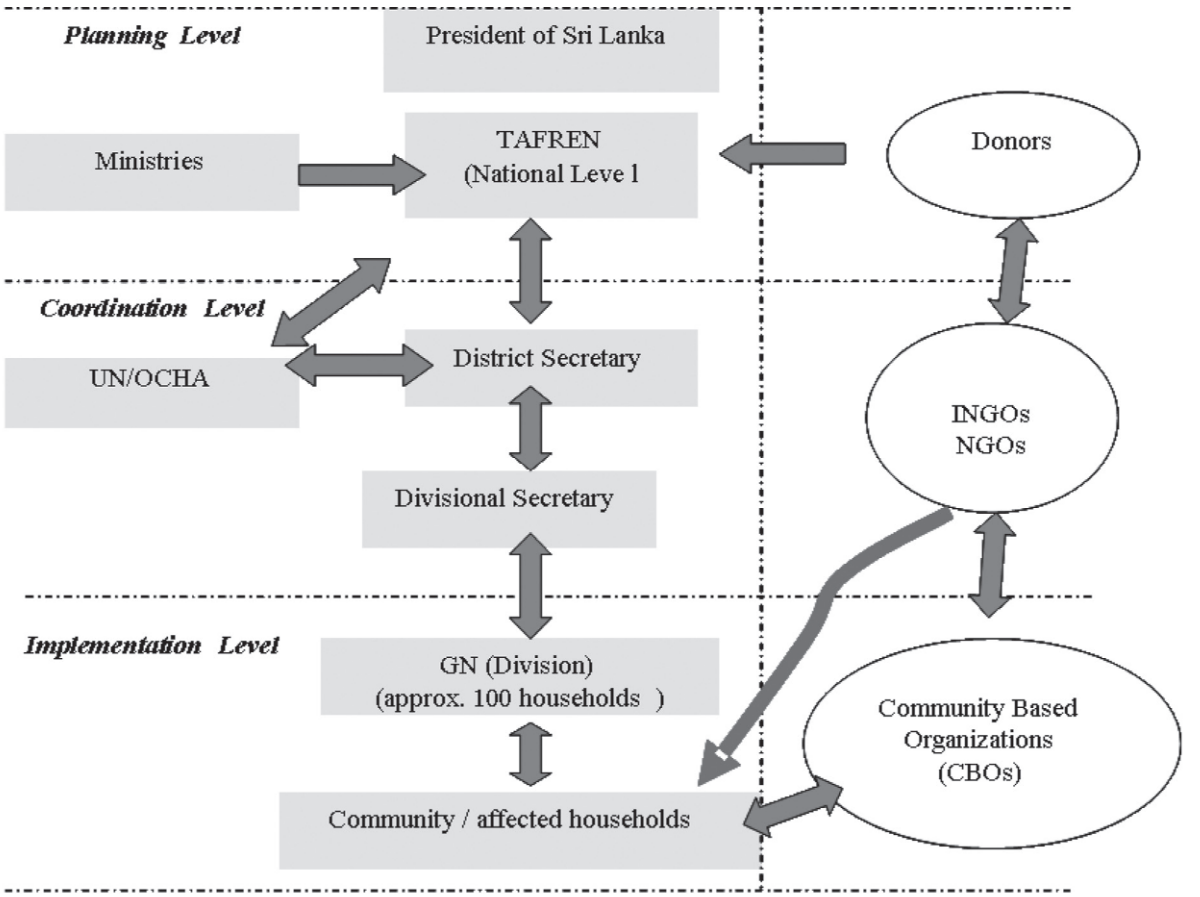
Some donors, aid agencies, and INGOs were very selective regarding the beneficiaries of their support, for example, in some cases Muslim households were primarily supported by NGOs from Muslim countries. These client-oriented policies generated additional conflicts over access and distribution of aid. In the case of Sri Lanka, particularly the civil conflict between the army and the *Liberation Tigers of Tamil Eelam* (LTTE) intensified partly due to the recovery process. Whilst international support was needed, it was not free from specific interests and agendas which in some cases generated additional conflicts within the affected regions.

In this context, Hettige (2007) concluded that the sudden influx of large numbers of aid providers overwhelmed the capacity of state institutions to effectively coordinate relief and reconstruction efforts (Hettige 2007: 5). Furthermore, the enormous inflow of external aid and financial support also generated a climate in which fast and short-term solutions were favoured while in most cases – for relocation projects and new settlements – time was needed to plan and communicate appropriately. Ingram, Franco, Rumbaitis-del Rio and Khazai (2006: 612) concluded that hurried policies with long-term implications should be avoided in disaster recovery and reconstruction to ensure that long-term vulnerability reduction can also be achieved.

68.6.7 Actors and Changes in Competence

The role of organizations also changed during the tsunami disaster response. Due to the strong financial support and funding received by INGOs, NGOs, and aid agencies, some organizations – like the Red Cross – suddenly started to rebuild whole villages, although their competence had consisted until then in relief work and disaster assistance. This may have contributed to the additional problems identified within the

Figure 68.8: Key stakeholders and their structure in the post-tsunami process, **Source:** Own figure based on Amarasinghe (2005) and Hettige (2007).



context of the (unequal) development of relocation sites and the insufficient integration of these sites into an overall planning and development strategy. Interestingly, in the study area of Galle, most relocation sites were constructed by INGOs and NGOs only, while the government had promised to build and/or secure the physical and social infrastructure in these new settlements. But in relocation sites and in the buffer zone this was not successfully accomplished. The government has not provided sufficient access to schools, transport, and hospitals in some relocation sites. Therefore, the work share between the INGOs and the government was questionable. Furthermore, Muggah (2008) also argues that the hundreds of international NGOs that moved into the country after the Tsunami 2004 undermined community structures and contributed to a misdirected distribution of assistance including the allocation of new houses (Muggah 2008: 186–215)

Further, the changes in the agendas of major external stakeholders shifting from disaster aid to the development of new villages also created new problems and difficulties, since their experience in integrated urban planning, land use, and the region was often very limited or at least not secured and audited. This distribution of work might have also allowed the state and municipalities to sneak out of their responsibility to provide adequate transport as well as physical and social infrastructure for these new settlements.

The divergent power structures with a powerful central government and rather weak local institutions also hampered the development of specific local concepts and solutions. Destabilization processes were caused by the problematic location of some relocation sites and the type of aid which entered the country. Regarding the relocation sites, the analysis of risk perceptions based on own household surveys conducted in 2005, 2006, and 2008 in the region of Galle clearly showed that some locations had been built close to flood prone areas with the consequence that people had difficulties during the flood season to get

to their place of work or to the city. The analysis of individual risk perceptions showed that particularly among those who are still living in relocation sites and who are not fishermen, the tsunami risk is viewed as significantly lower than by the average population, whereas flood risk is significantly higher prioritized by this group than by the average population interviewed.

68.6.8 Type of Assistance

Moreover, the type of assistance given may also have severe long-term consequences for the coupling processes between society and nature in the affected communities. Many donors and agencies involved in the rehabilitation focused first and foremost on the construction of buildings or the donation of fishing boats. Although all these items were heavily needed after the tsunami, some reports clearly outline that for example the fishing boats were just brought in from outside, with little opportunities for the local economy to benefit from this development (Risvoll 2006). In some regions, more fishing boats were donated than fishermen had previously owned. This tendency might lead to new destabilization processes, since the fishing grounds near the shore were already overfished in many parts. Overall, a tendency could be observed towards replacing physical structures and 'media marketable' items such as fishing boats and houses, compared with livelihood programmes or intangible support. Additionally, it was a positive surprise for the international community (UN/ISDR, UN/ISDR-PPEW, UN/OCHA) and many INGO's (e.g. German Red Cross; Misereor, etc.) that governments and the public in the 'North' donated large amounts of money for disaster aid and recovery programmes.[17] The magnitude and the speed of the money inflow for example through donations over the internet or donations by governments might also have contributed to a certain type of assistance and the spending attitude.

17 The extraordinary magnitude of financial donations made for the Indian Ocean Tsunami Disaster 2004 may also have been influenced by the huge coverage of the disaster in the mass media, the specific period of the year (duuring Christmas), and also the fact that these regions were major tourist destinations.

68.7 Conclusions

The conclusions encompass two parts. The first summarizes major findings of the empirical case study regarding the analysis of coupling and regulation within post-disaster processes. The second part combines the review of theoretical and conceptual approaches (68.2–68.5) with the empirical case study based results from Sri Lanka (68.6), and formulates key-questions that can guide future research for capturing coupling and regulation within socio-ecological crises.

68.7.1 Conclusions Based on the Empirical Case Study

Overall, the tsunami could have been an opportunity to reorganize, reconsider, and reshape management practices and organizational structures and livelihood dependencies on the sea – and could have been used as an opportunity to promote more sustainable and resilient socio-ecological systems. However, in most of the cases examined, there have been very few stimuli for these reorganization processes. While important organizational changes were introduced after the tsunami – for example the establishment of the Disaster Management Centre in Sri Lanka (Birkmann/Buckle/Jäger/Pelling/Setiadi/Garschagen/Fernando/Kropp 2009) - the most affected communities remain within their livelihood patterns and dependencies. That means that transformation of or adaptation to the tsunami risk, for example through the development of multiple livelihood strategies for coastal communities, was very limited.

Although the tsunami was a major disaster and caused a severe disruption of the life of the coastal communities, it did not bring about a fundamental change at the national or international level. Only rather technical interventions and rules were introduced amongst which the buffer zone and the relocation strategy figure most prominently.

At the individual level, most dependencies and practices in the societal relationships with nature and the reciprocal interactions within coupled socio-ecological systems were just re-established after the disaster - also due to massive external support, e.g. donation of fishing boats, etc. But the awareness of the tsunami risk is still high – as analysed in studies in the city of Galle in Sri Lanka and in the cities of Padang, Cilacap, and Kuta in Indonesia conducted by UNU-EHS. Thus there is clear evidence that the tsunami did change the perception of risk and therefore also changed some elements of the regulation of relation-

ships of society-nature interactions. The reasons why these changes in individual risk perception did not lead to further changes in communities are manifold and comprise among other issues the lack of alternative options in the post-disaster process. Thus, it is still difficult to come to a final judgement about the success or failure of different strategies to make these communities, which are deeply embedded in coupled socio-ecological systems, more disaster resilient. Particularly the diversification of livelihood patterns is still a problem. We know from our own and other disaster studies that diversified livelihood patterns in a household can make these households more resilient to the impact of the tsunami. That means insufficient attention has been given to the strengthening and reorganization of diversified livelihoods. Most donors and agencies involved in reconstruction often solely emphasized the rebuilding of physical structures and the replacement of the destroyed fishing fleet.

It has become evident that the concept of societal relationships with nature can provide an additional lens to examine different problem perspectives and respective solutions or interventions before a crisis or disaster and thereafter. Further, the concept can provide a basis for examining different phases of stabilization and destabilization that might also imply contradictory measures and actions. In contrast, the general concept of regulation theory (Aglietta 1979) does not provide a sufficient framework, since, according to this theory, changes would bring about major transformations in economic development models that are rather unlikely after disasters of natural origin. Nevertheless, the Indian Ocean Tsunami triggered many societal changes, for example the peace process in northern Sumatra, so that other pre-existing structures were indeed contested.

The discussion of these more social science based approaches and the more environmental and natural science driven approaches (e.g. MA 2005) show that the integration and combination of both perspectives is still underdeveloped. The field of system theory and cybernetics might offer an opportunity to improve the linkages between these concepts, particularly if feedback processes are examined from both perspectives, namely the social and the natural sciences. However, in this context, also epistemological differences have to be acknowledged that represent important barriers for integration.

One of the conclusions is that it seems to be more and more important to conduct longitudinal studies on the progress and failure of recovery and reorganization of communities affected by disasters linked to hazards of natural origin. This requires on the one hand a better understanding of the stabilization and destabilization processes in the medium and long run and on the other hand a more in-depth review and evaluation of changes regarding regulation elements and coupling processes of coupled socio-ecological systems influenced by the disaster from the social and environmental science perspective. Capturing these aspects is particularly difficult in north and east Sri Lanka, since these regions are still difficult to visit due to the intensification of the military conflict. In the context of interventions in coupled socio-ecological systems after disasters, international disaster aid regimes also need to be critically evaluated, for example, regarding the period of funding (often short-term) and the respective funding items.

Overall, the analysis of coupling and feedback processes in the post-disaster process in Sri Lanka underlines that besides theoretical and conceptual frameworks, the specific spatial context and the place-specific destabilization and stabilization processes in socio-ecological crises have to be examined. To better understand these coupling and feedback processes, different theories need to be applied to and modified for the specific context. As shown before, coupling and interlinkages between social and ecological systems might change fundamentally also due to the influences from higher levels, such as in this case the international aid and support received.[18]

In the context of crises, catastrophes, and collapse, Bohle (2008: 81) underlines that, given the uncertainty and the limited knowledge, one of the most important challenges is to provide affected communities and decision makers with adequate knowledge on how socially induced destabilization processes within socio-ecological systems function and how coupling processes as well as the regulation of societal relationships with nature work in case of crises.

Finally, the chapter (68.7.2) offers some guidance for further research and a synthesis of the theoretical-conceptual discussion and the empirical case study by deriving key questions for capturing coupling and regulation between society and nature within socio-ecological crises linked to natural hazards. These key

18 The actual breakdown of coupling processes (fishing, water supply etc.) could be compensated mostly through disaster aid and relief organizations for a certain period of time. The general feedback processes expected and known in normal times also change due to new rules and response actions introduced by formal organizations and governments during and after disasters.

questions are a first entry point to combine different perspectives and apply them to disasters and crises linked to natural hazards.

68.8 Key Questions for Capturing Coupling and Regulation of Socio-ecological Crises in the Context of Natural Hazards

The analysis of different theories and conceptual approaches to identify and explain coupling and regulation processes showed the variety of existing concepts. Overall, the critical review of the theories regarding their value to explain regulation and coupling processes within socio-ecological crises in the context of natural hazards showed that no theory alone can capture and/or explain the diversity of the different coupling and regulation processes between society and nature, particularly when taking into account the observed coupling and regulation processes based on the empirical case study work in Sri Lanka. However, it became evident that empirical research can benefit from parts of the theories and concepts used, since these theories are able to sharpen the research focus and to explain different aspects and processes observed and examined in the empirical case study on the post-disaster process in Sri Lanka after the devastating tsunami in 2004. While traditionally, most disaster research focuses on the sudden-onset event itself and its consequences, the theoretical approach of Görg regarding the 'regulation of societal relationships with nature' can help to draw attention to the role of crises to trigger changes within societies and their relationship to nature. Particularly the conceptual differentiation between large and small crises can also be transferred to natural hazard phenomena which might not be taken into consideration when they are small. In contrast, larger disasters can not be managed by existing institutions and organizations and therefore imply major disruptions and might lead to change. Relocation policies and the buffer-zone established after the Indian Ocean Tsunami 2004 in Sri Lanka are, among other issues, signs of these changes. However, one also has to acknowledge that the disaster response and recovery process missed the opportunity to promote change towards the development of more resilient and sustainable coastal communities as shown in the case study example.

The following key questions will serve as a guide when analysing regulation and coupling processes of society and nature within socio-ecological crises linked to natural hazards:

- What are the different views and definitions of the problem?
- Who defines the situation and relations as a problem?
- What are the major characteristics of the socio-ecological crises phenomena which manifest themselves in dynamic interactions of different components of socio-ecological systems or societal nature relations?
- What are the key interactions between the different components of these systems and relations?
- What are the elements and processes that stabilize or destabilize the relationship or coupling processes between society and nature?
- What are the changes observed after crises within the relationship of society and nature?
- Are the changes linked to the intensity of the crises (large versus small crises)?
- Is it possible to distinguish between different phases of stabilization and destabilization?
- What are the key factors underlying the transformation of relationships between society and nature or of socio-ecological systems before a collapse takes place?
- Which demands and agendas do different stakeholders have when utilizing nature or environmental resources and services?
- In which way are such contested terrains structured (actors, agendas)?
- What are potential tipping points of social, ecological, and socio-ecological systems?
- How do shocks and disruptions generate feedback processes at different scales?
- In which way do these feedback processes at different scales influence coupled socio-ecological systems within disaster affected communities?
- How do feedback processes manifest themselves in the ecological, social, and cultural dimension of relationships between society-nature and/or coupled socio-ecological systems?
- How do different temporal scales influence regulation, stabilization, and transformation?
- What types of intended regulation exist or are being implemented after disasters and which feedbacks do they provoke?
- How do issues of non-linearity and surprise manifest themselves within disasters and disaster response processes?
- What are potential interventions to promote sustainable transformation?

Overall, the questions above are a lens to examine coupling and regulation processes within socio-ecological crises linked to natural hazards. This set of questions might need to be adjusted and modified for the place and hazard specific characteristics of the respective crises. Nevertheless, these questions can guide further research particularly when aiming to explore dynamic coupling and regulation processes between society and nature in the context of natural hazards and disaster responses. Lastly, these questions should also be considered by actors dealing with recovery and reconstruction in order to ensure that strategies and actions taken after a disaster are based on a more comprehensive understanding of the complexity and dynamics of coupled socio-ecological systems. At the moment, most disaster response agencies conduct damage and needs assessments solely without taking into account the various dependencies, coupling, and regulation processes within socio-ecological systems.

69 Differentials in Impacts and Recovery in the Aftermath of the 2004 Indian Ocean Tsunami: Local Examples at Different Scales in Sri Lanka

Katharina Marre and Fabrice Renaud

69.1 Introduction and Conceptual Framework[1]

During the 26 December 2004 Indian Ocean Tsunami, Sri Lanka was one of the hardest hit countries in the affected region. The tsunami impact was most severe in the island's East and South. It was the first tsunami that occurred in Sri Lanka in living memory. Therefore, Sri Lanka was entirely unprepared for such an event.[2]

This disaster in particular re-enforces the call for a shift from a hazard focused disaster reduction strategy to a vulnerability focused approach, because the human influence on the occurrence of a tsunami (the hazard) is zero. Engineered protection measures such as breakwaters and seawalls in the near shore area of Sri Lanka do not yield a favourable cost-benefit ratio given its high costs and the very long return periods of such a tsunami (at least 400 years according to Stein/Okal 2005b). In that context Kawata (2006) recommended structural measures only for high frequency-low impact events while rare, catastrophic events should be addressed through 'soft preparedness measures' such as information and education.

The ongoing paradigm shift in the understanding of disasters from a hazard-centred perspective to a vulnerability-centred perspective leads to more multi-dimensional concepts, and more complex strategies and policies in disaster reduction (Birkmann 2006a). Extreme phenomena only become disasters if people are affected. As noted above, more often than not, there is no control over the imminent extreme phenomenon itself. However, there are usually a number of measures to directly and sustainably influence the underlying vulnerability of people with its complex, multi-disciplinary and multi-dimensional characteristics. Understanding vulnerability is the starting point for sustainable and effective policies for its reduction.

The number of definitions and concepts for vulnerability is large with no universal definition at hand and many disciplines have developed their own work-

1 The research reported here was implemented in partnership with scientists based in Sri Lankan Universities, notably Prof. K. Thedchanamoorthy, Eastern University; Prof. A. Ranasinghe, University of Colombo; and Prof. Raveendranath of Eastern University. Prof. Raveendranath has sadly been a direct victim of the civil conflict in the country shortly after the surveys were completed.

2 Seismo-tectonic Setting: From a seismo-tectonic perspective the Indian Ocean is and was known to be prone to tsunamis. Particularly along the subduction zone of the Sunda Trench the geological and seismological conditions are conducive to tsunamis and have triggered tsunamis in the past: in 1797 a M8.4 earthquake tsunami flooded Padang; in 1833 a M8.7 earthquake tsunami flooded the southern part of western Sumatra; in 1861 a M8.5 earthquake tsunami affected the western coast of Sumatra; in 1881 a M7.9 earthquake tsunami of 1 m height hit the eastern Indian coast; in 1883 after the Krakatau explosion a large tsunami affecting Java and Sumatra; in 1941 a M7.7 earthquake probably caused a tsunami. However, a tsunami like the one of 26 December 2004 with that magnitude and with that direction of propagation had not been recorded before (NOAA/NGDC 2008).
The Sumatra-Andaman Island earthquake was caused by a thrust faulting on the interface of the Indian Plate and the Burma plate (subduction rate 45–60 mm/yr). The rupture length was about 1,200 km with a width of ~200 km. The maximum displacement on the fault zone is assumed to have been ~20 m – the sea floor would have been uplifted by several meters (Stein/Okal 2005a; Liu/Lynett/Fernando/Jaffe/Fritz/Higman/Morton/Goff/Synolakis 2005). Sri Lanka is all but aseismic. The earthquake occurred some 1,600 km away and it took almost 2 hours after the rupture on the Sumatra Trench at 7:58 am local time for the first tsunami wave to reach Sri Lanka.

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ing definition. An overview of many of those definitions can be found for example in Cardona, Hurtado, Duque, Moreno, Chardon, Velasquez and Prieto (2003a), Schneiderbauer and Ehrlich (2004), Green (2004), Brauch (2005), Birkmann (2006), and Thywissen (2006).

The research presented in this chapter focused on the differential impacts of the tsunami and is embedded in the conceptual framework of Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003) for vulnerability assessment. This framework postulates that vulnerability rests largely within the conditions and dynamics of the coupled human-environment systems exposed to hazards. According to Turner and his colleagues (2003: 8074) "Vulnerability is the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressors". Further, vulnerability is formally composed of exposure, sensitivity and resilience; these elements are dynamic, interactive and scale dependent.

Here the authors define the exposure component of vulnerability as the number of elements at risk (individuals, houses, households etc.) and the physical/environmental conditions of the location which can enhance or dampen the impact of a specific hazardous phenomenon. Those physical/environmental conditions can be the distance to the coast (for coastal hazards), the topography of the area, protective vegetation along the coast etc. The sensitivity component, as described by Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003), is the social and biophysical capital that influences the existing coping mechanisms, which take effect when the exposure is experienced. The social and biophysical responses and coping mechanisms may have a mutual effect on each other, so that a response in the human subsystem could make the biophysical subsystem more or less able to cope and vice versa. The responses of the coupled system and their outcomes determine its resilience. In general, the resilience of the coupled system can be characterized by complex feedback loops altering the vulnerability of the system altogether.

In order to prevent and mitigate for future disasters the understanding of vulnerability is crucial. Since vulnerability is a forward looking and predictive parameter there is no way of verifying it except after a disaster. In that sense the damage pattern of a disaster and the observed dynamics of disaster recovery provide unique information because they reveal all underlying vulnerability factors – known or unknown (e.g. Birkmann/Fernando 2008).

The research presented here is based on two *rapid appraisals* (RA) which were carried out with the objective to shed light on two different components of vulnerability: impact sensitivity and resilience. The authors identify some critical interactions in the coupled human-environment system that at the same time represent response opportunities for decision and policy makers leading to a reduction of vulnerability.

69.2 The Empirical Approach and its Limitation

The research in this chapter is based on two *rapid appraisals* (RA) of different characteristics and objectives (Kachandham 1992).

The first study, a comparative analysis on the district and divisional level, was carried out with the objective to gather existing data from many different sources in a relatively large area of the two districts Galle and Batticaloa. The RA offers the best results for the given financial scope, time frame, and the size of the study area. Defining a fast and low cost methodology was particularly important for the authors in order to develop a procedure that is easily repeatable with Sri Lankan capacities at a different point in time and/or in a different area. The data used was intentionally data that is generated on a routine basis in Sri Lanka, but often not easily accessible (stored in remote data repositories, in hardcopy format and written in the local languages). Thereby, this analysis provides a tool ready to use in Sri Lanka that does not involve the high costs of data acquisition.

The data gathering for this study was carried out in close collaboration with the Eastern University in Batticaloa and the University of Colombo. The meta data collection in each of the two districts of Galle and Batticaloa focused on the affected coastal *District Secretary* divisions (D.S. division which is the next smaller administrative unit in a district). Teams of researchers from Eastern University and from the University of Colombo identified data repositories, collected the data, translated them into English and converted them into electronic format. Data availability was limited and inhomogeneous and the data quality was often poor. Certain data were available in some divisions but not in others. A difficulty also arose from the fact that the political boundaries in Batti-

caloa are ambiguous. The size and number of the D.S. divisions in Batticaloa change depending on the data source. Information on many socio-economic parameters was only available on the district level (if at all). But particularly for an impact assessment it is important to consider damage and impact parameters (number of fatalities, people affected etc.) on a D.S. division level (see 69.3).

The second study, a questionnaire-based household study, had to generate new data since the information needed did not exist at this high level of detail. The RA was conducted in the Batticaloa District and targeted rural communities. It was designed to collect information on the human, natural, financial, physical and social capitals available at the household level after the tsunami, thus broadly following the sustainable livelihoods concept of DFID (1999). However, in this RA, only targeted questions pertaining to the various above assets were considered. These were incorporated in a structured questionnaire addressing personal information; household information; land ownership; crop cultivation before and after the event and irrigation methods; losses to property; affected agricultural land; distance of the agricultural activities to the coastline; displacement following the event; post-impact biophysical problems; availability of inputs (including labour) and their costs; yields of the following cropping cycle; and assistance received. The surveys were conducted in communities engaged either in paddy or vegetable cultivation systems.

The choice of the two study areas of Galle and Batticaloa was driven by one or several of the following conditions and is summarized in table 69.1 below:

- locations should be strongly affected by the tsunami;
- the locations should allow for a comparison between a Singhalese and a Tamil context;
- the towns should be large enough to encompass a number of sectors (administration, agriculture, industry) and to represent a variety of livelihood approaches;
- the locations should be accessible with respect to the security level (this condition applies to the location in the Tamil area which was and still is subject to acute conflict and restricted access).

The structure of this chapter is as follows: first the results of the two empirical case studies are presented starting with the lower resolution study analysing the impact sensitivity on the basis of selected parameters (69.3) followed by the high resolution household study analysing the resilience and coping capacity (69.4). The chapter concludes by summarizing the most important results of both case studies and discussing their implications for policy making (69.5).

Table 69.1: Selection criteria for the choice of the study areas. **Source:** For the number of victims, see DCS (2005b).

Selection Criteria	Galle	Batticaloa
Location	South West	East
Size (population)	90,000 (City of Galle)	80,000 (City of Batticaloa)
Ethnic majority	Singhalese	Tamil
Tsunami impact based on no. of victims per district	3,315	4,852
Accessibility/Security	easily accessible, safe	access limited, but possible, elevated UN security level

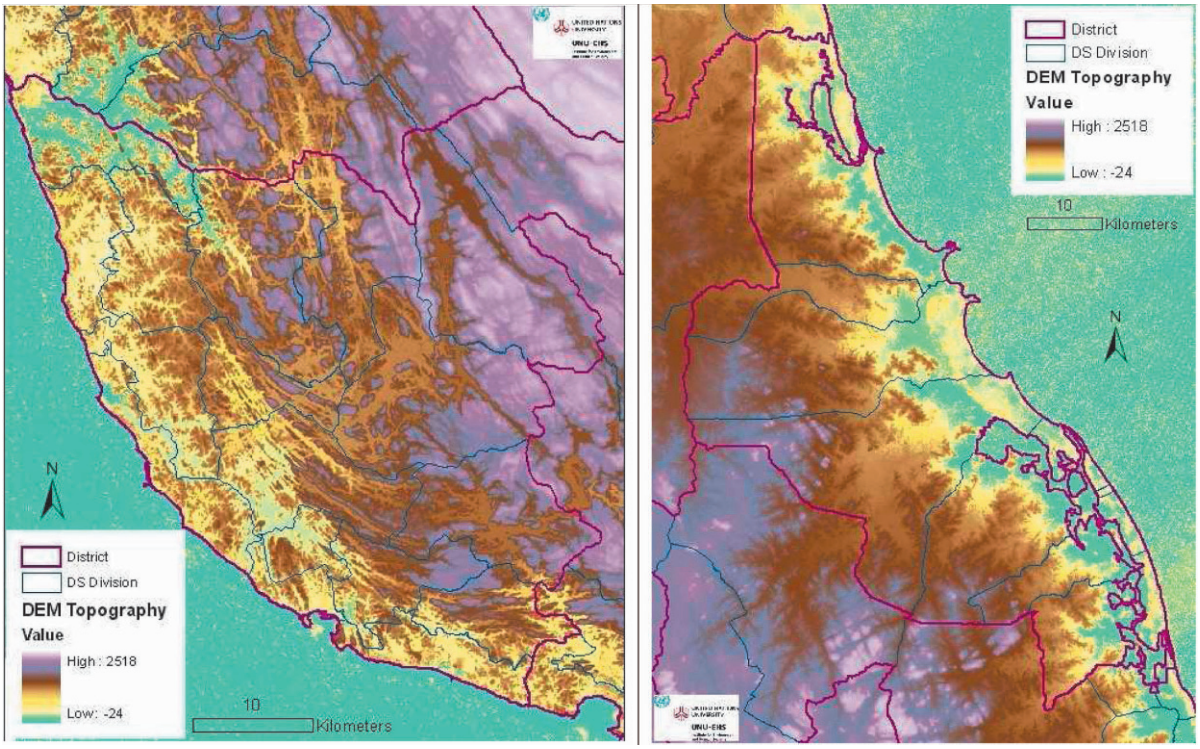
69.3 Empirical Case Study: Impact Sensitivity on the District and Divisional Level

This case study was carried out with the objective to shed light on the sensitivity towards the tsunami impact in the districts of Galle and Batticaloa by analysing and comparing the tsunami impact on the basis of a number of selected physical, environmental, socio-political and economic parameters. Thereby this study identifies those parameters that were driving the impact pattern. The authors do not claim to provide a complete picture of all possible impact parameters, but the selected parameters and their relative influence on the damage pattern provide important information for the design and implementation of disaster reduction policies that target vulnerability.

69.3.1 Physical and Environmental Characteristics of the Study Areas and Their Influence on the Tsunami Impact

The general geographic layout of the two districts is quite different: Batticaloa, located on the Eastern coast of Sri Lanka, is characterized by its 251 km long coastline and a large lagoon which parallels the coast for about 110 km. The total district area comprises 2,854 km^2 with a total population of ca. 520,000. The district capital is the city of Batticaloa with a population of ca. 80,000 in 2001 (Dept. of Census and Sta-

Figure 69.1: Landsat DEM (resolution 90 m) showing the topography in both districts. **Source:** The data for this digital elevation model (DEM) was provided by the International Water Management Institute; at: <http://www.iwmidsp.org> and processed by the authors with ArcGIS. The DEM data stem from the United States Geological Survey (USGS) that are in the public domain.



tistics 2005). The majority of the population is concentrated on the land strip between the lagoon and the seashore. The region to the west of the lagoon is sparsely populated and accommodates about 90 per cent of Batticaloa's paddy lands.

Galle, with a total population of about 991,000, is located in the Southwest of the island with a coastline of about 80 km length and a total area of 1,652 km² (table 69.2). The district capital is the city of Galle with about 90,000 inhabitants (2001). The city of Galle is the site of the second largest port in the country.

Table 69.2: Distribution of land and inland water areas for the inland water ways. **Source:** DCS (2005).

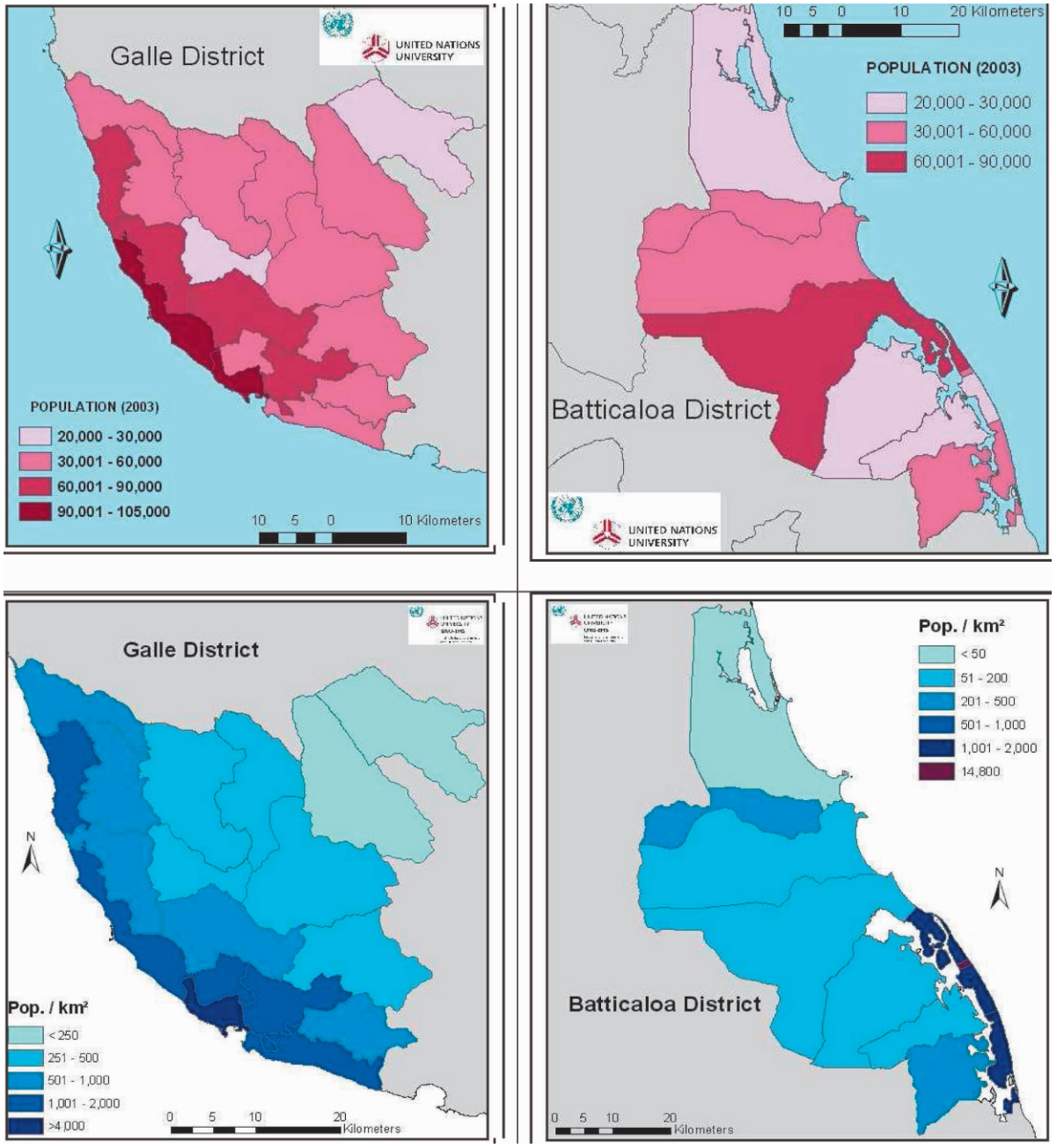
	Total area (km²)	Land (km²)	Inland water (km²)
Galle	1,652	1,617	35
Batticaloa	2,854	2,610	244

The shape of the affected districts as well as coastal topography are driving factors for the number of fatalities and affected people as well as for economic damage. A long coastline results in a higher tsunami exposure than a short coastline and hence, will prove more damage prone. Similarly, a division paralleling the coast versus one stretching far inland will suffer more losses. Of the two districts under consideration Batticaloa has the longer coastline and as the Landsat (digital elevation model with a resolution of 30 m) shows the topography along the coast is markedly flat while Galle is more elevated (figure 69.1). In both districts most of the population is concentrated along the coastline leading to a high exposure towards coastal hazards such as storm surges and tsunamis.

The tsunami reached Batticaloa between 8:00 and 8:50 in the morning (IUCN 2005). In Galle the first wave arrived at about 9:22. The wave heights documented by Liu (2005) reached a maximum of about 5 m in Galle and about 4 m in Batticaloa. The maximum inundation distance from the coast in Batticaloa was about 1,700 m according to IUCN (2005) while the median depth of encroachment was 130 m. The median depth of inundation in Galle was 70 m (UNEP 2005).

The number of people at risk is one of the basic preconditions for a large damage. The total popula-

Figure 69.2: Population distribution and density by D.S. Division in the Districts of Galle and Batticaloa. **Source:** Based on data by the Sri Lanka Department of Census and Statistics (2005b: 1-21) the figures were produced by the authors.



tion of the Galle district is almost double the population of the Batticaloa district and in both districts the majority of the population is concentrated along the coast as the population density map points out (figure 69.2).

The number of people at risk along the coast of the two districts is higher than the average population density of the districts implies, resulting in the high numbers of fatalities and affected people because a large portion of the population is exposed to the tsunami impact. Considering only the population of the coastal D.S. Divisions it turns out that in Batticaloa a higher percentage of the population is concentrated along the coast (52 per cent) as opposed to Galle (45 per cent). In addition, in Batticaloa the exposed population lives on a narrow, water-locked strip of land

(figure 69.2) of which large parts were inundated by the tsunami. This represents one important element for vulnerability assessment in the framework used here.

A scaling effect is observed when the impact on a district level is compared to the impact on the division level as the percent of the dead and missing doubles (table 69.3).

Table 69.3: Tsunami impact in terms of fatalities and people affected for Galle and Batticaloa on a district level and a D.S. divisional level. **Source:** DCS (2006: 18, 22).

Impact on the whole districts (in percent)		
	dead and missing	people affected
Galle	0.5	14
Batticaloa	0.6	49
Impact on the affected divisions only		
	dead and missing	people affected
Galle	1	31
Batticaloa	1	75

Table 69.3 shows the percentage of victims and people affected and illustrates that the tsunami impact in both districts seems to be comparable in terms of fatalities, but Batticaloa has a significantly higher percentage of affected people. The main reason for that presumably lies in the different topography. Batticaloa has a flat landscape so the tsunami waves could progress farther inland than in Galle. That is also confirmed by the inundation depths described earlier. The fact that one does not see the same difference in impact when it comes to the percentage of fatalities and missing can be explained through the wave dynamics: tsunami waves are most fatal where they have their highest momentum (determined by water level and velocity). The wave momentum attenuates rapidly when it advances inland. Therefore, the area of high-momentum impact is probably comparable in Galle and Batticaloa leading to a comparable number of fatalities.

To create the link with the vulnerability concept of Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003), this damage pattern is the result of the coupled human-environment system where certain factors in both subsystems, the human subsystem and the environmental subsystem, play unfavourably together leading to a strongly elevated vulnerability: the population distribution and density together with its atypical building stock (usually single-floor, simple brick or wood structures) of the human subsystem that intersects with the topographic and vegetation features of the environment subsystem.

69.3.2 Socio-political Factors of Vulnerability

The data on the tsunami victims show that age and gender have a strong influence on the vulnerability of the population at risk as was also shown by the survey of Birkmann and Fernando (2008). The data in table 69.4 and table 69.5 only include the number of dead and missing according to the population that lived in the damaged housing units. In comparison to the number of dead and missing recorded by the district secretariats the post-tsunami census captured only a portion of the victims: in Batticaloa 53 per cent of the victims (1,751 vs. 3,315) and in Galle 37 per cent of the victims (1,783 vs. 4,852) were captured. Therefore, there remains some uncertainty in the following statistics on age and gender.

Table 69.4: Age distribution of the tsunami victims in Galle and Batticaloa based on the post-tsunami census. **Source:** DCS (2006: 17, 21).

	Age Structure				
	0 - 4	5 - 9	10 - 18	19 - 29	> 29
Galle Population 2001	9%	9%	19%	15%	48%
Galle Tsunami Victims	13%	8%	7%	10%	63%
Batticaloa Tsunami victims	15%	14%	15%	11%	45%

The data in table 69.4 and 69.5 show that the young and very young children suffered the highest mortality. The Galle data and other reports from the literature also indicate that the elderly were highly vulnerable. This latter tendency is not clearly visible in Batticaloa, but there was no reference point for the age structure of the district before the tsunami. Overall the data showed that the 0–10 and >61 years age groups (irrespective of gender) had higher relative mortality in Batticaloa when compared to other age groups.

A systematic pattern regarding the victims' gender is even more distinct. In both districts about two thirds of the victims were women. The data from the Batticaloa District Secretariat reflect this tendency less clearly where 56 per cent of the victims are

Table 69.5: Age and gender distribution among the tsunami victims according to the post-tsunami census. **Source:** DCS (2006: 19, 23).

Dead & Missing Galle					
	Row Percentage		Column Percentage		
	Male	Female	Male	Female	Total
0 to 4	44	56	17	11	13
5 to 9	39	61	10	7	8
10 to 18	30	70	6	7	7
19 to 29	22	78	7	12	10
Over 29	32	68	60	64	63
Total	33	67	100	100	100
Dead & Missing Batticaloa					
	Row Percentage		Column Percentage		
	Male	Female	Male	Female	Total
0 to 4	53	47	22	11	15
5 to 9	46	54	18	12	14
10 to 18	33	67	13	15	15
19 to 29	18	82	6	15	11
Over 29	32	68	41	47	45
Total	36	64	100	100	100

women. Despite the different data structures, the gender and age biases revealed above are similar to observations summarized by Birkmann and Fernando (2008) in the cities of Galle and Batticaloa where they observed that female casualties and missing were significantly higher in both areas.

The causes for the high mortality among women have not been clearly identified yet, but there are numerous, rather anecdotal and speculative reasons described in the literature (MacDonald 2005):

- women stayed behind to look after their children and relatives;
- women in these areas often cannot swim or climb trees;
- the tsunami hit on Sunday morning when they were at home and the men were out on errands away from the seafront;
- women play a major role in processing the fishing catch and were waiting on the shore for the fishermen to bring in the catch.
- In Batticaloa the tsunami hit at a time when women who lived on the east coast usually took their baths in the sea.

Beyond age and gender it was of interest to this case study to find out if ethnicity and/or religion led to quantifiable differences in the damage pattern. The ethnic and religious representations in Galle and Batticaloa are expectedly very different as it was a selection criterion for the case study areas (tables 69.6, 69.7).

With 94 per cent Singhalese, Galle has less ethnic diversity than Batticaloa where 62 per cent are Sri Lanka Tamils and 36 per cent are Sri Lanka Moors. The relative homogeneity of the districts does not allow for an analysis of systematic differences within one district regarding ethnic or religious differences.

The Tamil dominated areas are located in the North and the East of the country which are also the areas that had to bear the brunt of the tsunami impact. Therefore, there is a disproportionately high percentage of Muslims among the tsunami victims. Nine per cent of Sri Lanka's population are Muslims (this percentage does not include the Northern and Eastern districts) but they account for 41 per cent of the dead. Out of the total of about 30,718 people killed in Sri Lanka 12,562 were Muslims; the Amparai district alone accounted for 7,258 (58 per cent) of the total Muslim fatalities.[3]

With respect to the coupled human-environment system, the above paragraph provides insights on the demographic subsystem. It also points out a crucial issue for any vulnerability assessments on the basis of the coupled human-environment system: It is important to determine which of the subsystems contain the drivers and which contain the circumstantial factors. According to the fatality statistics the Muslim population group seems to have a much higher vulnerability. However, the historically, politically and culturally determined distribution of the Muslims places the majority of them in the North, East and South East. Those areas coincide with the highest physical tsunami impact and the flattest topographic profile. Therefore, the vicinity to the hazard together with the environmental factors (environment subsystem) are the driving parameters of the impact pattern, while the ethnicity in this case represents the circumstantial factor.

3 The number of Muslim fatalities were mentioned in Yahoo India News, 2005: "Lanka's tsunami dead."; at http://in.news.yahoo.com/050515/32/5yjxx.html> (30 June 2006): 1.

Table 69.6: Representation of the main ethnic groups in Sri Lanka according to the last census in 2001. **Source:** DCS (2001).

	Singhalese	Sri Lanka Tamil	Indian Tamil	Moor	Burgher	Malay	Chetty	Bharatha	Other
Galle	94.3	1.2	0.9	3.6	0	0	0	0	0
Batticaloa	0.8	62.2	0.1	36.1	0.8	0	0	0	0

Table 69.7: Representation of the main religions in Sri Lanka. **Source:** DCS (2001).

	Buddhist	Hindu	Islam	Rom. Catholics	other Christians	other
Galle	94.1	1.6	3.6	0.4	0.3	0.0
Batticaloa	0.7	53.8	36.1	6.6	2.6	0.2

Table 69.8: GDP development in 2004 and 2005. Sources: Economist Intelligence Unit (2006: 1). *The GDP for the 4th quarter (Qt). in 2005 was taken from data provided by the Central Bank of Sri Lanka (2007: 1) .

	2004				2005			
GDP at constant 1996 prices (Mio. Rs)	**1 Qtr**	**2 Qt**	**3 Qtr**	**4 Qtr**	**1 Qtr**	**2 Qt**	**3 Qtr**	**4 Qtr**
	240.48	223.38	248.66	267.64	250.95	236.68	264.47	284.58*

69.3.3 Economy and Poverty as Vulnerability Factors

Sri Lanka is economically, ethnically, linguistically, and religiously very diverse. In addition civil unrest and conflict between the *Liberation of Tamil Tigers Eelam* (LTTE) and the Singhalese government of Sri Lanka has been going on since the 1950's. This conflict has strong repercussions not only on the welfare and security of the population but also on the national economy and development as well as severe impacts in conflict areas such as in Batticaloa (Bohle 2007). Sri Lanka's main source of gross national product is agriculture, forestry and fishing is 17.9 per cent in 2004 (Economist Intelligence Unit 2006). The main export goods are textiles, tea, precious stones and petroleum.

The tsunami of December 2004 caused tragic human loss and trauma to Sri Lanka's population but the immediate impact was restricted to the coastal areas. Even though the GDP at constant 1996 prices dropped from 2004 to 2005, this drop was more likely to be related to political unrest and high oil prices rather than to the tsunami (table 69.8).

For the Sri Lankan economy the course of the peace process was then a major uncertainty and immediate threat. In the aftermath of the tsunami, the Economist Intelligence Unit (2006: 2) noted:

> Even if the country does not revert to war, increased militant activity could dampen growth through its negative impact on the services sectors (primarily tourism) and investment. [...] Nevertheless, GDP is likely to expand by an annual average of 5.7 per cent in 2006/7, owing to a strong recovery in agriculture in 2006 and ongoing robust growth, both in industry and also in services sectors [...]. Growth in services will return to trend in 2006/7 as tourism recovers from the effects of the tsunami. Tsunami-related reconstruction, combined with the start of infrastructure projects in power, roads and ports, will boost investment.

For 2006/2007 the Economist Intelligence Unit indicated that the tsunami could even have an economically stimulating effect. On a national scale the impact of the tsunami had reached a turning point where the losses were turned into opportunities. The relatively positive outlook made in 2006 was overshadowed by the deterioration of the conflict situation in Sri Lanka that was prevailing then. After numerous violent incidents inflicted on both sides in 2007, the government formally annulled the ceasefire agreement in January 2008 that had been signed with the LTTE in 2002. Those developments were then expected to dampen the eco-nomic development: foreign investments were likely to decrease, the real economic growth could slow to 4.6 per cent from an estimated 6.5 per cent in 2007 (Economist Intelligence Unit 2008). The conflict-related situation in Sri Lanka has dramatically changed in 2009 and the projections made before that date have now to be reassessed.

According to the summary of the national economic situation in 2005/6 the tsunami had only a

minor impact on Sri Lanka. Since large and economically strong parts of the country were not affected by the tsunami this national overview can only provide a smoothed picture of the economic impact of the tsunami. As it will be shown in this section, the higher the resolution of the analysis the more drastic an effect of the tsunami will be revealed, the highest impact being seen on the household level.

In UNDP's (2006) ranking of 177 countries according to their *Human Development Index* (HDI) Sri Lanka occupies rank 93. The mean household income differs quite strongly from province to province and is lowest in the conflict stricken Northern and Eastern Provinces (table 69.9).

Table 69.9: Mean monthly household income per province. Source for all Provinces except Northern and Eastern. **Sources:** DCS (2004: 2). *Source for the Northern and Eastern Province: DCS (2003: 3).

PROVINCE	Mean monthly household income (Rs) 2002
Western	17,732 (170 USD)
Central	11,175 (107 USD)
Southern	11,229 (108 USD)
North Western	10,918 (105 USD)
North Central	9,926 (95 USD)
Uva	10,388 (100 USD)
Sabaragamuwa	8,439 (81 USD)
Northern*	**8,155 (78 USD)***
Eastern*	**7,640 (73 USD)***

The level of poverty, social and human security in the country changes with the region, profession and other parameters. Poverty has been defined by the Department of Census and Statistics (DCS 2002) as the barrier to prosperity and lack of resources and opportunities, feelings of being disenfranchised from various support systems (i.e. educational, economic, cultural, and social), and diminished feelings of empowerment to obtain these resources and opportunities. As such it is a very complex and personalized parameter and rather difficult to quantify in its entirety. Thus, poverty is usually measured by means of proxies, such as income and expenditure. The Sri Lanka *Department for Census and Statistic* (DCS) carries out a '*household income and expenditure survey*' (HIES) in a 5 years interval.

The poverty information in this study stems from the HIES in 2002 and 2003. The DCS defines the poverty line as the amount necessary to purchase a defined consumption basket that is needed to meet nutritional and basic living needs and the per-capita expenditure needed to meet a nutritional intake of 2030 kcal, which was set at 1,423,- Rs in 2002. Due to cost, that survey has only been possible on a district level excluding the Eastern and Northern districts. Based on the district data the Department for Census and Statistics estimated poverty levels for the D.S. Divisions based on the 'small area estimation technique', by combining census and household data. It becomes evident that this study compares a district in the poorest province (Batticaloa in the Eastern Province) with a district in one of the most affluent provinces (Galle in the Southern Province). On a district level this already indicates very different financial coping capacities (table 69.10).

Table 69.10: Comparison of the monthly household income [in Rs] in Galle and the Eastern Province. Data on the district of Batticaloa alone were not available. **Sources:** *Data source (DCS 2002: 4) and **data source (DCS 2003: 5).

	Mean household income 2002	Median household income 2002	Monthly average household expenditure (2002) (food and non-food)	Poverty line (2002)
Galle District*	12,724	8,800	11,901	1,466
Eastern Province**	7,640	5,500	10,769	No data

According to the DCS (2002) 27 per cent of the population in Galle lived below the poverty line. In Batticaloa no information on the poverty line was available but the district profile from 1999 specifies that 76 per cent of the families lived on less than 1,000 Rs per month (equivalent to 10 USD). Bearing in mind the incomparability of the numbers at hand, the general differences in poverty between these two districts is still evident with Batticaloa being the much poorer district.

The Census Department has carried out a survey on the damaged housing units in all tsunami affected districts. This survey revealed that the household income of the completely damaged housing units (completely damaged + partially damaged un-usable) and the partially damaged housing units (partially dam-

Table 69.11: Grouping the affected housing units by damage degree and household income. **Sources:** DCS (2006: 18, 22).

		<5,000 Rs	5,000-9,999 Rs	>10,000 Rs
Batticaloa	Completely damaged	73	17	7
	Partially damaged	63	23	11
Galle	Completely damaged	49	25	25
	Partially damaged	36	27	35

aged usable) varies systematically between the two damage classes.

Table 69.11 shows that the damage degree is selective, with poorer households suffering more severe damage to their houses. This trend occurs in Galle as well as in Batticaloa but in the latter district this trend is more pronounced. The reason for this trend can most likely be found in the distribution of the breadwinner's occupation and their general level of income. Families living close to the coast, i.e. the more exposed families, were more likely making their living from fishing, which provided lower incomes than e.g. the service sector. That means the pattern of occupation of the coastal population often puts poorer households and lower quality houses close to the more exposed shoreline.

Table 69.11 also illustrates that the households in Batticaloa with their smaller income have significantly smaller financial coping capacities. That was confirmed in a household survey by Birkmann and Fernando (2008) who estimated the time span households needed in both districts to fully recover from their economic losses. Batticaloa households needed significantly longer to recover than households in Galle.

69.3.4 Livelihood Factors of Vulnerability

The employment distribution has been surveyed by the DCS in 2004 before the tsunami (table 69.12).

The type of occupation proved to be an important factor for the Tsunami impact and recovery where two factors interact. The first factor lies in the different exposure of the various occupations. Nearly 90 per cent of the fishermen have been seriously affected, with nearly 80 per cent of the country's fishing vessels being destroyed (ITDG 2005). According to the DCS (table 69.13 below) only 22 per cent of the persons engaged in fishing (that does not include subsistence fishing families) were still engaged in fishing after the tsunami in Batticaloa. In Galle that percentage amounted to 35 per cent. In contrast, 95 per cent of the persons under government employment in Galle and 92 per cent in Batticaloa were still engaged in that sector after the tsunami.

Table 69.12: Comparison of the employment distribution of 11 different employment groups in Galle and Batticaloa (in per cent). **Sources:** DCS (2004a: 11).

	Galle	Batticaloa
Senior Officials and Managers	0.6	0.7
Professional s	5.9	6.5
Technical and associate professionals	6.2	7.7
Clerks	4.3	2.1
Proprietors and managers of enterprises	14.5	2.0
Sale and service workers	6.6	12.3
Skilled agricultural and fishery workers	15.4	22.2
Craft and related workers	14.1	17.0
Plant and machine operators and assemblers	3.8	5.9
Elementary occupation	27.5	23.4
Unidentified	1.0	0.2

Table 69.13: Number of people employed in fishing and government before and after the tsunami. In both districts the government sector is much less affected by the tsunami . **Sources:** DCS (2005: 1).

	Engaged in fishing		Government employment	
	before	after	before	after
Galle	2,213	769	2,445	2,313
Batticaloa	4,413	949	2,615	2,397

In Batticaloa the proportion of the population engaging in fisheries is significantly larger than in the Galle District (table 69.14). Thus, the economic impact of

the tsunami on households was more severe in Batticaloa.

Table 69.14: Number of fishing households in Galle and Batticaloa. **Sources:** Ministry of Fisheries and Aquatic Resources (2004), quoted in: DCS (2005).

	Fishing Villages	Fishing households	Active fishermen	Population of fishing households
Batticaloa	172	16,700	21,600	86,020 (~17)
Galle	155	6,700	6,300	21,960 (~2)

The second factor lies in the wages paid in different industries (table 69.15). Agriculture and fisheries are paying the lowest wages, whilst the service sector pays the highest. Hence, in Batticaloa, with more people working in the fisheries and in the agricultural sector, the economic coping capacity has been lower than in Galle. Table 69.13 above shows that the ratio between government employees to fisheries employees (before the tsunami) was 59 per cent in Batticaloa and 110 per cent in Galle.

Table 69.15: Comparison of the monthly wages in Sri Lanka between the sectors agriculture (incl. fisheries), industries, services. **Source:** DCS (2006a: 9); * Includes fisheries.

Monthly wages [Rs]			Daily wages [Rs]		
Agriculture*	Industries	Services	Agriculture	Industries	Services
5,866	9,016	12,791	4,048	6,630	6,089

In terms of impact sensitivity, the type of occupation is one of the driving factors of economic vulnerability and coping capacity of the affected population. However, that relationship between the type of occupation and vulnerability is strictly hazard specific. That particular pattern of relationships is only valid for tsunamis and storm surges (coastal hazards). The pattern would look very different for other hazards such as droughts, storms, river floods or fires. In the case of droughts for instance, the most exposed occupational group is the farmers not the fishermen.

In Batticaloa many livelihoods are based on agriculture (29,000 families) and fishing (16,000 families) (Eastern University 2001). Coastal agriculture was also severely affected by the tsunami. The force of the tsunami waves, salt water and debris intrusion affected the crops in the fields and salt water intrusions polluted many freshwater wells in the coastal area. However, overall paddy production of the district was not severely impacted (table 69.16).

Table 69.16: Comparison of the paddy yield (kg per Ha) in the Maha seasons from 2002 to 2006 **Source:** DCS (2007: 4).

	Maha 2002/3	Maha 2003/4	Maha 2004/5	Maha 2005/6
Galle	3,438	3,383	3,711	3,498
Batticaloa	2,581	2,815	2,360	3,207

Here again, the aspect of scale is crucial as productivity lost in the narrow tsunami-affected coastal fringe could have been compensated by increased productivity outside of that fringe. When looking at the tsunami impact on agricultural households in Batticaloa the strong impact as well as different coping capacities and recovery strategies between different farming communities and households becomes evident. The next part discusses this issue based on a field study that was carried out in the district of Batticaloa in 2005.

69.4 Empirical Case Study: Differentials in Recovery on the Household Level in the Agricultural Sector

So far the different characterization of the two districts in combination with a scale-dependant extent of damage highlighted the inherent difficulty to measure and compare vulnerabilities. It also showed which parameters were the driving underlying vulnerability factors of the damage pattern that was observed after the tsunami (environmental conditions, age, gender, poverty, occupation/income). The public interest in disasters usually tapers off rapidly after the immediate humanitarian relief phase. But the length and course of the recovery phase is a crucial aspect of the disaster impact. Are affected families able to return to a pre-disaster impact stage and how long does it take them, what aid mechanisms are being used? These questions in an agricultural context were the basis for the household study that was carried out in Batticaloa one year after the tsunami. The aim was to find out if and how farmers in seven tsunami affected villages in Batticaloa were able to re-engage in agriculture, what were their main obstacles and what aid they had received if any – within the specific conflict constraints of the country at the time. The area under consideration was

highly exposed to the tsunami, sensitivity before the tsunami was already high with respect to both human (poor communities living in a conflict area) and environmental (e.g. pollution of coastal aquifers) conditions. Coping responses were reduced because of the conflict situation, the impact of the event was high and adaptation opportunities reduced, again because of the conflict. All these elements underline the high vulnerability of communities when referring to the vulnerability model of Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003). Nevertheless, there were disparities in impact and recovery between the surveyed areas which are analysed further below.

The impact of the tsunami in terms of agricultural production at the national scale was not significant. This is illustrated by the fact that the performance of the agricultural sector nationwide improved in the first quarter of 2005 thanks to favourable weather conditions as paddy rice value-added grew by 19.1 per cent (DCS 2005a). This is also due to the fact that the tsunami affected only relatively small amounts of arable land when considering the entire country, whereas an activity that takes place almost exclusively on the coastline such as fishery, saw its value added decrease by 68 per cent in the same quarter of 2005 (DCS 2005a).

Although the impact on the agricultural sector nationwide was not detected in official statistics, the tsunami destroyed the livelihoods of many farming families locally, notably in the East of the country. The tsunami destroyed or severely affected most of the resources required for agricultural production such as human and financial assets, land, water, and equipment. However, the time-scale of the effect varied depending on the asset considered.

The study area belongs to the low country dry zones with a mean rainfall in the district of 1,500 mm with close to 80 per cent falling during the Maha season from October to January (Raveendranath/Arulnandhy 2005). Approximately 80 per cent of the population of the District depended on agriculture for their main source of income (Raveendranath/Arulnandhy 2005). Two agricultural systems were investigated.

Farmer households were interviewed in a total of seven villages in September and October 2005: Mavadiodai (n = 29 farmers), Kokkuvil (n = 4), Farm Colony 211F (n = 6), and Mankerny (n = 21) all engaged in paddy cultivation (hereafter called PS for Paddy System), constituting a total sample of 60 farmers out of a total of 107 farming families living close to the seashore in these areas; and Kaluthawala (n = 60), Mankadu (n = 10), and Cheddipalayam (n = 10) all engaged in the cultivation of vegetables (hereafter called VS for Vegetable system), a total sample of 80 farmers out of a total of 305 farming families living between the sea and the lagoon. Farmers were selected randomly from the survey areas and interviewed individually. The paddy cultivation system is only rainfed in this region with one crop per year during the maha season. The vegetable cultivation system consists in the cultivation of various crops such as brinjal, onions, okra, tomatoes, chilli, various legumes such as bushitao or cowpea, and gourds such as snake gourd. Crops such as brinjal, okra, tomatoes are cultivated twice a year, cowpea three times a year and all the rest once a year. The crops are irrigated from either wells tapping shallow groundwater (agrowells) or from surface retention ponds.

69.4.1 Results of the Agricultural Household Survey in Batticaloa

Despite the fact that farmers interviewed had the same ethnic background (100 per cent Tamil) and similar religious beliefs, there were large differences in household parameters between the two locations as is depicted in table 69.17.

Table 69.17: General information concerning the household heads. n = 60 for paddy area and n = 80 for vegetable area. **Source:** Based on the field study by the authors and their collaborators.

Parameter	Distribution (per cent)			
Age	< 30	30-60	> 60	
Paddy	41.7	55.0	3.3	
Vegetable	16.3	73.7	10.0	
Religion	Hindu	Muslim	Christian	Burger
Paddy	80.0	0.0	20.0	0.0
Vegetable	98.7	0.0	1.3	0.0
Education	No schooling	Primary	Secondary	Tertiary
Paddy	60.0	30.0	10.0	0.0
Vegetable	2.5	41.2	36.3	20.0

Farmers involved in vegetable farming generated a higher monthly income than those involved in paddy farming, an indication of the higher value of the commodity they produced. However, it needs to be kept

in mind that investments in vegetable farming are higher than those in paddy farming (e.g. Kielen 2005).

Table 69.18: Income distribution for the two agricultural systems under consideration. Income distribution (per cent) in the two agricultural systems. Income is in Sri Lankan Rupees (USD 1 = 100 Rs). **Source**: Based on the field study by the authors and their collaborators.

Monthly income (Rs)	**Paddy System**	**Vegetable System**
< 2000	28.3	16.3
2000 ñ 5000	70.0	21.3
5000 ñ 7000	0.0	32.4
> 7000	1.7	30.0

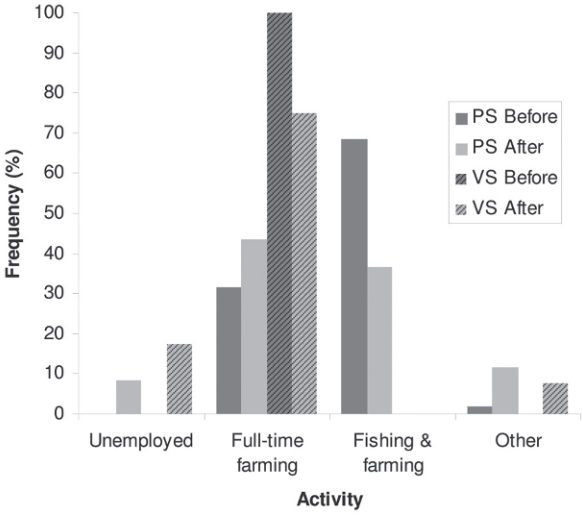
Only 32 per cent of the household heads in paddy farming considered themselves full-time farmers with 68 per cent of the reminder having other activities aside from farming (predominantly fishing but also waged labour and small businesses). Since the dependency on one type of income is not as strong as for less diversified households which fully depend on one type of income, this relatively high percentage of alternative incomes make, in principle, the paddy farming households less vulnerable than the vegetable farming households, particularly in terms of coping. Unfortunately this principle does not apply in this case as the fishing sector was also severely affected by the tsunami.

In contrast, 93.6 per cent of the vegetable farmers considered themselves full-time farmers and had more farm experience than paddy farmers (80 per cent had been involved in farming for more than 10 years as opposed to 21.6 per cent in paddy farming). This is due to the fact that their main activity is farming so the farming tradition and generational transmission is stronger than in paddy farming. In addition, 43 per cent of the adults other than the household head in paddy farming were involved in farming before the tsunami, decreasing to 32 per cent after the event, whereas the proportions for vegetable farming were 47 per cent and 43 per cent, respectively.

69.4.2 Consequences of the Tsunami on the Agricultural Activity

The impact of the tsunami on the resources of the farmers combined with opportunities brought about by reclamation activities affected employment patterns in the villages surveyed. After the tsunami, the proportion of full-time farmers engaged in paddy cultivation increased to 43.3 per cent as sea-fishing activities were severely disrupted and more government land was made available to farmers. 20 per cent of the farmers either became unemployed (8.3 per cent) or engaged in other activities than full- or part-time farming (11.7 per cent). Changes also took place in vegetable farming where all farmers were involved in farming before the event (97.5 per cent full-time and 2.5 per cent part-time) while 17.5 per cent of them became unemployed and 7.5 per cent were engaged in other activities after the event.

Figure 69.3: Farming activity before and after the tsunami. **Source:** Based on the field study by the authors and their collaborators.



Paddy farmers mainly farmed government land (67 per cent of surface area), while owned land represented approximately 29 per cent of their cropped area and the amount of leased land was very small (table 69.19). To farm government land, farmers have to apply to the Divisional Secretary and are then allowed to clear land and farm rent-free. Land ownership did not change after the tsunami but there was a slight increase in the amount of government land availability. It is important to note that having access to government land does not mean that the land was farmed at the time of the interview as some farmers could not re-engage in agriculture for various other reasons. In contrast, most vegetable farmers owned land (78 per cent of farmed land), the remainder being leased. This ownership is an important component of vulnerability as it represents an important criterion in terms of sensitivity and coping representing an available capital that can be accessed in case of

Table 69.19: Land ownership before and after the tsunami (ha). **Source:** Based on the field study by the authors and their collaborators.

Crop System / Land	Before tsunami			After tsunami		
	n	Mean (±S.D.)	Total	n	Mean (±S.D.)	Total
Paddy						
Owned	17	0.81 (±0.41)	13.8	17	0.81 (±0.41)	13.8
Government	42	0.75 (±0.39)	31.7	45	0.98 (±0.47)	44.1
Leased	2	0.9 (±0.42)	1.8	1	1.2 (±0.00)	1.2
Vegetable						
Owned	75	0.39 (±0.33)	31.9	75	0.39 (±0.32)	31.5
Leased	34	0.11 (±0.16)	9.0	17	0.05 (±0.12)	4.2

Table 69.20: Mean and total affected cropland (ha) and mean and total monetary losses (1,000 Rs) ñ based on farmers estimates. **Source:** Based on the field study by the authors and their collaborators.

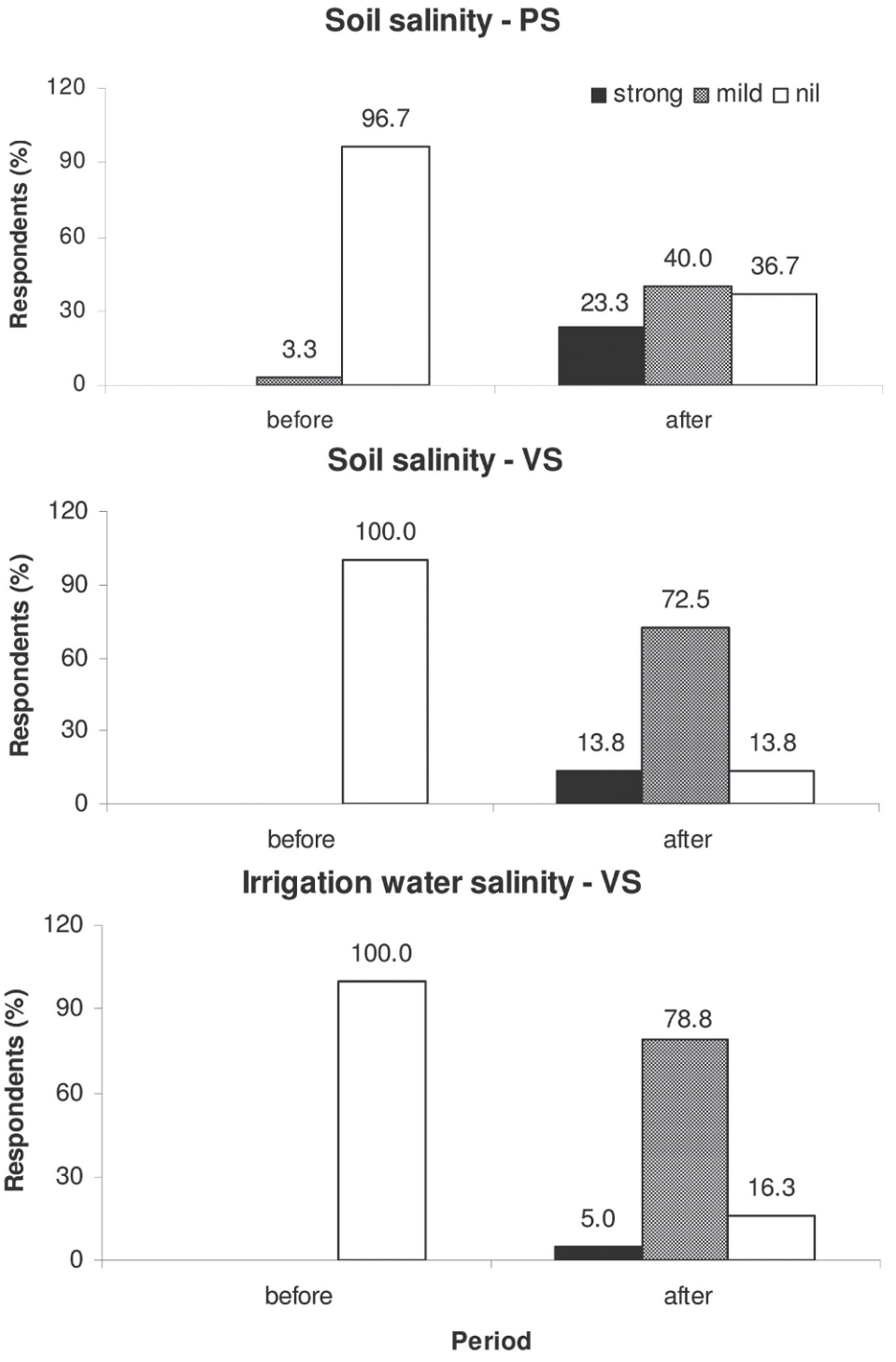
System / Crop	n	Affected cropland		Monetary loss	
		Mean (±S.D.)	Total	Mean (±S.D.)	Total
Paddy System					
Rice	60	0.78 (±0.40)	46.80	40.0 (±17.7)	2,400
Vegetable System					
Brinjal	80	0.11 (±0.09)	8.87	252 (±234)	20,120
Onions	79	0.04 (±0.07)	3.47	102 (±181)	8,054
Okra	79	0.07 (±0.09)	5.61	137 (±176)	10,800
Tomatoes	79	0.008 (±0.03)	0.65	15.7 (±73.9)	1,242
Chili	79	0.13 (±0.11)	10.17	245 (±228)	19,376
Legumes	79	0.02 (±0.05)	1.67	24.7 (±60.2)	1,955
Gourd	79	0.002 (±0.01)	0.20	7.2 (±46.5)	567
Other cops	79	0.0006 (±0.005)	0.05	2.5 (±22.5)	200
Total for system	79		**30.68**		**62,317**

need (see Ingram/Franco/Rumbaitis-del Rio/Khazai 2006). Here too, land ownership did not change, but there was a decrease in the number of farmers leasing land and in the surface area of leased land after the event (table 69.19), reflecting the fact that some farmers were not able to re-engage in farming after the event. Some leases were still running though and although not farming, some farmers still had to pay rent.

69.4.3 Impact on Crops, Land, Irrigation Water and Equipment

More than three-quarters of all the land (79 per cent) farmed by the respondents in paddy farming after the tsunami was affected by the seawater while 86 per cent of the land farmed by farmers after the event in vegetable farming was affected. The term affected implies here a loss of income whereby some crops were destroyed during the event or subsequent problems were observed such as salinization of land or freshwater. For vegetable farming, the surface area cultivated decreased by more than 50 per cent the season following the tsunami when compared to the pre-impact situation, although it needs to be noted that in a few occasions, the exact quantified extent of cultivated area was not exactly known to the farmers and the collected data were estimations. With the exception of gourd, all other crops were cultivated on less land. A similar comparison could not be made for paddy farming as no data were available concerning the extent of rice put in production at the time of the interviews. The monetary loss was much higher in

Figure 69.4: Farmersí opinion of post-tsunami soil and irrigation water salinity problems one year after the event (PS = paddy system, VS = vegetable system). **Source:** Based on the field study by the authors and their collaborators.



vegetable farming than paddy farming as vegetables require more investments than paddy rice but then are sold at much higher prices (table 69.20). This partly explains why the amount of land cultivated after the event in vegetable farming decreased by more than

half as farmers could not afford to cultivate (and thus re-invest) the entirety of their land.

The perception and/or experience of the farmers was that a year after the tsunami, some of their land still suffered from salinity problems despite the fact that a full cycle of rainy seasons had taken place (figure 69.4). For paddy farming, only 3.3 per cent of the respondents considered that some of their land was having mild salinity problems before the impact.

One year after the tsunami, 23 per cent of farmers estimated that some of their land still had severe salinity problems and 40 per cent believed their land had mild salinity problems (the degree of impact was based on their perception of the disruption of their activities). In vegetable farming, no salinity problems for soil or irrigation water were observed before the tsunami. However, mild salinity was reported by a majority of the farmers for both soils (72 per cent) and irrigation water (79 per cent) and strong salinity by 14 per cent and 5 per cent of farmers, respectively. Paddy farming is rainfed but in vegetable farming irrigation is required and 32.5 per cent of the respondents had agro-wells.

In addition, the tsunami affected the agricultural equipment of farmers as well as other means of production. Paddy farmers participating in the survey estimated that a total of USD 970 worth of equipment (particularly hand tools) was lost. In vegetable farming, the total amount was roughly USD 3,200 but in addition the farmers lost machinery (e.g. water pumps) worth USD 27,000 and farm houses worth USD 900. The much larger extent of loss in vegetable farming when compared to paddy farming is, again, due to the fact that vegetable farming requires much more inputs and equipment than in the paddy system. The per cent breakdown of losses in vegetable farming is given in table 69.21 which shows that when damages occurred, the piece of equipment or machinery was totally lost for the farmer.

Table 69.21: Estimated damage to agricultural equipment in the vegetable cropping system. **Source:** Based on the field study by the authors and their collaborators.

Degree of damage	Percentage of respondents			
	Machinery	Equipment	Tools	Farmhouse
No or little damage	5	49	34	91
Some damage	0	0	1	0
Severe damage or destruction	95	51	65	9

69.4.4 Resource Availability After the Tsunami and Assistance

Following the tsunami, many of the resources required for re-initiating farming activities were missing to variable degrees (table 69.22). In paddy farming roughly 50 per cent of the respondents claimed that there was an insufficient supply of water, fertilizers, pesticides and equipment a year after the tsunami. These are usually available in normal circumstances. The lack of seeds was emphasized by 72 per cent of respondents. Regarding water, although farmers do not use irrigation and only grow rice during the Maha season, water is insufficient during the Yala season (March to August), regardless of the impact of the tsunami. This is reflected in table 69.22. Similar observations could be made for vegetable farming except that only 53 per cent of respondents claimed that seeds were in short supply and 99 per cent had no problem with the supply of water for irrigation, taking a quantitative perspective only (more farmers complained about water quality issues). This weakness in institutional support is another factor of vulnerability particularly influencing the resilience of the coupled human-environment system.

Table 69.22: Availability of resources to re-start agricultural activities in the paddy and vegetable cropping systems (per cent of respondents). For all categories, n = 60 for paddy system and n = 80 for vegetable system. **Source:** Based on the field study by the authors and their collaborators.

Availability	Water	Seeds	Fertilizers	Pesticides	Equipment
Paddy					
Sufficient	48	28	48	48	43
Not sufficient	52	72	52	52	57
Vegetable					
Sufficient	99	47	54	59	50
Not sufficient	1	53	46	41	50

In addition, labour availability for agricultural operations decreased following the tsunami. This was high-

lighted by farmers of both paddy farming and vegetable farming and probably contributed to the fact that not all the land that could potentially be cultivated was farmed in vegetable farming.

69.5 Conclusions

The vulnerability was found to be driven by a number of factors, most of them not new. They include physical parameters such as the distance to the coast, topography of the area, density of the population exposed; socio-economic parameters such as household income, the type and diversity of livelihood; and socio-cultural parameters such as age and gender.

The case study on the district and D.S. division level confirmed that the physical/environmental factors together with the number of people exposed to the hazardous phenomenon create the precondition for disaster. More interestingly, the topographic situation of the affected divisions could explain the differences between the two study areas that were observed in numbers of fatalities versus number of affected people (69.3.1).

The comparison between the different scales (district and division) revealed that severity of a disaster is a relative – and to a certain extent also a subjective measure. Conclusions regarding disaster impact have to be drawn with care. The informative value of damage or impact statistics depends to a large extent on the scale and the context to which they are applied. Common disaster measures such as the number of fatalities or economic losses have to be considered in their local context which is defined e.g. by the size of the area, population density as well as living costs and poverty level of the region under consideration. If death tolls for example are expressed in relation to the population of larger administrative units, such as districts in Sri Lanka, the resulting ratios can severely underestimate the impact since large parts of the district are not exposed to a tsunami. In terms of poverty, the same monetary loss can mean two quite different disasters in two affected divisions, if in one division the majority of the population lives below the poverty level and in the other division the majority of the population lives well above the poverty level.

Comparisons on the district and divisional scale not only showed that scaling effects (e.g. from a divisional to the district level) encumber vulnerability analyses, they also underline that the conclusions to be drawn from correlating data need to be differentiated – correlation often cannot be taken at face value. For example the level of poverty measured in household income correlated quite well with the level of tsunami damage in a way that decreasing monthly family income correlated with an increasing incurred damage level (housing damage). However, that correlation is driven by the fact that the low-income households are often fishing households and hence, they are situated closer to the coast and more exposed to the tsunami hazard.

Age and gender were important factors to explain observed fatalities with the very young children, the elderly as well as women representing the most affected groups. Besides the obvious physical reasons that explain the higher risk of those three groups with their lower physical strength, there are also socio-cultural implications that are not yet fully understood, such as behavioural patterns of women, who, in their role of the care taker, might perish in their attempt to help and protect the children and the elderly. Other assumptions place women at the shore at the time of the tsunami because they were awaiting the fishermen to process the catch. Those explanations still remain more anecdotal than scientific and call for further investigation.

The case study on the household level showed on the basis of the damage and recovery situation that in one and the same district communities with an agricultural livelihood approach engaged in the path of recovery in different ways and had to face different challenges to resume their activities. Notwithstanding the differential of physical impacts of the tsunami (such as wave height, run-up distance which was not evaluated), differences in the agricultural systems (paddy vs. vegetable) also implied differences in socio-economic systems (education, production means, wealth) which determined in part the different recovery paths of the communities. This is similar to the conclusions reached from the analysis of data at the district level and presented above but highlights the fact that even within one social grouping or profession ('farmer') great differences in recovery potential existed and thus targeted and adapted help is required.

The household study also illustrates the vulnerability concept of Turner, Kasperson, Matson, McCarthy, Corell, Christensen, Eckley, Kasperson, Luers, Martello, Polsky, Pulsipher and Schiller (2003) who postulate that there are usually multiple interacting stressors. The tsunami waves were only the primary stressor, but other stressors linked to the tsunami include the pollution and salinity of the drinking water and the irrigation water. Feedback loops created through response measures often lead to further

stresses. Those feedback loops were observed in the farming community: since most surface water reservoirs were contaminated more irrigation water was pumped from the freshwater aquifers which could lead to an increasing salinization of the aquifers (through, for example, salinity intrusion) jeopardizing the long-term farming perspective in that area. Another feedback loop resulting in a new stressor was identified in the household study in relation to relief operations that employed the local affected population in the clean-up process. Without doubting the good intentions and the immediate benefits of these measures, they negatively influenced the agricultural sector. Since the wages offered by relief organizations were significantly higher than the wages offered in the agricultural sector, the farmers were faced with a lack of labour to work the fields. Another example can be found in the relocation measures taken in Sri Lanka during the early recovery phase. The social problems arising from that relocation are described in other places (Ingram/Franco/Rumbaitis-del Rio/Khazai 2006; Birkmann/Fernando 2008; Grote/Engel/Schraven 2006).

What are the implications for policy-makers? The two empirical case studies revealed a number of complex causal relationships between different components and factors of vulnerability that offer a large field of response opportunities. Just to name a few, it became evident that policies for the reduction of vulnerability have to be very diverse and specific at the same time to make them effective and sustainable. Long-term land use planning needs to take the physical characteristics and exposure towards all relevant hazards into account. Not only poverty but also the lack of livelihood diversity makes people vulnerable. This is where vulnerability reduction and development agendas need to be linked – from the local to the subnational level. More protection and response measures need to target women, children and the elderly more explicitly. The recovery process can be sped up if the different and very specific needs of relatively small groups can be met, such as the different needs of vegetable and paddy farmers. A more detailed oriented relief plan will reduce the loss of relief money and help more people to recover faster. A win-win situation.

70 Risks in Central America: Bringing Them Under Control

Juan Carlos Villagrán de León

70.1 Introduction

For centuries Central American communities have been experiencing disasters which provoke fatalities, injuries, and losses of various kinds. During the conquest in the early 1500's the Spanish conquerors experienced their first disaster when a hurricane on 11 September 1541 triggered a massive landslide that buried the town of Santiago de los Caballeros which was the seat of the Spanish government at the time in Central America. As a consequence, the town was relocated from the skirts of the Agua volcano (Guatemala) to the central part of the Panchoy valley, almost 10 kilometres away. Unfortunately, two centuries later, the new city of Santiago de los Caballeros was destroyed by a series of massive earthquakes in 1773 which provoked many fatalities, injuries, as well as losses of many kinds. As in the previous case, the Government decided to relocate the city to another valley farther away from the active Fuego volcano, and supposedly, farther away from earthquakes. Unfortunately, the destruction of villages, towns, and cities in Central America has been a rather frequent occurrence due to the location of Central America in a highly seismic zone which gives rise to active volcanoes. The situation is worsened when considering the fact that the region lies on the path of hurricanes which provoke floods and massive landslides.

But while in colonial times such disasters were associated with punishments by God, and images of the Virgin and of Christ were brought out to the plazas and local governments prompted people to pray for forgiveness; in the last century such events began to be recognized as rising as a consequence of the dynamical nature of the planet in terms of its geology and its atmospheric activity.[1] The newest view which has risen in the 1990's points to the notion that disasters are not just such natural phenomena, but the combination of socially constructed vulnerabilities in geographical areas exposed to such phenomena.[2] This new risk paradigm is being introduced at the national and local levels within Central America by authorities and by NGOs to promote an awareness with respect to the fact that disasters are a consequence of the traditional frameworks of development, which have not been adapted adequately to the different types of phenomena which manifest themselves in this region of the world.

This chapter outlines factors which have been contributing to the generation of risks and subsequent disasters in the region during the past centuries, and the efforts carried out within this region to promote a more sustainable development, where the term 'sustainable' is linked to a framework of development which is capable of resisting the impacts of such natural events, and therefore the cycle of destruction-reconstruction-destruction is eluded. The analysis is conducted within the framework of disaster-risk reduction proposed by the *International Strategy for Disaster Reduction* (UN/ISDR 2001), where the assessment of risks and impacts related to disasters leads to the identification and implementation of measures along the lines of awareness raising, political commitment, the application of risk reduction measures, and efforts along the lines of early warning and

1 Accounts of such religious responses to catastrophes during colonial times can be found in: Domingo Juarros (1936). An indicator of the change in this paradigm regarding the origin of such disasters could be the establishment of national institutes or observatories by governments of Central America to conduct research and to monitor natural phenomena such as earthquakes, volcanic activity, and meteorology. Another indicator could be the explicit reference to the disasters as provoked by such natural phenomena by national authorities during interviews with the press when documenting such events. The explicit introduction of the term 'reduction of vulnerability' by the governments of Central America can be found in the 'Declaration of Antigua' (Guatemala) on the occasion of the XX Summit of Presidents of Central America, held in October 1999, in which the *Strategic Framework for the Reduction of Vulnerability and Disasters in Central America* was presented as the outcome of this summit.

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preparedness. Figure 70.1 offers a schematic diagram for this framework.

Figure 70.1: Framework for disaster-risk reduction adapted from ISDR's framework. **Source:** author.

The selection of this framework is based on the fact that it highlights explicitly two relevant facts:

- The crucial role in terms of political commitment required for risk management measures to be implemented.
- The fact that risks can be conceived as composed of hazards, vulnerabilities, and deficiencies in preparedness (chapter yx by Villagrán de León).

This chapter describes a variety of factors which have led to the generation of risks and subsequent disasters within Central America (70.2); it assesses in more detail those which contribute to the generation or enhancement of vulnerability (70.3) and documents recent measures which have been introduced in the region to reduce the impacts related to such events (70.4).

70.2 Risks and Disasters in Central America

Due to its geographical location, Central America is exposed to multiple natural hazards. Much of the landscape of the region is shaped by the interaction of three tectonic plates: the Caribbean plate on which most Central American countries are located; the North American plate in which the northern segment of Guatemala resides, and the Cocos plate, which interacts with the Caribbean plate through a subduction process, giving rise to the chain of active and inactive volcanoes that spans the entire region. In addition, chains of mountains such as the ones in Guatemala and Honduras are also shaped by the interaction of the North American and the Caribbean plate. As a result of this tectonic interaction, the region is characterized by steep slopes on mountains and volcanoes, some valleys in central areas, and coastal plains leading to the Pacific Ocean in the south and to the Caribbean Sea in the north and the east.

The geographical location of the region in terms of latitude and the fact that it is bounded by the Caribbean Sea and the Pacific Ocean predisposes this region to be affected by hurricanes. Hurricanes and tropical storms have continually provoked floods in some valleys and flood plains. In addition, the high seismic activity within the region has altered the geological formations, leading to unstable conditions in terms of landslides. As such, earthquakes, storms, and hurricanes can sometimes trigger massive landslides. In contrast to floods, droughts can also manifest themselves in various regions of Central America. In fact, in some regions of Central America, the El Niño impact manifests itself as drought, particularly in the northern areas.

2 Since the early 1990's, members from the *Network of Social Studies on Disaster Prevention in Latin America* (La Red) have published books and articles in the journal '*Desastres y Sociedad*' on the subject of disasters and their prevention in Latin America, among them: *Los Desastres no son Naturales*, compiled by Andrew Maskrey (1993). The Inter-American Development Bank commissioned the design of an index to measure risks at the national level in Latin American countries which has been coordinated by O.D. Cardona, National University of Colombia in Manizales. A collection of theoretical documents and the methodology to assess risks can be found at the University of Manizales; at: <http://www.manizales.unal.edu.co/idea/modules.php?op=modload&name=Web_Links&file=index&req=viewlink&cid=1>; at the Inter-American Development Bank; at: <http://www.iadb.org/SDS/ENV/news_2533_s.htm>; The World Bank also published a variety of books and reports on the subject of disasters and their reduction in Latin America; at: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTDISMGMT/0,,contentMDK:21415621~menuPK:341035~pagePK:210058~piPK:210062~theSitePK:341015,00.html>. Material on risk management and disaster reduction has been also published and distributed by UN-ISDR, UNDP-BCPR, ECLAC, the German Technical Cooperation Agency (GTZ), the Swiss Cooperation Agency for Development; CARE, and OXFAM.

Table 70.1: Impacts associated with recent disasters in Central America. **Source:** EM-DAT: The OFDA/CRED International Disaster Database (Brussels: UniversitÈ Catholique de Louvain, Data version v03.07); at: <www.em-dat.net> (26 January 2008).

Year	Event	Country	Deaths	Affected	Total Damages (millions of US$)
1972	Earthquake	Nicaragua	10,000	720,000	845
1974	Hurricane	Honduras	8,000	600,000	540
1976	Earthquake	Guatemala	23,000	4,993,000	1,000
1986	Earthquake	El Salvador	1,100	770,000	1,030
1998	Hurricane 'Mitch'	Central America	18,791	3,186,628	6,008.5
2001	Earthquake	El Salvador*	1,159	1,590,550	1,848.5
2005	Hurricane	Guatemala	1,513	475,314	988.3
	Total		**63,563**	**12,335,492**	**12,260.3**

Data corresponding to the two earthquakes which took place on Jan. 13 and Feb. 13, 2001.

From a disaster perspective, the establishment of many cities during the conquest and colonial periods may be considered as a process leading to such disasters. With no prior knowledge regarding the region in terms of earthquakes, hurricanes, and volcanic eruptions; many towns were established in hazard-prone areas, only to be relocated after experiencing grave consequences. Until present, many cities in Central America have experienced centuries of calamities provoked by such events, and continue to be exposed to future events.

Hurricane Mitch which impacted the region in late October of 1998 can be considered as the worst regional disaster in Central America during the last decades; it caused nearly 19,000 deaths in four of the five countries of the region. Honduras and Nicaragua experienced major economic losses in agriculture for export and local consumption, as well as destruction of vital road infrastructure, lifelines, and public and private infrastructure. Box 70.1 contains a brief description of the impacts provoked by this hurricane in the five countries of the region.

Other factors leading to disasters in Central America can be associated with the adoption of building techniques imported from Spain during colonial times, which again were not adapted to the types of natural events taking place in Central America. Private, public, and religious buildings all succumbed to earthquakes in the centuries following the conquest due to the combination of building techniques and construction materials not adapted to this hazard. In fact, the use of adobe as a material for the construction of walls in combination with extremely heavy clay-tile roofs in Latin America is a tradition within urban and rural settings which continues to cause fatalities during earthquakes when these houses collapse, burying their dwellers instantly.

Since the 1950's, Central America has seen an emergence in risks and disasters which stem from the combination of high population growth in the region (compared with developed countries), the lack of land-use policies that minimize exposure to these hazards, and migration processes to cities due to both pull effects of cities due to their economic boom, as well as push factors from rural areas which are no longer able to provide the quality of life and other conditions which are demanded from the local population. In addition, the region has experienced extensive migrations due to the political conflicts stemming from the Cold War, a process that started in the 1950's in the region. In this context, migration to cities was a solution to the human insecurity problems faced by people living in rural areas, where the battle between armies and guerrillas took place (Rojas 2008, 2009. Table 70.1 offers data on the most catastrophic disasters in Central America from 1972 to 2008 triggered by natural phenomena.

Earthquakes and hurricanes have occurred once or twice every decade, provoking more than 60,000 fatalities and affecting nearly twelve million people. The impacts of volcanic eruptions, landslides, and drought were less severe. Financial losses during the last four decades top nearly twelve billion US dollars for these events alone. In addition to affecting people in urban and rural areas, these events have a direct impact on the foundations of development in these

countries, as impacts also include the destruction of public infrastructure, in particular highways necessary to fuel local, national, and regional economies; hospitals and health facilities; schools, markets, and productive facilities (industries). Another impact on the development planning process once a disaster has taken place is the necessary deviation in terms of national and municipal budgets which would have been allocated for development programmes to target reconstruction efforts, which can last up to a decade.

As stated above, one factor which has been enhancing risks is population growth in combination with migrations to urban areas, a process which may lead to the exposure of people to a variety of hazards. The rates of population growth for Central American countries between 1950 and the 1990's range between 3.2 per cent and 4.1 per cent in urban areas, and between 1.8 per cent and 2.7 per cent in rural areas (table 70.2; ECLAC 2001).

Table 70.2: Average population growth rate for Central American countries for urban and rural areas (1950-1990). **Source:** CEPAL: Boletín Demográfico (2001: 75-109).

Country	Urban growth rate (per cent)	Rural growth rate (per cent)
Guatemala	3.3	2.2
Honduras	3.6	2.7
El Salvador	3.2	1.8
Nicaragua	4.1	2.4
Costa Rica	4.1	2.7

Box 70.1: Hurricane Mitch and its Impacts in Central America. **Source:** The author.

Rising as tropical depression number 13 in the year 1998, Mitch was declared a hurricane on 24 October 1998, and subsequently a category 5 hurricane in the Saffir-Simpson scale on 26 October. As a late event in relation to the typical hurricane season, it hit Central America between 17 October and 2 November 1998. The hurricane followed a path initially impacting the Caribbean coasts of Honduras and Nicaragua, and later impacting the central areas and Pacific coasts of Nicaragua, El Salvador, Honduras, and Guatemala. The human and economic losses were heaviest in Nicaragua and Honduras where both the floods and rainfall-triggered landslides contributed to heavy death tolls and destruction of infrastructure.

Table 70.3: Impacts provoked by Hurricane Mitch in 1998. **Source**: EM-DAT: The OFDA/CRED International Disaster Database (Brussels: Université Catholique de Louvain, Data version v03.07); at: <www.em-dat.net> (26 January 2008).

	Guatemala	El Salvador	Honduras	Nicaragua	Costa Rica	Total
Deaths	384	475	14,600	3,332		18,791
Affected	105,700	84,000	2,112,000	868,228	16,700	3,186,628
Economic losses (millions of US$	748,0	388,1	3,793.6	987.7	91.1	6,008.5

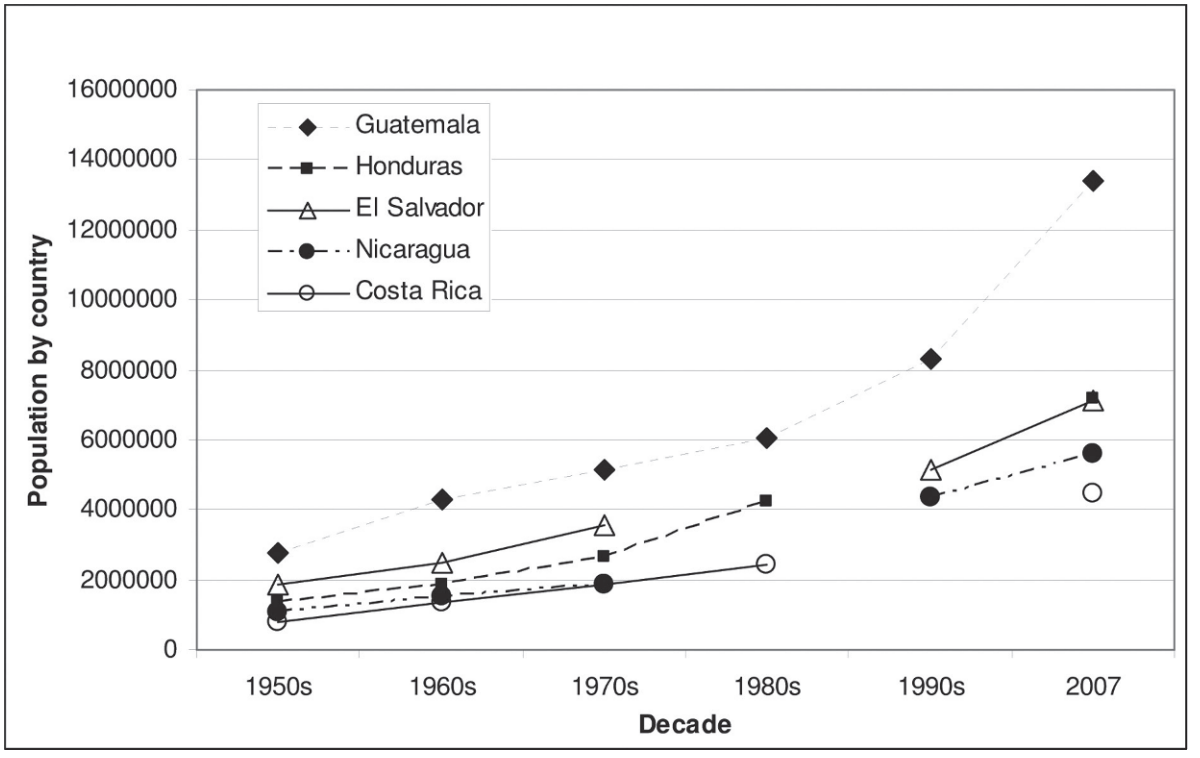
The *Economic Committee for Latin American and the Caribbean* (ECLAC, CEPAL), carried out an assessment of the economic impacts of the hurricane in all countries of the region and estimated direct damages totalling 2,918 million US dollars, and indirect damages totalling 3,100.3 million US dollars. The hurricane provoked extensive destruction and damage in most sectors such as housing, health, education, energy, agriculture, transportation, telecommunications, and lifelines. Additional assessments of the impacts of this event were carried out by the *Inter-American Development Bank* (IADB), by the *Pan-American Organization of Health* (PAHO), and by the *Office of United States Foreign Disaster Assistance* (OFDA). However, data contained in the various institutional reports display some differences which can be related to the original sources consulted for such a purpose.

As a result of the catastrophic impacts, international agencies for development from developed nations and international agencies such as the United Nations and the European Union launched humanitarian assistance programmes, and later established additional programmes to strengthen disaster preparedness and to promote efforts along the lines of disaster reduction in all countries of the region.

Table 70.4: Past and projected population growth for the five Central American countries (1950-2050): **Source**: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*; at: <http://esa.un.org/unpp>; (14 November 2007). Compiled by Hans Günter Brauch.

	1950	1980	2005	2025	2050	Change 1950-2005	Change 2005-2050	Change 1950-2050
Belize	69	144	276	389	487	+207	+211	+418
Costa Rica	966	2 347	4 327	5 549	6 426	+3 361	+2 099	+5 460
El Salvador	1 951	4 586	6 668	8 525	10 040	+4 717	+ 3 372	+ 8 089
Guatemala	3 146	7 013	12 710	19 926	27 473	+9 564	+14 763	+24 327
Honduras	1 487	3 633	6 834	9 682	12 079	+5 347	+5 245	+10 592
Nicaragua	1 295	3 257	5 463	7 075	8 169	+4 168	+2 706	+6 874
Total	**8 914**	**20 980**	**36 278**	**51 146**	**64 674**	**27 364**	**28 396**	**55 760**
Central America (including Belize, Mexico, Panama)	37 515	92 255	143 775	180 108	202 045	106 260	58 270	164 530

Figure 70.2: Growth of population for the five Central American countries between 1950 and 2007. **Sources:** ECLAC (2001); Central American Population Center (2007).



Guatemala and El Salvador have the lowest growth rates in urban areas, whereas El Salvador has the lowest in rural areas. Nevertheless, the growth rates in urban areas exceed those in rural areas in all countries. In absolute figures by the UN Population Division, the population of the five above Central American countries plus Belize and of the whole Central American region (including Mexico and Panama) has grown significantly between 1950 and 2005, and it has been projected to continue to grow in Belize, and Guatemala even more (according to the medium variant) intensively, while the projected population growth for the next 45 years will be below the real

population growth for the past 55 years in Costa Rica, El Salvador, Honduras, and Nicaragua (Table 70.3).

Figure 70.2 documents the population growth for each country since the 1950's. In 2007 Guatemala had the largest population, followed by Honduras and El Salvador, then Nicaragua and finally Costa Rica. Population growth has been highest during the last decade.

Within the context of risks, the previous paragraphs not only depict the existence of hazards, vulnerabilities, and deficiencies in preparedness in Central America, but also processes which are leading to the establishment or enhancement of such risks, in particular vulnerabilities.

70.3 Vulnerability: The Social Cause of Disasters

Vulnerability has been defined by the International Strategy for Disaster Reduction of the United Nations (UN/ISDR 2004: Annex 1: 7) as "the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards." Unfortunately, as pointed out by several researchers (Alwang/Siegel/Jorgensen 2001; Brooks 2003; Brauch 2005; Thywissen 2005; Villagrán de León 2006a), there are many connotations given to this term by researchers from different disciplines, and as Cardona states (Cardona 2001) there is no single definition which may unify or collect in a consistent and coherent fashion all those found in the literature. Comprehensive reviews of the term in the context of risk management have been carried out by Villagrán de León (2006a) and in the wider framework of security threats by Brauch (2005).

In the context of drought, Chambers (1989: 2) introduced the notion of vulnerability as "the exposure to contingencies and stresses and the difficulty which some communities experience while coping with such contingencies and stresses." Thus, Chambers defines the internal side of vulnerability to focus on conditions of defencelessness and *incapacity to cope* with damaging losses; and the external side of vulnerability as related to *exposure* to external shocks and stresses.

In 2004, Birkmann and Bogardi introduced the BBC conceptual framework (Birkmann 2006) which integrates these notions of exposure, coping capacity, and vulnerability with the social, economic, and environmental spheres of sustainable development. The risk framework is complemented with an intervention system which proposes measures in the context of risk reduction along these three spheres, as well as in relation to hazards. The incorporation of the spheres of development links the vulnerability framework with social, economic, and environmental aspects, blending itself to handle such aspects as climate change, as well as social and economic factors related to exposure and coping capacity. But the link to the sustainable development framework in terms of these three spheres neglects explicitly to the physical dimension of vulnerability. Disasters around the world have demonstrated that this dimension of vulnerability can lead to fatalities, injuries, and massive economic losses for earthquakes, landslides, and tsunamis, where the collapse of infrastructure has led to massive fatalities and injuries.

Within the academic community devoted to research regarding natural disasters in Latin America, Cardona and other members of LA RED (Cardona/Hurtado/Duque/Moreno/Chardon/Velásquez/Prieto 2003: 13; Cardona 2004: 43) have proposed a definition of vulnerability as "the predisposition of an element, a system, or a community to be affected or susceptible to damage." In the context of risk, vulnerability is defined as the internal risk factor in contrast to hazard which is defined and the external risk factor. Cardona has proposed that vulnerability originates as a consequence of three factors:

- *Physical fragility or exposure*, linked to the susceptibility of human settlements to be affected by natural or social phenomena due to its location in a hazard-prone area.
- *Socio-economic fragility*, linked with the predisposition to suffer harm due to marginalization, social segregation in human settlements, and due to poverty and similar factors.
- *Lack of resilience,* related to the limitations of access and mobilization of resources, and incapacity to respond when it comes to absorbing the impact of a disaster. It can be linked with underdevelopment and the lack of risk management strategies.

One important aspect with regard to vulnerability is its dynamic nature. There are several factors which can augment, maintain, and reduce them at any time (Villagrán de León 2004: 25). Figure 70.3 outlines several of these factors which can modify vulnerability, including poverty, weak governance, as well as factors which can be attributed to the people themselves. Among them, population growth, migration to urban

Figure 70.3: Factors which generate or enhance vulnerability. **Source:** The author.

areas, unwillingness to change, and the lack of a culture regarding vulnerability management.

Two issues that characterize most Central American countries, except Costa Rica, are the large percentage of their population which can be classified as poor and the disproportionate differences between the wealthy and the poor (table 70.4 based on UNDP 2006). In the framework proposed by Cardona, poverty leads to economic fragility, while in the BBC framework poverty would be linked to the incapacity to cope in case of an event. In the proposed framework, the economic limitations which are connected with poverty inhibit poor people from securing low vulnerable housing for example.

Linked to poverty is the limited access to assets which may inhibit poor people to emerge from poverty and to reduce their vulnerabilities, and may restrain their capacity to cope with extreme events. Within Latin America, Attanasio and Székely (2001) have pointed out that policies and poverty alleviation programmes in Latin America have not targeted the elimination of the restrictions that prevent the poor from accessing and accumulating assets.

Migration from rural to urban areas generates additional vulnerabilities as the new settlers in most cases migrate with little or no economic resources to build proper houses, and they live in weak structures, based on their initial perception that they will remain only temporarily in high hazard areas. As mentioned in the previous section, several countries underwent massive migration processes related to armed conflicts fuelled by the Cold War between the United States and the former Soviet Union. Nevertheless, while the conflicts ended since a decade ago or more, the migration process continues to take place, fuelled by the lack of opportunities and high degree of poverty which exist in rural areas, and the attraction which the capital city may offer for such people from rural areas to satisfy their needs and opportunities to improve their way of life.

With respect to weak governance, one of the main problems which some countries experience, with the exception of Costa Rica, is the continuous change of staff in government institutions and the tradition of launching new government programmes by newly elected government officials. In addition, short-term goals are preferred to complete tasks within one electoral period, rather than long-term goals such as disaster prevention which would require decades to be completed.

In the context of building codes it is important to stress that most codes do not necessarily include relevant aspects for all hazards, and their enforcement by authorities remains a problem. The problem is enhanced when people with limited economic resources build their own houses or hire unqualified workers to construct houses which are vulnerable because guidelines contained within such building codes are sidestepped.

Regarding the lack of awareness and experience managing vulnerabilities to natural hazards and the practically inexistent disaster prevention culture, the variety of day-to-day social and economic problems which people have to face, and the vast needs which governments have to satisfy in terms of human security, health, education, and social welfare inhibit both the people and governments to shift from a reactive approach to a more proactive or preventive one. Since the 1960's governments opted for a disaster response approach by setting up national emergency committees to manage such disasters once they have occurred.

As a final remark, the issue of unwillingness to change must be addressed. This refers in some cases to the use of adobe as a material for walls, which has been a tradition imported by the Spanish conquerors centuries ago and which is difficult to change in many parts of Central America, particularly in areas where earthquakes are not frequent.

70.4 Recent Advances in Central America in Disaster-Risk Management

Three emergent processes which may allow Central American communities and governments to deal with risks and disasters are:

1. The adoption of a framework of risk management which emerged from the International Decade for Natural Disaster Reduction which took place between 1990 and 1999.
2. The support of the international donor community to conduct various projects and programmes to strengthen capacities at the regional, national, and local levels promoting the disaster-risk management framework.
3. New sources of income for rural areas from remittances of legal and illegal migrants in the United States.

In response to Hurricane Mitch (1998), most Central American countries modified their legislation incorporating risk management, except in Guatemala that had adopted its new legislation already in 1996. Prior to Hurricane Mitch all Central American national emergency committees had the mandate to respond in case of disasters, but not to prevent such disasters or to prepare for them. After Hurricane Mitch the governments modified their legislation permitting these committees to coordinate and execute a variety of tasks before, during, and after such events at all levels (national, regional, municipal, and local), and they have been strengthened with additional budgets and resources.

The Presidents of Central America incorporated the goal to reduce the vulnerability in their 20th Presidential Summit in Antigua City (Guatemala) in October 1999. According to the Presidential Summit Declaration, the reduction of vulnerability should embrace all sectors of development. Based on this mandate, the *Central American Coordination Center for Natural Disaster Prevention* (CEPREDENAC) established the Quinquennium for the Reduction of Vulnerability 2000–2004, which concluded with a symposium in December 2003 to review progress and to discuss future needs and approaches for the management of vulnerabilities. In the context of the Disaster-Risk Management framework presented in figure 70.1, such actions manifest the commitment of governments at the highest level in relation to disaster reduction through risk management.

The request for humanitarian assistance by Central American governments during Hurricane Mitch and the subsequent adoption of this risk management framework in new laws prompted the international donor community not only to provide typical humanitarian assistance, but also to establish long-term programmes of support through special lines of funding to facilitate risk management efforts during the reconstruction period. Since 1999, the *European Community Humanitarian Office* (ECHO) supported such efforts with its *disaster preparedness programme* DIPECHO facilitating European NGOs and international organizations to reach local communities throughout Central America with a variety of projects focusing on local- or community-based risk management and disaster preparedness. USAID established similar programmes, as well as other NGOs such as CARE, OXFAM, Action Against Hunger, and the German Agro-Action to name a few. In addition, several governments have also provided technical assistance to national agencies in Central America to facilitate

the incorporation of risk management into government practices. The *German Technical Agency* (GTZ) has been executing projects along these lines in all countries of the region since 1997 as part of their efforts to strengthen municipal governments. Several United Nations agencies have also contributed to these efforts, in particular the *International Strategy for Disaster Reduction* (UN/ISDR), and the *Bureau of Crisis Prevention and Recovery of the United Nations Development Programme* (BCPR-UNDP), as well as the *International Federation of the Red Cross* (IFRC). In the context of factors which enhance vulnerability, these efforts by the international community are helping to establish a culture regarding disaster prevention and are aiding communities to become aware of experiences and ways regarding vulnerability management and preparedness.

Among the measures which have received much attention both by national and local government agencies, as well as by international NGOs and development agencies, are the topics of disaster preparedness and early warning. Since 1998, all countries in the region have improved their capacities to:

- *Operate early warning systems for hazards* such as floods, drought, volcanic eruptions, tsunamis, and famine. Efforts target both systems operated by national scientific and technical agencies, as well as by communities under the coordination of disaster-management agencies.
- *Manage information and coordinate inter-institutional response* efforts through the set-up of Emergency Operation Centres at the national level, as well as locally.
- *Coordinate humanitarian assistance and international relief* efforts through the establishment of protocols for this purpose.

The third element related to disaster-risk-management refers to additional sources of income from remittances sent by millions of people who have migrated to the United States which target vulnerable rural areas throughout Central America. In recent years the remittances have become substantial compared with other sources of funding which drive local economies. The World Bank (2007) estimated that remittances for Central American countries are reaching a level somewhere between 12 and 20 per cent of the gross domestic product (GDP). These funds are transferred directly to the people in rural and urban areas, and are used to reduce poverty, and to some degree also vulnerability (IADB/FOMIN/Pew Hispanic Center 2003), as part of the remittances are used for health, education, and housing needs. In many rural areas of Central American countries such additional funding alleviates poverty, allows local citizens to reduce the structural or physical vulnerability of their houses, and enhances their capacities to cope with disasters.

Other factors contributing to the reduction of vulnerability in the housing sector were triggered by the impact of earthquakes. As a result of the post-earthquake assessment of seismic hazards in 1973, Managua City, the capital of Nicaragua, shifted from a tradition of high buildings to one or two storey houses. It also adopted land-use norms that prohibited the reconstruction of entire sectors in the city centre.

The 1976 earthquake in Guatemala destroyed many towns where the use of adobe as material for walls and clay-tile roofs was common. The correlation between these construction materials and the pattern of destruction provoked by the earthquake changed the mentality of surviving Guatemalans who now use cement blocks and reinforced concrete structures with a very light roof made of metallic sheeting. This modern, seismic-resistant technique was adopted in most areas that were severely affected by the earthquake, where considerable reconstruction was necessary. However, in areas far away from the epicentre, traditional adobe-built houses still exist.

A review of the progress achieved in vulnerability and risk reduction are contained in the report based on the evaluation of the Quinquennium for the Reduction of Vulnerability 2000–2004 that is documented in table 70.5 (Novelo/Smith 2005). While such efforts contribute to a reduction of vulnerabilities, it remains a challenge to ensure that these processes are carried out in an integrated fashion, and that disaster prevention is recognized and accepted as a long-term goal which should be respected by electoral processes. The aim of governments, the private sector, and the people should be to achieve the goal of risk management by combining efforts instead of advancing in isolation sector by sector.

70.5 Conclusions

Central America, due to its geographical location in the central segment of the American continent, as well as its setting on top of three interacting tectonic plates, is a multi-hazard region that is constantly impacted by hurricanes, earthquakes, volcanic eruptions, floods, landslides, and other natural phenomena. While native ethnic tribes might have adapted to such phenomena, the Spanish Conquest led to the estab-

Table 70.5: Main results of the evaluation of the Quinquennium for the Reduction of Vulnerability (2000-2004). **Source:** Novelo/Smith (2004: 3-6).

Topic	Main achievements and progress	Comments, suggestions, identified needs
Institutional strengthening	Strengthening of capacities of institutions in charge of risk management and disaster response within the region.	It is important to insert such institutional strengthening in the national development plans of every country.
Information and research	More systematic monitoring of hazards. New academic programmes at the level of universities on risk management have emerged. In some countries, advances can be seen in improvement of building codes. Research has been geared towards the assessment of potential impacts related to hazards.	Advances on the use of Geographical Information Systems (GIS) to manage information regarding risks (hazards, vulnerabilities, risks). There is a need to socialize the newly generated scientific information regarding risks as a support for the planning process, budgeting, and decision-making process at national, regional, and local levels.
Early Warning	Strengthening of early warning systems, particularly in the case of hydro-meteorological hazards. Enhanced technical capacities at the regional level to design and implement early warning systems.	A need has been identified for promoting people-centred early warning. It is important to consider issues related to the sustainability of such early warning systems.
Strengthening of local capacities on risk management.	Advances in some countries through projects and actions carried out at the local level. Enhanced awareness concerning risks and risk management at the level of communities and decision-makers. Strengthening of capacities of grass-root organizations.	The need has been identified to incorporate risk management measures in local development plans, as well as in the national agendas of development.

lishment or risks, which continue to be the root causes of disasters faced by most of these five countries. Settlements with vulnerable conditions in high hazard areas impacted by floods, mudslides, and volcanic eruptions, have been destroyed and rebuilt over centuries, and in some cases, relocated due to extreme patterns of destruction.

Within the proposed framework some addressed factors generate or enhance vulnerability. The region is also faced with processes which have led to vulnerabilities, and processes which have reduced it, such as poverty, migration from rural to urban areas, and armed conflicts.

However, by the 1960's, governments in Central America established national emergency committees to respond to disasters of multiple kinds. Such committees played crucial roles during such disasters as the Nicaraguan, Guatemalan, and El Salvador earthquakes in 1972, 1976, and 1986 respectively. In a similar fashion, the committees were engaged in response efforts during hurricanes such as Fifi in 1972 and Mitch in 1998. During the 1990's, the United Nations launched the International Decade for Natural Disaster Reduction which promoted the framework of risk management as a means for countries to minimize the impacts of disasters. Having been severely impacted by Hurricane Mitch, Central American governments modified their approach to disaster management by changing the operational framework of the emergency committees into risk management agencies. By 2006, all Central American countries introduced legislations to complete this transition from disaster-response to risk management. Such a transition is fuelling efforts to change the paradigm related to disasters, introducing the notion of vulnerability as one of the two causes which explain why such countries continually experience disasters.

In recent years, two additional complementary processes have contributed to the management of such vulnerabilities. On the one hand, the efforts by donor agencies and developed nations which have established tailor-made programmes to promote the adoption of this new paradigm of risk management at the national, regional, and local levels in all countries of the region, and the emergence of new sources of funding at the local level for families to cope with such vulnerabilities and disasters through monetary remittances from the United States.

While the region continues to face serious problems associated with poverty, unequal access to

resources, weak governance, and social problems such as uncontrolled migration from rural to urban areas, delinquency and organized crime; initial results can be seen on a variety of fronts regarding the adoption of this new paradigm of risk management within the region. Such results include the strengthening of institutional capacities, the establishment of academic programmes focusing on the subject, enhanced awareness at national and local levels, and the establishment of legislation to target vulnerability by recognizing it as the leading cause of disasters at the highest political levels.

Efforts in all Central American countries regarding risk management are now carried out by governments at national and local levels, by civil society, and by the private sector. However, it will take years before such efforts reach all corners of the region, as the needs in other areas of development continue to press governments and the people of this region. Nevertheless, the new paradigm regarding vulnerability as a root cause of disasters is allowing people and decision-makers to understand the root causes of disasters differently. Factors which are linked to its generation or enhancement have been identified, and now the need remains in ways to assess it, as well as on the allocation of national and local resources to reduce it. It is interesting to note the fact that complementary resources are being allocated by the international community, national governments, as well as by the people themselves to reduce such vulnerability.

Whether such efforts will have the desired impact in reducing typical disasters, the true test will come in future decades due to climate change, which is projected to lead to more frequent and more intensive hydro-meteorological events (IPCC 2007a: 583–607; chap. 32 by Lacambra/Zahedi; chap. 85 by Zapata-Marti).

Considering both the positive changes within the region in terms of policies, institutional strengthening, awareness efforts, and disaster preparedness; as well as trends related to environmental degradation, population growth, and migration to urban areas which may increase vulnerabilities and hence risks, it is important to conduct inter-disciplinary studies which may focus on the multi-faceted nature of disasters and disaster-risk management.

While this chapter has presented a review of factors which may increase and constrain risks, it is important to conduct assessments of risk at the national, provincial, municipal, and local levels, and to identify trends with respect to changes which can be linked to different hazards. While there are some efforts to assess vulnerability and risk, there is yet no consensus on which methodology to use for such purposes. There is a lacking consensus on methodologies, as well as on definitions of key terms like risk, vulnerability, and risk management. This issue must be addressed in each country, but the challenge remains also at the global level.

Box 70.2: Projected Climate Change Impacts for Central America and of the probability of hydro-meteorological hazards until 2100. **Source**: IPCC 1998, 2007: 892-896, 2007a: 583-607.

According to the assessment presented in section 11.6 of chapter 11 of the IPCC Fourth Assessment Report: Working Group I Report "The Physical Science Basis" (2007: 892–896), Central America is expected to experience a warming trend in the next century which could be in the order of one to three degrees Celsius by the year 2050 and between 1 and 5 degrees by the year 2080, depending on the review of models used to forecast the temperature change.

With regard to precipitation, the models forecast decreases in mean precipitation during all seasons, which could lead to water stress and hence food insecurity, given that the majority of the population relies on subsistence farming for their livelihoods. By the year 2050, precipitation may change between -12% and +5% during the dry season and between -15% and +5% during the wet season. Forecasts for the year 2080 imply changes ranging from -20% to +8% in the dry season and between -30% and +5% during the wet season.

However, as stated in the report, such models do not take into consideration the effects of hurricanes. In such cases precipitation may increase during such events, as has been seen in recent years. In addition, it is expected that the frequency and magnitude of such events may increase in decades to come.

71 Economics and Social Vulnerability: Dynamics of Entitlement and Access

Koko Warner

71.1 Introduction

This chapter examines the dynamics of entitlement and access, and the degree to which economic and social capital are substitutes during and after natural disasters. It explores how individuals manage a shock from a natural disaster by accessing a spectrum of social and economic assets, and it illustrates the importance of accounting for social capital and its affect on access to entitlements during and after shocks like natural disasters. This chapter discusses substitution of economic and social capital to explain in part why and how shocks affect certain groups disproportionately.

The approach points towards two insights for social vulnerability and natural hazards: *First*, it examines the relevance of imperfect substitution between a relational good (social capital) and a private good (economic capital) in shock situations such as natural hazards. *Second*, it explores how this substitution effects may mask the impacts of hazards on society's most vulnerable following natural hazards (negative externalities).

Research on evacuation efforts in New Orleans before and after Hurricane Katrina (August 2005), compared with other hurricanes in the Caribbean region, indicates the role of social capital for those affected by natural hazards. Entitlements failures and lack of access can lead to a social capital gap (social vulnerability) which arises when shocks prevent people from substituting social and economic capital. With this perspective, a more differentiated view of the effects of Hurricane Katrina and other hurricane events in the region on vulnerable groups emerges. Preliminary results suggest the importance of pursuing a research agenda to better understand the disruption of social networks and social vulnerability during and after shocks.

Research suggests that vulnerable groups, particularly impoverished groups, bear a disproportional burden of direct and indirect damage from natural hazards. One author notes

> For both developed and developing countries, the lower the economic, political, and social status of the people ... affected by hazards, the larger the loss burden. ... Consequently, the people and activities most affected by natural hazards are bound to be those belonging to the poorest and most powerless social sectors of less developed countries, especially in those countries undergoing rapid transition with little or no regard for social consequences at the margin (Albala-Bertrand 1993).

Every major study of the impacts of natural catastrophes in developing countries reaches this conclusion (Otero/Marti 1995; Sen 1999; World Bank 2000; UN-ISDR 2002a; Benson/Clay 2004), which will be further exacerbated by climate change (IPCC 2007a). The poor generally are more vulnerable, suffer greater costs, and have less capacity to take compensating action than richer societies or households. By 'vulnerable', the definition provided by Blaikie, Cannon, Davis and Wisner (1994) is applied here, namely "the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society" (Blaikie/Cannon/Davis/Wisner 1994: 12). While there is consensus that vulnerable groups suffer the larger loss burdens from hazard events, the mechanisms of how shocks affect the coping capacity of households require greater understanding.

The chapter first briefly looks at the discussion of entitlement failures that can result from shocks which prevent substitution between different types of capital (71.2), and reviews economic valuation methods of the impacts of natural hazards and some of the shortfalls of these approaches (71.3). It examines evidence of the effects of social capital on disaster management, and compares the experience of Hurricane Kat-

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rina with that in managing hurricane risk in the region. It assesses evidence of how entitlement failures and lack of access affects the management of disaster situations such as Hurricane Katrina and other hurricanes (71.4) and it analyses why approaches are needed that capture the effects of social capital on access to entitlements during and after shock situations (71.5). Finally, it draws conclusions and makes recommendations for further investigation (71.6).

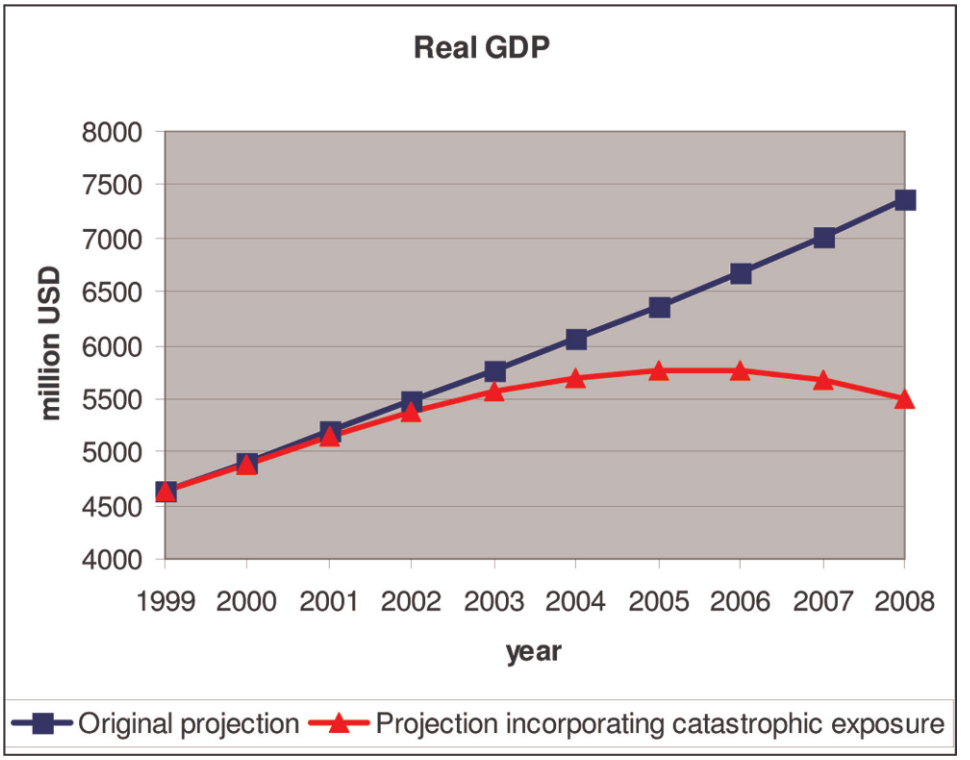
71.2 Entitlements, Access, and Substitution

Amartya Sen argued that to understand vulnerability, it was also necessary to understand all the various substitutions or channels through which a community accessed the resources it needed to survive (Sen 1981). Entitlement failure, resulting from an inability to obtain the necessary resources for survival, occurs when the entitlement of a person or community is disrupted and they cannot substitute to another method of obtaining the necessary resources (Sen 1981). This failure in entitlements and inability to substitute different types of capital results in vulnerability (Sen 1986). The entitlement framework is useful because it disaggregates the reasons why a person or group may become vulnerable to shocks such as natural disasters. It is not only the physical shock which poses problems – communities worldwide face large and small physical hazards on a regular basis but not all communities are devastated. The entitlement perspective allows more insight into how the ability to substitute between capital endowments (here social and economic capital are discussed) affects vulnerability to such shocks. This chapter characterizes coping capacity as a spectrum of economic and social capital that people substitute imperfectly to achieve their objectives in the face of a shock.

Here social capital is defined with two major components reflecting the primary understanding in the literature: Social capital is the collection of those productive assets which are incorporated in the social structure of a group, and which allows cooperation among its members to reach common goals. Social capital is used as a collective asset held by the group and depending on interpersonal relationships for capital accumulation or depreciation (Bordieu 1983; Coleman 1990; Putnam 1995; Becker 1996; DiPasquale/Glaeser 1999; Dasgupta/Serageldin 2000; Sacco/Vanin/Zamagni 2004). Examples of social capital include trust, effective civic codes of conduct/norms, and networks of voluntary associations. A particular feature of social capital is that it is not accumulated through a standard mechanism of individual investment, since most of its benefits are not privately appropriable. Rather, social capital is accumulated to a large extent through social participation in group activities (Uhlaner 1989; Comeo/Jeanne 1999; Gui 2000). This participation may only partially be regarded as an investment since it is perhaps mainly an activity that entails the simultaneous production and consumption of relational goods.

There is a long discussion about the effects of the growth in economic capital on social development (see e.g. Alexander 1993; Knack/Keefer 1997; Edwards/Foley 1998; Woolcock 1998; Putnam 2000). For example, Hirsch (1976) as well as Foley and Edwards (1999) argued that negative social externalities may accompany private growth as individual time constraints become increasingly binding, thereby inducing a shift from time-intensive activities including social participation to time-saving ones including many forms of private consumption. People may substitute between both types of capital – such as relying to a greater extent on social networks if economic capital fails (such as the breakdown of financial infrastructure following a natural hazard), or substituting economic capital for social capital when interpersonal networks may become disrupted, such as during evacuation in the face of a hazard. A challenge can arise for certain segments of the population during shock situations when substitution is imperfect. Situations may arise in which it may become difficult for people to substitute social for economic capital. For example, if people become isolated from their normal social relations, they may not be able to organize activities that require high degrees of social capital and trust, such as child care when parents need to organize reconstruction or other shock-related responses. Further, shocks can reveal underlying social isolation or lack of entitlements that prevent people from substitution like increasing labour supply. In such situations people are prone to experience a social capital gap – or social vulnerability – when their social networks fail to sustain them (either through lack of participation, exclusion/isolation, etc.) and when they cannot substitute towards economic capital (such as increasing their labour supply). The literature has still to examine the implications of shocks like natural disasters on the ability to substitute between social and economic capital, in particular when certain groups have a predisposition to vulnerability because of their stock (or lack thereof) of social capital.

Figure 71.1: Shocks disrupt economic performance over time. **Source:** Freeman/Warner (2001: 27), reprinted with permission.



71.3 Do Valuation Methods Capture the Dynamic of Access Failure after Shocks?

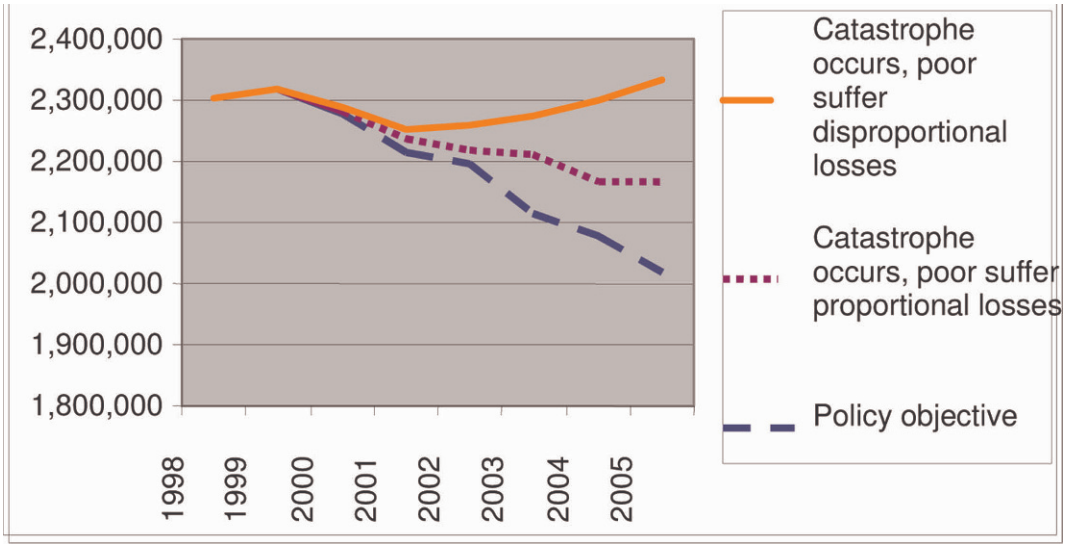
Current economic valuation methods examine the disruption of capital assets (capital stock), and a part of this literature focuses on macroeconomic effects (Freeman and Warner 2001, Freeman et al. 2002 and 2003). Economic impact information available in most cases is aggregated, often stated in terms of GDP per capita losses or estimates of direct damage in currency terms. One study estimated the impacts of a natural hazard destroying a percentage of capital stock in Honduras. The authors found that economic growth at first did not deviate significantly from the planned growth trajectory (figure 71.1). With time, however, economic growth lagged and even started to decline. It was estimated that Honduras would need an additional $170 million annually of currently unbudgeted financing to stay on its projected macroeconomic growth path (Freeman/Warner 2001).

Figure 71.1 shows that in the immediate years following the shock, economic performance closely mirrors the projected macroeconomic growth path. This is in line with literature which finds that negative externalities can actually stimulate economic growth, and may in part explain why inflationary spikes are observed in the aftermath of natural hazards as economic capital including aid money may become more available.

While such macroeconomic approaches (see e.g. Atkins/Mazzi 2000; Freeman/Warner 2001; Freeman/Martin/Warner 2004) provide insights about economic impacts of natural hazards, they are less suited to generating information about patterns of losses, such as what groups are more affected when hazards occur. Even if the macroeconomic costs are small, the costs for the most vulnerable within society may be large yet underrepresented using current evaluation techniques. Natural hazards can pose a more serious threat to particular groups than would appear from the macroeconomic data (Albala-Bertrand 1993; Bartolina/Bonatti 1997, 2004; Vatsa/Krimgold 2000; Antoci/Sacco 2001; Benson 2003).

Some work has been done on measuring the impact of natural disasters on the poor, by supplementing macroeconomic modelling with household models. For example, figure 71.2 illustrates the results of

Figure 71.2: The number of people in poverty increases if the poor suffer disproportionately from catastrophic events. **Source:** Freeman/Warner (2001: 32). Reprinted with permission.



an assessment done on the impacts of Hurricane Mitch on the poor. This figure suggests that hazards slow or stall the reduction of poverty, and can even worsen poverty over time if the most vulnerable are affected disproportionately (Freeman/Warner 2001).

Beyond widely accepted conclusions that the poor bear the heavier load from direct damages to capital stock from extreme events (Ferroni/Mody 2002; Martines/Guzman 2002; Carter/Little/Mogues/Tewodaj 2007) quantifying this burden has proved difficult. Because the poor are not well reflected in macroeconomic data, analysis of that data alone disguises the consequences of natural hazards on the most vulnerable segments of society, and the role that social capital plays in failures to access entitlements that are available during and after a disaster.

Different research approaches have sought ways to address this need (Putnam 1995, 2000; Antoci/Sacco 2001; Vanin 2005) but not from the perspective of shocks and social vulnerability. Some economists have begun experimenting with approaches that extend the understanding of the mechanisms by which people who are vulnerable to shocks might manage the risk, and the consequences of an inability to substitute economic and social capital to manage the shock.

Box 71.1 outlines an approach by Bartolini and Bonatti (2004) as an example of how social capital might be incorporated into production and utility functions. The interesting point is that social capital is modelled as a homogenous asset, rather than as an asset with different substitution characteristics in different situations (such as shock situations).

71.4 Relevance for Social Vulnerability

Bartolini and Bonatti (2004) attempted a modelling approach that included social capital in the production and utility function to examine the effects of social capital on economic outcomes. This approach is discussed briefly in the annex. The relevance for such approaches to social vulnerability requires further research, and simulation under shock situations and under the assumption of imperfect substitution are needed.

Entitlement failure results from an inability to obtain the necessary resources for survival occur when the entitlement of a person or community is disrupted and they cannot substitute another method of obtaining the necessary resources. This failure in entitlements and inability to substitute different types of capital results in vulnerability (Sen 1981, 1999). The entitlement framework is useful because it disaggregates the reasons why a person or group may become vulnerable to shocks such as natural disasters. It is not only the physical shock which poses problems – communities worldwide face large and small physical hazards on a regular basis but not all communities are devastated. The entitlement perspective allows more insight into how the ability to substitute between capital endowments (here social and economic capital are discussed) affects vulnerability to such shocks. This chapter characterizes coping capacity as a spectrum of economic and social capital that people substitute imperfectly to achieve their objectives in the face of a shock.

Table 71.1: Social capital types and access to entitlements during times of shock or disaster. **Source:** Compiled by the author.

	Bonding social capital • geographically specific • useful for survival, group identity	**Bridging social capital** • geographically flexible • useful for (individual) access to entitlements
Degree of substitution with economic capital	Low to medium Most useful in securing group goods. If entitlements are linked to the group, bonding capital may be fungible with economic capital.	Medium to high Most useful in securing personal goods such as employment or entitlements (if defined individually). Less useful for securing social safety in times of physical danger (group identity is not a market good).
Relevance to disaster situations	May ensure physical survival (particularly relevant within first 72 hours to few weeks following event), less helpful in accessing entitlements (depends on characteristics of the group).	Useful for recovery process, reestablishment of normalcy, accessing entitlements like aid, help in reconstructing, getting jobs back, getting insurance payouts, etc.

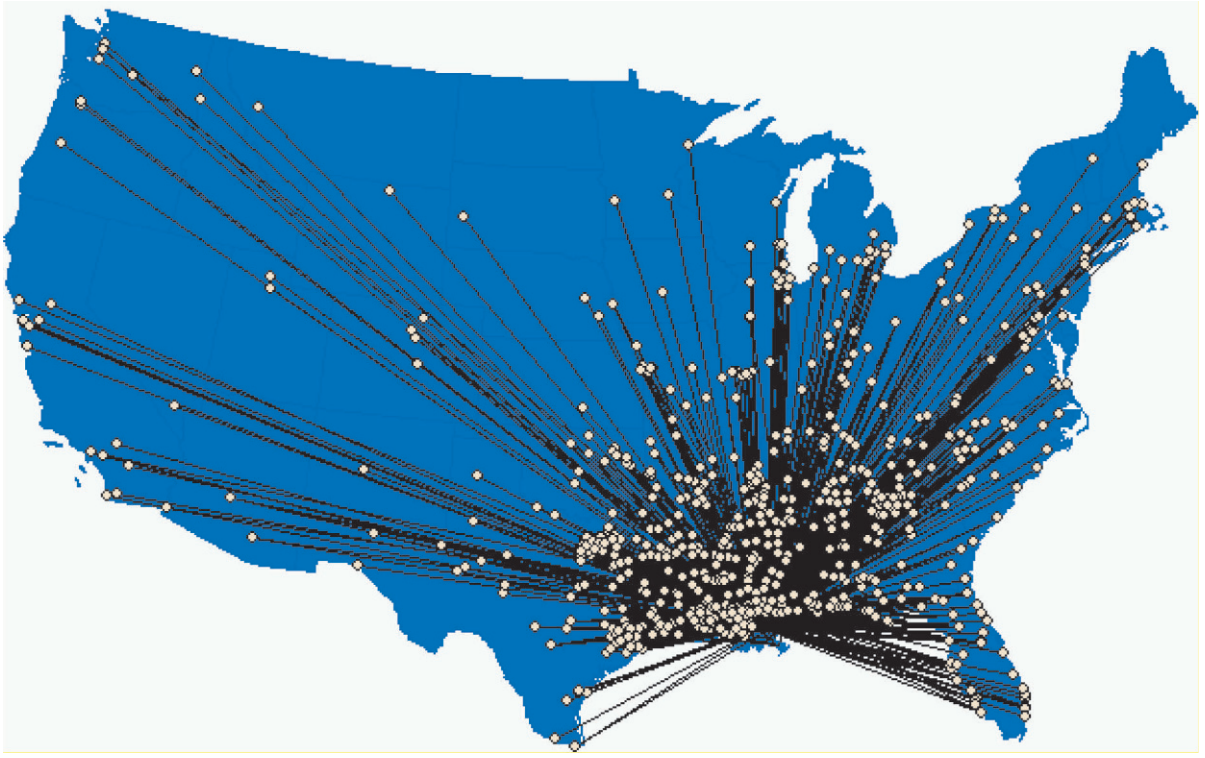
Using this approach, Bartolini and Bonatti (2004) suggest (in non-shock situations) that social capital deterioration is represented as a negative externality. Modelling approaches to capture the effects of shocks often do not account for the negative externality of social capital deterioration, i.e. when social capital of different types (bonding and bridging) is lost or seriously disrupted. Social capital forms are often overlooked until a shock situation. In such times of stress, people may not be able to substitute their particular endowments of social capital with their endowments of economic capital. These losses can be systematic, so that groups of people experience a loss of resources they may need to access entitlements that help them deal with the effects of a shock. As social capital deteriorates, agents compensate for this deterioration by increasing their labour supply and accumulation in order to increase the output used to substitute diminishing social capital. Table 71.1 presents a simple matrix of social capital and its affects on access to entitlements during times of shock or disaster.

The degree of substitution between social and economic capital depends on spatial or temporal factors. In times of disaster, for example, people can experience disruption of their normal routines and in some cases must even be evacuated. Groups possessing a relatively large endowment of bonding social capital may be particularly vulnerable to developments that disrupt the spatial arrangement of their social ties. Evacuations which have a disorganizing effect on neighbourhoods, such as the Superdome experience following Hurricane Katrina, can cause bonding social capital to deteriorate and reduce the ability of people to cooperate in order to gain access to services and goods they need to manage the situation. In contrast, those individuals with bridging social capital – useful for securing employment or individually defined entitlements – were able to find shelter and resources they needed through a combination of economic capital such as money (i.e. to rent hotel rooms, travel away from the hurricane- and flood-affected areas, or find new jobs in new locations).

The relevance of bonding and bridging social capital types in disaster situations also has bearing on access to entitlements. Bridging social capital may have helped affected people substitute economic capital to gain safety from the effects of Hurricane Katrina. Further studies must be performed to test the hypothesis that those with greater endowments of bridging social capital were those that were able to either successfully move away from the New Orleans area and re-establish themselves in other locations, or facilitated better recovery in the New Orleans area following the hurricane. Group identity may be sacrificed (bonding social capital) but access to entitlements needed to recover from the disaster at least in economic terms may have been enhanced due to larger endowments of certain groups of bridging social capital.

Applying these arguments to shock situations sheds some insight into the economic and social impacts of natural hazards. It is hypothesized that, if the shock disrupts social capital (such as social networks), people will substitute labour and other economic capital to compensate for the diminished social capital. Further, it is hypothesized that the most vulnerable segments of a population may be less able to substitute social capital and economic capital and that these segments may experience social vulnerability, or a so-

Figure 71.3: Places of displacement following Hurricane Katrina. **Source:** Epodunk website, 2007: "Places of Displacement Following Hurricane Katrina"; at: <http://www. epodunk.com/top10/diaspora/destination-map.html> (21 March 2007). Reprinted with permission.



cial capital gap. To explore these hypotheses, the chapter turns to qualitative evidence from agent behaviour during and after Hurricane Katrina and other devastating hurricanes in the Gulf of Mexico.

71.5 Evacuation, Entitlement Failure, Social Vulnerability

Research on evacuation efforts in New Orleans before and after Hurricane Katrina indicates the role of social capital for those affected by natural hazards. Entitlement failures and lack of access can lead to a social capital gap (social vulnerability) which arises when shocks prevent people from substituting social and economic capital. Emerging understanding of the social dynamics surrounding Hurricane Katrina sheds some light on the mechanisms through which people cope with natural hazards. Hazards can disrupt social networks that facilitate cooperation, especially in the reconstruction and recovery phase.

Hurricane Katrina was initially a category 5 hurricane which was 'weakened' to a category 3 when it made landfall just outside of New Orleans, Louisiana in August of 2005. The hurricane devastated much of the north-central Gulf Coast of the United States, threatening millions of people and their assets. The hazard was the costliest and one of the deadliest hurricanes recorded in the USA (estimated at $150 billion, Munich Re 2006).

Hurricane Katrina resulted in the largest displacement of Americans in the country's history, dwarfing the impacts of the Dust Bowl – another case of environmental degradation and migration, in a period of about 14 days. Hurricane Katrina ultimately caused about 1.5 million people to be displaced temporarily (Wood 2001).[1] Figure 71.3 shows the places of displacement for these hazard-induced migrants. Of the 1.5 million displaced people, an estimated 107,000 illegal immigrants and temporary guest workers experienced secondary displacement due to Katrina.[2]

1 Peter Grier: "The great Katrina migration", in: *The Christian Science Monitor* (12 September 2005); at: <http://www.csmonitor.com/2005/0912/p01s01-ussc.html>.

2 E. Eduardo Castillo: "Illegal immigrants afraid to get storm aid" (Associated Press, 10 September 2005); at: <http://www.chato.cl/blog/2005/12/we_are_not_criminals.html>.

71.5.1 Social Capital and Hurricane Katrina

Yet, given these widespread negative impacts, economists projected a 0.5 per cent impact on GDP and the formal economy including oil and gas production appeared to recover quickly, not incorporating the negative social and environmental externalities of this hurricane.

The evacuation strategies of most upper and middle-income people living in the New Orleans area reflected a relative ease in substitution between social capital and economic capital. Among the first to leave New Orleans before Katrina arrived were those who had family and friends to assist them and give them shelter in safe places. Affluent people withdrew cash from their bank accounts, left the city in their cars, rented hotel rooms in a safer area.[3] This relatively affluent group had sufficient economic capital to evacuate in an orderly way that did not leave them exposed physically to the storm or the ensuing flooding. Access to economic capital or the ability to substitute social capital for economic capital made this group less vulnerable to Hurricane Katrina. Additionally, the temporal opportunity costs of early evacuation – in the one to two days before landfall – were relatively low, since the storm was predicted to arrive on a Monday. Few if any work or school days were missed for the affluent group which evacuated early.[4]

In comparison, lower income New Orleans residents had fewer entitlements to help them prepare for Hurricane Katrina. Those without social networks outside the neighbourhoods of New Orleans were among the last to evacuate and were most dependent upon the different levels of government offices to provide transportation, shelter, food and water, and medical assistance. The nature of this later evacuation was forced, with the strategies of evacuation depending on the degree of social capital available. Evacuation strategies depended upon whom people could count on for help. Shelters were set up for these storm victims, but systems were not in place to allow a reestablishment of social networks and substitution effects. Research notes that these shelters did not take advantage of the shelter residents' own social capital, especially social networks. The result was a longer-than-necessary recovery period.

Economic capital flows were at a low point when Hurricane Katrina came. The storm came at the end of the month, when people receive their pay checks. At the time, economic resources for evacuation (hotel rental, cash, purchasing emergency supplies and fuel) were scarce. Low-income residents were less likely to own cars, making voluntary evacuation more costly and difficult to arrange. Although 35 per cent of the city's black households did not own their own automobile (only 15 per cent of white households did not own a car), city planners based emergency evacuation plans on individual car ownership.[5] Federally subsidized housing where the poorest residents of New Orleans lived was located in the lowest-lying areas that were most dramatically affected by the levee breeches following the storm. This group was hardest hit by the storm and at the same time had the fewest entitlements that would allow evacuation.

71.5.2 Social Capital and Declining Trust

There appears to be an increase in transaction costs connected with a decline in trust, the main source of cooperative behaviour (Fukuyama 1995; Levi 1996). Reputational mechanisms may be less effective or spatially bounded. That is, the hazard shock may force people to leave the bounds of their spatial networks such as the forced migration caused by the hurricane, causing them to become anonymous which in turn reduced the efficacy of such mechanisms in forming bonding social capital (Oliver-Smith 2007). There appears to be a negative externality for groups with deteriorated social capital such as undocumented migrants. The degree of opportunism and the degree to which reputational mechanisms that contribute to bonding social capital break down is related to how the hazard affects the group's social capital (Rodríguez/Dynes 2006). Further study is needed to explore whether groups with intact social capital will experience less opportunism and interruptions to these mechanisms than groups with less social capital.

This loss of trust was manifest in New Orleans immediately following Hurricane Katrina in the form of increased opportunism of individuals relative to the degree of disruption in social capital experienced by that individual's group. Katrina heavily affected specific social groups in New Orleans. One-fifth of those

3 Rebecca Mowbray: "No room at the inn, New Orleans hotel officials say", in: *New Orleans Times-Picayune* (29 August 2005)

4 Ed Anderson: "Evacuation scramble puts contraflow plan to the test", in: *New Orleans Times-Picayune* (29 August 2005): A-4.

5 Jason DeParle: "What Happens to a Race Deferred", in: *New York Times* (4 September 2005).

displaced by the event were likely to have been poor, and 30 per cent had incomes more than one and a half times below the poverty line. Many of those displaced had strong community ties, and some of those displaced such as the elderly, disabled, and children relied almost exclusively on social capital for their survival (Gabe/Falk 2005). Studies suggest that the social networks of many Katrina refugees were disrupted, in part due to the physical disruption of the hurricane and levee breaches, as well as the evacuation attempts and longer-term reconstruction issues (Kates/Colten/Laska/Leatherman 2006). Media reports indicated declining trust and cooperative behaviour in the aftermath. Looting and deterioration of civic order in New Orleans erupted as social and physical networks, and behavioural norms were unsettled by the hurricane (Rodríguez/Dynes 2006).[6] It has been observed that in post-hurricane reconstruction, sharp reductions in supply chains allowed 'unscrupulous' businesses to charge prices far above market equilibrium for services like roofing or other repairs to damaged housing, as well as energy (Browne-Dianis/Lai 2006; Fletcher/Pham/Stover/Vinck 2006; Fussel 2006).

71.5.3 Social Capital in Caribbean Countries facing Hurricanes

In comparison, social capital has played a central role both in the preparatory phase to reduce the effects of the disaster and in response to the reconstruction and return to development following a disaster in the Gulf region. In Grenada those communities which could organize quickly and without outside facilitation fare well even in the face of dangerous hurricanes. Bonding social capital gives group members a deep sense of connectedness and has historically helped them fare better during and after hurricanes than newcomers to these communities. Villages that display strong bonding social capital include Apres Tout and Rose Hill (Kambon 2007). Members of these groups organized immediately following hurricanes to clear roads, repair roofing and buildings, and take care of those members who are not as strong (elderly, sick, children). Although these villages are aware of entitlements, they also have strong social capital and a tradition of self-reliance and independence (substituting bonding social capital for entitlements or economic capital) (Abramowitz 2001). The Economic Commission for Latin America and the Caribbean (ECLAC) reports that those households where members did not feel a strong sense of bonding social capital, were also noticeably slower in repairing homes following hurricanes. These communities include immigrant destinations like the Grande Anse Valley. The immigrants possessed little bridging social capital, were not informed about their entitlements, and required more assistance in order to better their circumstances (ECLAC 2007).

71.6 Summary and Discussion

Results from recent major natural disasters point towards the importance of pursuing a research agenda to better understand the disruption of social networks and social vulnerability during and after shocks. The impacts of shocks such as natural disasters often rely on economic valuation methods to indicate the extent of damage and the rate of recovery. Often the negative externalities of these shock events – those aspects which are not measured as results of a shock and which can work to the detriment of goals such as recovery – also prevent people from accessing entitlements which further dampen recovery. The loss of social capital – both bonding and bridging – can be one explanatory variable in why certain groups do not recover well following a disaster. Certain types of entitlements cannot be accessed, or can be accessed only with great difficulty, because available social capital has either deteriorated beyond a certain point or because it is not readily substitutable with other forms of capital such as money or other resources. The observation is important for disaster management and planning, particularly for socially vulnerable groups.

First, current measurement methods for the effects of natural hazards often do not account for losses to social capital, and disaster management plans sometimes assume that people or groups of people can substitute economic and social capital almost perfectly. Economic methodologies aid planning for measures to reduce the impact of natural hazards. Some gaps exist, however, which hinder the ability to understand the degree of economic impact and the vulnerability of different demographic groups to natural hazards. The deterioration of social capital does not necessarily manifest itself in lower GDP. While the nationwide economic effects of the hurricane were subtle and even growth-creating in specific sectors, it appears that the deterioration of social capital worsened the welfare prospects of individuals in the

6 See: "Governor: Evac Superdome, Rescue Centers", in: *FoxNews*; at: <http://www.foxnews.com/story/ 0,2933, 67653,00.html> (30 August 2005)

regional economy. Disasters appear to pose a largely unmeasured deterioration of social capital which imposes a loss of welfare for group members. This welfare loss is not reflected in current techniques to estimate the costs of natural hazards on society.

Long-run economic growth is not necessarily slowed by shocks to groups with the least social capital; hence the effects on these groups appear underrepresented in the current literature. Economic performance following the shock may mask the substitution between social and economic capital, so that a deterioration of social capital may lead the economy towards inefficiently high levels of per capital output. This further masks the loss of social capital (negative externality), and may drive individuals to continue substituting social capital for economic capital.

This situation can lead to rising social vulnerability as the social capital stock is further depleted. Diminishing trust appears to have imposed a loss of welfare for group members affected by Hurricane Katrina which is not reflected in current techniques to estimate the costs of natural hazards on society. With the growth of new types of approaches which explore the effects of substitution between social and economic capital, the effects of social vulnerability are becoming more prominent in the discussion.

Second, social capital has a spatial/network element that can break down and relax the constraints on behaviour that facilitate cooperation in shock situations. Hazards can negatively affect groups who have social vulnerability, i.e. multiple stressors lead to a breakdown of the ability of social networks to secure actual or potential resources. An erosion of trust and social capital led individuals – such as the undocumented Hispanic migrants discussed above – to increase labour, spending, or other economic activities.

A household can smooth consumption and manage the effects of a natural hazard by substituting social assets such as trust, solidarity, and cooperation if hazards destroy material and financial assets. A household may likewise substitute economic capital to manage the effects of a natural hazard if social assets cannot be sufficiently accessed. Economic and social assets are imperfect substitutes in part because many types of social assets are bounded, spatially or institutionally. Social assets such as trust can deteriorate in the face of shocks that affect the way people relate to one another in specific settings such as communities, church groups, or neighbourhoods (Oliver-Smith 2002). One of the immediate social impacts of natural hazards is the disruption of social networks, and efforts to re-establish contact with family members and friends is one of the first post-hazard activities undertaken by people (Blaikie/Cannon/Davis/Wisner 1994; Pelling 2003; Cole 2004; Schelling 2007). Media attention of post-hazard recovery efforts sometimes highlight – as it did after Hurricane Katrina – the abject conditions of poor people affected by the storm. Social vulnerability is a pre-existing state, but often made manifest when a large disruption such as a natural hazard occurs.

Future research will move this modest beginning forward, including theoretical articulation of shock situations, substitution, and social vulnerability. Applied research may examine the implications of disaster management policy, such as evacuation, resettlement, and reconstruction in ways that encourage the accumulation of social capital and the avoidance of disrupting social networks so important for social resilience. Such research will expand the understanding of underlying social vulnerability, and make the negative externalities associated with deteriorating social capital more explicit (box 71.1).

Box 71.1: Substitution between Social and Economic Capital in Hazards. **Source**: The author.

Recognizing the need to better understand how and why shocks affect certain groups disproportionately, the chapter examines one example of a strain in the economics literature showing how negative externalities can foster growth. This approach augments a Solow-Ramsey growth model by including a labour-leisure choice, social capital in the production function, negative externalities affecting social capital and which deteriorate social capital while increasing economic activity, and substitution of social for economic capital. It is useful to try to understand the consequences of social capital substitution for specific groups of people. The utility and production functions following Bartolini and Bonatti (2004) will now be examined.

The *utility function* is constructed in each period t, where the utility of the representative household is an increasing function of consumption and leisure:

(1a) $U_t = \ln(C_t) + \varphi\ln(1-L_t)$, $\varphi < 0$, $L_t \leq 1$,

where C_t is consumption and L_t is the time spent working in period t by the representative household (total amount of time available to each household in time t is normalized to be one).

The *production function* shows how each household produces a single good Yt according to the technology used such that:

(1b) $Y_t = L_t\alpha K_t\ 1-\ \alpha A_t\beta$, $0 < \alpha < 1$, $0 < \beta \leq 1$

where K_t is physical capital and A_t is a variable affecting factor productivity.

The physical capital evolves according to the following function:

(1d) $K_t+1 = I_t(1 - \delta)K_t$, K0 given , $0< \delta <1$ where I_t is investment.

The variable affecting factor productivity A_t depends on a state variable that evolves with time, and on the amount of output that each household devotes in period t to boosting factor productivity such that:

(1c) $A_t = R_t + \Phi X_t$, $\Phi > 0$

where R_t is the state variable and X_t is the amount of output devoted by the representative household to boosting productivity. For simplicity, R_t and X_t are assumed perfect substitutes.

The state variable R_t evolves according to

(1d) $R_t+1 = \gamma R_t + S - \eta Y_t$, R0 given $0< \gamma <1$, $S > 0$, $\eta \geq < 0$, $R_t \geq 0$ t

where S is constantly influencing the growth rate of R_t. The evolution of R_t may be influenced (if $\neq 0$) by the productive activities undertaken by households.

The representative household must satisfy its period resource constraint such that:

(1e) $Y_t\ I_t+X_t+C_t$

Therefore the intertemporal optimization problem amounts to choosing $\{L_t\}0\infty$, $\{I_t\}0\infty$, $\{X_t\}0\infty$ and $\{C_t\}0\infty$ in order to fulfil the following:

$$\infty$$

(2) $\max \Sigma\ \theta\ Ut$, $0 < \theta <1$, subject to (1)

$$t=0$$

Using this approach, Bartolini and Bonatti (2004) suggest (in non-shock situations) that social capital deterioration is represented as a negative externality. As social capital deteriorates, agents compensate for this deterioration by increasing their labour supply and accumulation in order to increase the output used to substitute diminishing social capital. A modelling approach by Antoci and Sacco (2005) is related to the one presented above and assumed perfect substitutability to simplify the mathematics. Relaxing this assumption – a step that in part suggests that social capital has different characteristics (i.e. relational social capital, bridging social capital) – could reveal some more subtle economic consequences for social vulnerability, but makes closed-form solutions hard to obtain. Antoci, Saco, Vanin (2005) simulated a version of the model with the hypothesis of imperfect substitution, but did not gain any interesting insights.

The point of the Bartolini/Bonatti (2004) approach is to examine economic growth and negative externalities. However, the approach is examined above to consider the implications of substitution in shock situations, especially for socially vulnerable groups. The substitution of economic and social capital is of particular interest during times of shock. The innovative features of an approach like Bartolini/Bonatti (2004) which are relevant to risk management of natural hazards include the following:

- Deterioration of social capital imposes a loss of welfare for group members. This welfare loss is not reflected in current techniques to estimate the costs of natural hazards on society.
- Social capital has a spatial/network element that can break down and relax the constraints on behaviour that facilitate cooperation in shock situations.

The approach suggested by Bartolini/Bonatti (2004) indicates that long-run growth is not necessarily slowed by shocks to groups with the least social capital; hence the effects on these groups appear underrepresented in the current literature. Economic performance following the shock may mask the substitution between social and economic capital, so that a deterioration of social capital may lead the economy towards inefficiently high levels of per capital output. This further masks the loss of social capital (the negative externality referred to by Bartolini/Bonatti (2004)), and may drive individuals to continue substituting social capital for economic capital.

72 Social Vulnerability, Discrimination, and Resilience-building in Disaster Risk Reduction

Úrsula Oswald Spring

72.1 Introduction[1]

Discrimination represents a harmful as well as an unfair treatment of a person or a group, based on prejudice. Therefore it is related to a 'rejection process' of the other, emphasizing critical attributes such as race, sex, age, gender, social and marital status, class and caste, migrant or refugee status, religion, incapacity or handicap. These attributes are socially constructed and are results of the complexity of daily life and of existing power structures. Discrimination induces people to simplify their behaviour by identifying themselves with the ideology of the group and to reject the other. This often creates stereotypes of how to think, to believe, and to act. Thus, a system of values, ideas, beliefs, and practices influences discrimination, and often oversimplifies complex life situations.

This chapter deals with discriminative behaviour, attitudes and actions during dangers, hazards impacts, and disasters. Discrimination can lead to emotional and material benefits for the discriminator and increases social vulnerability of the discriminated. The hypothesis postulates that social, psychological factors, and race and ethnic concerns justify discrimination and therefore reduces effective *disaster risk reduction* (DRR). They often make existing complex disaster situations worse by impeding preventive behaviour, early warning (Villagrán 2006), and solidarity during and after a disaster. Discrimination and risks are not equally distributed. To overcome inequality and favouritism, the root causes of discrimination must be searched and a legal framework with sanctions must be adopted. Simultaneously, in each society the root causes of discrimination and social vulnerability must be analysed and politically overcome. An efficient combat against discrimination empowers the socially vulnerable and discriminated from the bottom up through special training, workshops, and daily life practices. The combination of top-down and bottom-up activities can reduce the existing social vulnerability and therefore enhance resilience of the discriminated, shorten their human suffering, and contribute to a fast recovery. Thus, an effective DRR response must be arranged prior and during disasters, but also during the reconstruction phase. A society with less discrimination and greater social equity can improve health and livelihood conditions for everybody, but also its human, gender, and social security.

The increase in number and magnitude of disasters induced scientists, international organizations, governments, and insurance companies to better understand the different impacts of disasters among regions, gender, social groups, and age groups. Social vulnerability tries to explain why the same type of an event could have different outcomes depending on the position of the people in the social structure, their personal preparedness, their social vulnerability, and the readiness of governments to help. Social vulnerability can be further aggravated by an inherent process of discrimination that may trigger already existing difficult situations. Thus, discrimination is a crucial political, psychological, social, and political phenomenon that can affect life, dignity, and wealth. As a socially constructed reality it can be changed. Often people who are frequently exposed to disasters are creating resilience (Ariyabandu/Fonseca 2009; Wisner 2004) through bottom-up learning and social organization (Oswald Spring 1991; MST 2005, Freire 1998), which can be reinforced with legal and institutional support.

This chapter offers a brief conceptualization of discrimination (72.2), what is followed by a typology

1 I want to thank Ben Wisner and Hans Günter Brauch for their helpful observations and suggestions, and Ronald Lappin for his kind efforts in improving the English. This chapter builds on previous studies by Oswald Spring (2007a, 2008, 2009) that evolved from her work as the first holder of the MunichRe sponsored chair on social vulnerability at UNU-EHS in Bonn, Germany (2005–2009).

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of discrimination where gender, race, class, age, physical handicap, migrants, and institutional neglect are reviewed regarding their conscious or unconscious discriminative behaviour. Both may increase social vulnerability in difficult situations (72.3). Then theoretical questions related to identity processes and social representations are discussed and how social vulnerability often increases due to adopted values, beliefs, and behavioural patterns (72.4). The fifth part reviews the triggering effects of these processes that may destroy human lives and wealth (72.5). The sixth part explores the potential of resilience-building with a combination of bottom-up participation that can be reinforced by institutional interventions, laws, norms, and social behaviour controlling discriminative behaviour (72.6). The conclusions (72.7) combine the conceptual discussion with practical outcomes, explaining *social vulnerability* (SV) and discrimination during *disaster risk reduction* (DRR) and *disaster mitigation* (DM).

72.2 Discrimination, Social Identity, Social Representations, and Social Vulnerability

The concept of 'discrimination' comes from the Latin word *discriminare* and implies an unequal behaviour that can enhance (positive) or limit social situations (negative discrimination). Normally, it is understood as a harmful and unfair treatment of a person or a group based on prejudice. It is measured as the discrepancy between norms and socially accepted mindsets and social realities or understandings. Discrimination is therefore based on a 'rejection process' of the other, emphasizing critical attributes such as gender, race, sex, age, social and marital status, class and caste affiliation, migrant or refugee status, religion, incapacity or handicap. Indirect discrimination occurs when through apparently neutral governmental, societal, and economic behaviour a specific group experiences disadvantages and is obliged to justify its legitimate aim and the means for achieving it. In a discriminative behaviour, mind and action can be distinguished. People who discriminate often derive both emotional and material benefits, also understood as malice.

The complexity of daily life induces people to simplify their existence by identifying themselves with the ideology of the group and rejecting the other. Tajfel (1981; Tajfel/Turner 1978) showed that the intra-group discrimination is due to social identity. Social identity permits a social categorization, including large (nations) and small groups (clubs). They provide their members with a sense of who they are. Social identities not only describe but also prescribe appropriate behaviour. According to this theory, the mere act of individuals *categorizing themselves* as group members was sufficient to lead them to display in-group favouritism. A person has not only a 'personal self', but several selves that correspond to widening circles of group membership and to social representations. Moscovici (1973) described social representation as:

> systems of values, ideas and practices with a two-fold function; first, to establish an order which will enable individuals to orientate themselves in their material and social world and to master it; secondly, to enable communication to take place amongst members of a community by providing them with a code for social exchange and a code for naming and classifying unambiguously the various aspects of their world and their individual and group history.[2]

A system of social negotiation has created its meaning, thus it is not a fixed and defined thing, belief, behaviour and thinking (Oswald Spring 2009).

Social representations and identity processes maintain the *status quo* of any organization and are often not conscious. Thus, discrimination is acute and discerning, but normally stereotypes are oversimplifying complex life situations, where the group decides how to think, to believe, and to act. Discrimination underlies also a system of values, ideas, attitudes, and practices. It establishes and uses culturally diverse circumstances to justify unequal behaviour with other races, colour, professions, and social status. Society confronts an individual with obstacles who criticizes or tries new ways.

Discrimination exists in all human, political, and social behaviour. Nevertheless, the existing habitus (Bourdieu 1972, 1980, 1990) is difficult to eradicate and only civil rights movements in the USA and a longstanding struggle against Apartheid in South Africa was able to force the white minority to grant equal rights in daily life to black people and create a rainbow democracy in South Africa. Corruption, authoritarian regimes, and lack of democratic participation increase discriminative attitudes within governments, elites, and by politicians. During the WTO ministerial meetings discriminative trade behaviour prevented an agreement in the Doha Round, because industrialized countries were unwilling to reduce their

2 See "Social Representation Theory"; at: <http://changingminds.org/explanations/theories/social_representation.htm>.

subsidies in agriculture and wanted to continue to flood poor countries with artificially cheap and subsidized products, thus destroying their agriculture, food security, and community life. In any discipline discriminative behaviour exists and must be analysed and countered with a transdisciplinary approach.

During disaster situations historically existing and socially and politically accumulated discriminations, due to poverty, race and class differences, undemocratic power structures, and neglect of the handicapped often manifest themselves.[3] This results in social vulnerability, defined as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard" (Blaikie/Cannon/Davis/Wisner 2004: 11). Discrimination increases the social vulnerability of these groups. Often, it is triggered by long-term emergency situations such as famine, physical or sexual violence, water scarcity and pollution, economic crises, gender, caste and class, governmental and business corruption, performance and exploitation. It reduces preventive actions, limits early warning and aid during an emergency, and impedes a holistic development during the recovery phase. Before these theoretical concepts are developed further a typology of the most current discrimination processes is offered.

72.3 Typology of Discrimination

Discrimination can be both cause and effect of triggering processes during disaster situations. The most common types of discrimination lead to this typology, each with different degrees: 1) political and institutional discrimination (neglect of governments, aid agencies, sponsors); 2) gender; 3) race, colour, ethnicity, religion, sexual orientation, and other minorities; 4) class, cast, and different socio-economic conditions; 5) migrants and refugees; 6) age factors (children, adolescents, elderly): and 7) the physically handicapped (disability, illness, HIV/AIDS-status).

72.3.1 Political and Institutional Discrimination

Institutionalized or *institutional discrimination* (ID) is a behaviour that is often accepted as normal in governmental objectives, plans, practices, procedures, and laws. The best known examples were Apartheid in South Africa and the institutionalized racial segregation in the USA after the Civil War until 1960, when bottom-up civil rights movements changed these discriminative processes. Other examples of ID are anti-Semitism in Germany (Schmidt/Hesse 2006) and the re-education camps in several communist countries (USSR, China, etc.).

Nevertheless, ID by governments is almost universal. Governments offer a better treatment for nationals than for immigrants or foreigners when they enter a country (Bannerji 2000). There are also structural IDs when poor or unemployed citizens may receive subsidies or welfare benefits from public funds, while others may be denied these payments due to neglect or bureaucratic obstacles. A problem of ID exists, e.g. with the focal approach to poverty alleviation promoted by the *World Bank* (WB), instead of granting general subsidies for marginal areas.[4]

The complexity of ID induced the *European Union* (EU) to analyse this type of discrimination more deeply to better understand that underlying mechanisms and social representations created racial discrimination and xenophobia with different ethnic groups. The EU was also focused on 'speech acts' of public discourses, on party programmes, and on the mass media that reinforced these discriminative forms of behaviour.

The institutionalization of ghettos becomes a legitimating process for undermining an equal treatment beyond ethnic or religious beliefs (Bourdieu 1980, 1990). "Once established the category gives birth to the understanding of 'the other' in terms of quota, i.e. number of children belonging to ethnic minorities to be allowed access to a given school" (Parekh 2000: 5).

The ID is more common in countries with a weak implementation of laws and high corruption, where a minority gets privileged access to public resources, thus widening the social gap. In these states often the

3 Nearly 9,700 people were victimized in the U.S. in 2008 because of their race, religion, sexual behaviour, disability or of other forms of discrimination. This represents an increase of 2 per cent over 2007; at: <www.fbi.gov/publications.htm>.

4 Poverty among particular groups can be reduced, but it always creates excluded people and generally increases bureaucracy. During disaster and emergency situations financial support is often canalized through existing channels based on discrimination. But sometimes they are deviated for political support during the next elections (Mouffe 2000).

victims of a crime are blamed of having provoked it or when they denounce a crime they are considered as the key suspect. When things go wrong, individuals often blame others for a crime nobody committed, in order to be free, inducing a new variety into the concept of the 'prisoner's dilemma'. This type of ID if it is combined with inefficiency and corruption often transforms jails into centres of detention of innocent people, of ethnic minorities and poor people who are unable to struggle for their rights and a just enforcement of the law. A similar situation occurs when people see the poor standing in line for welfare support. The poor often see themselves or are considered by others as a problem, instead of examining the root causes of poverty and their lack of basic human security (Brauch 2009b). These are two different sides of a process of blaming the victims for social discrimination.

In disaster situations ID is also common and it is often combined with neglect. This applies to all stages from early warning evacuations to the reconstruction process. For example, on 2 May 2008 killed at least 100,000 people in Myanmar (Burma) and the outbreak of dysentery and cholera later was threatening the lives of a further 1.4 million people (Oxfam 2006a). In September 2005, during Hurricane Katrina the Latino population in New Orleans also faced an ID. The *National Council of La Raza* (NCLR) analysed the failed US governmental response "... on at least two occasions, law enforcement officers raided Red Cross shelters, racially-profiled Latinos staying at the shelters, and then asked them to leave under the assumption that they were undocumented workers and not hurricane survivors" (Muñiz 2006: 13).

In early October 2005, Hurricane Stan together with torrential rainfalls caused economic damage of 2 billion US$ in Mexico alone. The worst impact was in the Mexican state of Chiapas. Officially the Mexican federal government reported only 98 fatalities, but after a month still 30 persons were reported missing. Stan severely impacted on indigenous people, due to a lack of preventive evacuation, which started only after the hurricane had destroyed the livelihood of 4 million inhabitants, whereof 83,825 persons had to live in 492 refugee camps (García/Marín/Méndez/Bitrán 2006). Two weeks later on 21 October 2005 Hurricane Wilma hit Cancun, an international high-value sea resort. In this case, early warning and preventive evacuation avoided human fatalities, and only 8 persons died. More than one million inhabitants were affected; all of them depending on tourism, but already three months later the infrastructure was rebuilt and the resorts were ready again for international tourism. In both hurricanes, during the same month and in the same country the governmental assistance fundamentally differed: ID prevailed in the marginalized indigenous region while the government offered credits, subsidies, renegotiation of debts, and a prompt payment from insurance companies for the resort.

In synthesis, ID can be found in laws, judicial decisions, public attention, employment opportunity, tax exemptions, civil rights and use of public facilities, based on race, nationality, colour, age, sex, and creed. Democratic states have enacted laws[5] against discriminative forms of behaviour and permitted lawsuits to enforce equal rights and protect minorities. Nevertheless, only improvement of citizens' participation and "associational rights-claims" (Rocco 2000), transparency, improvement of socio-economic conditions, education and trained public functionaries in civil rights, combined with an efficient system of law enforcement against ID, can overcome discriminate behaviour in government (Connolly 1995). In relation to poverty alleviation, general programmes in marginal areas will help to combat ID and political (ab)-use. With regard to structural ID, immigration laws, civil rights trained migration functionaries, and free transit between neighbour countries (e.g. Schengen in Europe) will reduce further human rights violations.

Several countries experiencing foreign immigration have created the ideology of multiculturalism with multiple meanings.

> What is common in the sociological content of the term in the West – but never spoken of – is that it was formulated as a framework, a set of policies, for the national accommodation of non-white immigration. It was a liberal response that skirted the reality of the already racialized constitution of these societies and masked the existence of institutionalized racism (Sandercock 2004: 1).

Most countries have signed and ratified UN Conventions on human rights and non-discrimination. In their constitutions most industrialized countries have prohibited discriminatory practices and promoted individual merits instead of inherited social conditions. But unfair treatment of persons or groups, based on prejudice and established social representations, still

5 The Civil Rights Act of 1964, the Voting Rights Act of 1965, the amendment to the Constitution of the USA mandating equal rights for women in the "Equal Rights Amendment" are some of the legal procedures to grant greater equality and equity.

exists and is greater in poor countries which are also more affected by all kind of hazards.

Confronted with multiple discrimination processes and after the Apartheid period was over, South Africa decided to put in its Constitution the right to equity for all citizens, independent of race, colour, economic status, and sexual preference. But in many countries constitutionally granted basic rights are not properly implemented. Thus, disasters often exacerbate the contradictions that have existed before the hazard occurred.

72.3.2 Gender

Gender discrimination refers to a different treatment based on biological differences between women and men (sexual dimorphism).[6] It includes connotations of values that change within different cultural contexts. It refers to the most common and longstanding discrimination (Butler 1990; Tickner 1997, 2001, 2002). It includes structural discrimination which is reflected in different kinds of vulnerabilities, reinforcing each other, including social, political, economic and personal discriminations. Most of them are based on identity patterns and include the rejection of the other (Moscovici 1976, 1984, 2000). The outcomes in form of social representations (Flores 2001; Serrano 2004, 2009; Oswald Spring 2008, 2009) have constructed discrimination among genders that are taken for granted around the world. "The very subject of women is no longer understood in stable or abiding terms" (Butler 1990: 1) ... "consequently, there is a need for a radical re-thinking of the categories of identity within the context of relations of radical gender asymmetry" (Butler 1990: 11).

Gender discrimination affects multiple aspects: social and family position, labour (Calas/Smircich 1993; Fox/Hesse-Biber 1984), politics, abuse, sex trade (Jeffreys 2008, 2009), and the body of women as a battlefield during the war (Rehn/Johnson 2002). It is reflected in feminicides, female feticides (Das Grupta 1987, 1997), rape, higher girls mortality and undernourishment, low education, etc.[7] This male organized system brings multiple discriminative habits into government, agencies, enterprises and law-making processes, limiting the empowerment of women. In most societies a married woman's civil identity is now covered by that of her husband. Property she brought into the marriage, segregation within the family, and lower wages make women dependent on men. They become the servant of the extended family caring about people, the house and animals, often also the orchards and food production. Many times they are also victim of rape by family members and their human rights violations go far beyond sexual and physical violence, including also psychological stress and deprivation of the right to leave the house alone, to speak with neighbours, in synthesis a condition of a slave.

For professional and trained women, barriers for upward mobility and better payment (table 72.1) are limited by the 'glass ceiling'[8] (Neville/Pennicott/Williams/Worrall 1990; Insch/McIntyre/Napier 2008; Thomas-Hunt/Phillips 2004; Judge/Livingston 2008), related to identity patterns and an epistemological understanding of science, progress, and gender in a rigid and hierarchical way (Harding 1986, 1993, 2001). These structural obstacles become nearly impossible to overcome the limits and achieve equality (Ridgeway

6 Butler (1990: 6) argued: "When the constructed status of gender is theorized as radically independent of sex, gender itself becomes a free-floating artifice, with the consequence that man and masculine might just as easily signify a female body as a male one, and woman and feminine a male body as easily as a female one."

7 The mortality at birth gives girls in Punjab, India a rate of 1.18 as they better survive. However, from 1 to 11 months the ratio of male/female drops to 0.53; from 12-23 months to 0.51 and from 24–59 months to 0.65. The explanation is that child mortality in early childhood is higher for girls because they are neglected by their parents and they have to work from childhood on as servants, getting less and bad quality food. They are abused by other family members and the threat of dowry when they get married induces infanticide. Another discrimination exists through the abortion by sex, when Amartya Sen (1990) refers to "100 million missing girls" (China 44; India 37; Pakistan 5.2; Bangladesh 3.7; and South East Asia: 2 millions), due to female feticides. Reproductive health is sensitive: each year 35,000 women and babies die in Nepal alone due to insecure conditions of birth and neonatal management (WDR 2006). In Afghanistan every 20 minutes a women dies while giving birth due to insufficient health services; the second highest rate of maternal deaths in the world, it is only worse in Sudan. Each woman has an average of more than seven children and sometimes husbands or grandfathers decide that it is more important to buy a buffalo than to spend the money for a woman in a hospital (WDR 2006).

8 While the term *glass ceiling* is metaphorical, many women find it very real, indeed, when they try to climb the labour ladder. Along with the image of barrier is the idea of glass: it is real, but transparent and not obvious to the observer.

2001). A United Nations document (2006a) noted that: "Women constitute half the world's population, perform nearly two thirds of its work hours, receive one tenth of the world's income and own less than one hundredth of the world's property."

Of women between 15 and 64 years, 61 per cent enter the paid labour force, but 86 per cent of men. Nevertheless, there are different payments for comparable work (table 72.1; Giele/Stebbins 2003), sexual harassment in the workplace, lack of family-friendly workplace policies, and often open discrimination. According to Forbes, in 2009 only five of the 500 biggest enterprises were directed by a woman. In 2007 the *Equal Employment Opportunity Commission* (EEOC) in the USA received 24,826 charges of sex-based discrimination.[9] Workplace fairness, legal protection, and equal salaries for similar jobs are some of the processes that could reduce discrimination at the workplace. Then there is the discrimination in household work, where the non-paid labour of women represents 37 per cent of the GDP of the USA (Vaughan 2004) and in poor countries this percentage increases up to 80 per cent when subsistence orchards are giving also the food for the extended family (FAO 2008f). In political terms, of more than 202 sovereign states in December 2008 only 12 were ruled by women (UNIFEM 2008).[10] Tickner (1999) asks "why here are so *few* women in position of power even in countries where legal equality has been in place for a long time. The power that gender role expectations exert, can tell us about this". There is not only a quantitative problem with women in politics but also with their visibility. Female ministers are concentrated in social areas (14 per cent) compared with legal (9.4 per cent), economic (4.1 per cent), political affairs (3.4 per cent), and the executive (3.9 per cent). Only 7 per cent of the world's total cabinet ministers are women (UN 2006). There is also a low correlation between a high rank on the HDI and women's participation in politics, but countries such as Iceland, Canada, Switzerland, Japan, France, and the USA still have gender discrimination patterns in government (table 72.2). Norway, Sweden, Finland and Germany have a higher female political participation, while Latin American countries are still struggling for more equality.

Table 72.1: Different pay in the manufacturing sector by sex for comparable work; **Source**: UN (2006: table 5g).

Country	Payment for women compared with men (%)
Sri Lanka	85
France	79
Mexico	71
Brazil	54
Bangladesh	50

Gender discrimination has been high in disaster agencies and in UN organizations working on disaster management. Most of them are still run by men irrespective that gender discrimination increases social vulnerability. In the Aceh Besar district the surviving men outnumbered females in a 3: 1 ratio (Oxfam 2005a). In a case study on Sri Lanka women represented 65.3 per cent of the fatalities (Birkman/Fernando/Hettige 2006). Ariyabandu/Fonseka (2009) found that the distribution of aid during the tsunami relief in Asia and the earthquake in Pakistan discriminated against women. They found that most support was given exclusively to men, as heads of household; women did not get direct access to relief aid, even when they were head of a family. External support often reproduces gender biases: while fishermen in Indonesia and India got boats and fishing implements, fishing women did not get any tools, what impeded recovery with dignity through productive self help.[11]

These historically developed gender gaps are mostly invisible. Thus, social identity is complex (Moscovici 1990, 1998, 2000) and stereotypes are among the root causes of any discriminative behaviour (Halsam 1995; Haslam/Oakes/Turner/McGarty

9 The EEOC resolved 21,982 sex discrimination charges during 2007 and recovered $135.4 million in monetary benefits for the charging parties and other aggrieved individuals (this data does not include monetary benefits obtained through litigation <http://www.eeoc.gov/types/sex.html>).

10 The Philippines and India (before also Indonesia, New Zealand, Bangladesh, Sri Lanka) in Asia; Argentina and Chile in Latin America and Caribbean (before also Panama, Jamaica); Finland, Germany, Ukraine, Bosnia/Herzegovina, Island and Moldavia in Europe (before Latvia, Ireland), and since 2006 Ellen Johnson-Sirleaf, President of Liberia in Africa and Luisa Diogo, Prime Minister of Mozambique. In 2005, globally 14 per cent of the parliamentarians were women and 11 per cent held a ministerial or sub-ministerial post. In Niger only 1 per cent of the members of parliament are women and Sudan has no female ministerial official. Several Gulf States with parliaments did not yet give women the right to vote or to stand for election (UN 2006).

Table 72.2: Rank of countries according to the HDI and percentage of women at the ministerial level in June 2007; **Source:** IPU [Inter-Parliamentary Union] (2007).

Rank HDI	Country	2005
1	Iceland	27.3
2	Norway	44.4
3	Australia	20.0
4	Canada	23.1
5	Ireland	21.4
6	Sweden	52.4
7	Switzerland	14.3
8	Japan	12.5
9	Netherland	36.0
10	France	17.6
11	Finland	47.1
12	USA	14.3
22	Germany	46.2
38	Argentina	8.3
40	Chile	16.7
46	Uruguay	0
48	Costa Rica	25.0
59	Bahamas	27.7
50	Seychelles	12.5
51	Cuba	16.2
52	Mexico	9.4

1995). The traditional role assignment of a woman is to be a housewife who cares for children, the family, old people, domestic animals, and orchards.[12] But it is above all the social identity process that reduced their survival opportunities (Anderson/Billing 1992). Men and women acquire different functions and attributes in any society (military vs. childrearing; public vs. private), that are based on social roles, norms, and traditions. Women's self-identity, social pressure, and life-learning processes have internalized their role for mothering (Chodorow 1978). They feel morally self-obliged to care for family members and their livelihood. In a moment of risk, their first reaction is to save children, elders, the handicapped, and often domestic animals. While a man can reach the highest level of honour offering his life as hero for the 'fatherland'; a woman gets her sublime self-realization by giving her life for others in a silent way.

To address gender discrimination, a policy in myriad form must be developed, where procedural issues, structural phenomena, training, and empowerment will change the thousands of years fixed rules that have created theses discriminative forms of social behaviour.

> If identities were no longer fixed as the premises of a political syllogism, and politics no longer understood as a set of practices derived from the alleged interests that belong to a set of ready-made subjects, a new configuration of politics would surely emerge from the ruins of the old. Cultural configurations of sex and gender might then proliferate or, rather, their present proliferation might then become articulated within the discourses that establish intelligible cultural life, confounding the very binarism of sex, and exposing its fundamental unnaturalness. What other local strategies for engaging the "unnatural" might lead to the denaturalization of gender as such? (Butler 1990: 15).

Sexual discrimination was outlawed in the United States through the Civil Rights Act of 1964 in the hopes of allowing women to rise in the working world once proper experience has been achieved (Hesse-Biber/Carter 2005). There remains the question why feminism has been vilified and why famous women (e.g. Hillary Clinton) were very cautious to use it, due to so many negative connotations. Without doubt, this is a political issue that is related to the preservation of power in the existing system of vertical, authoritarian and violent relations, also called patriarchy. Only a deconstruction or decolonization will be able to open the door for gender equity and solidarity to achieve the proposed Millennium Development Goals (Mohanty 2004; Oswald Spring 2009).

11 Another example of gender gaps is the discrimination of relief aid for single mothers in Pakistan after the earthquake; or the rape of women in the refugee camps of Darfur when they have to search for fuel early in the morning. In the recovery phase in Sri Lanka, a good intended project ended with gender discrimination. Government promised new houses once the widowers married again. Adolescent girls were obliged by their families to marry elder men often with children, only to get out of the refugee camp.

12 During the tsunami disaster, this was one of the reasons why women were inside their houses, busy with domestic work. They did not perceive the imminent danger. Due to cultural and misogynist taboos they were not trained in swimming and were dressed with saris and had long hair. All these factors imperilled their hazard response.

72.3.3 Race, Colour, Ethnicity, Religion and Sexuality

Racisms is a system of beliefs, sometimes organized as a doctrine, where biological differences among human groups determine individual and social opportunities, declaring one's own race as superior and exercising domination over others by a specific belief system. The Macpherson Report (1999) describes it as

> the collective failure of an organization to provide an appropriate and professional service to people because of their colour, culture or ethnic origin. It can be seen or detected in processes, attitudes and behaviours which amount to discrimination through unwitting prejudice, ignorance, thoughtlessness and racist stereotyping[13] which disadvantage ethnic minority people.

Combined with institutional neglect, discrimination happens all over the world. Two hundred tribal Iruars in the Cuddalore district in India had not received any governmental help a month after tsunami. As an ethnic group, they represent the bottom of the social hierarchy. Even if the situation of caste and ethnicity is complex, the government has a legal obligation to guarantee the human rights of the discriminated. Small groups react to this discrimination with isolation and when they organize in a bigger group they defend their human right to equity (Levine/ Moreland/Ryan 1997).

> Racism can be both personal and institutional so efforts to combat it must address both aspects. Individual racism is an isolated act by a single individual. Changing laws and culture have helped to reduce, but not eliminate it. A recent CNN Poll indicated that 84 per cent of Blacks and 66 per cent of Whites considered racism to be a 'very serious' or 'somewhat serious' problem; and 51 per cent of Blacks and 26 per cent of Whites claimed to have experienced some form of discrimination. But a singular focus on individual racism and discrimination can divert attention from a more insidious and subtle contemporary form – institutional racism and discrimination (Barbour 2008: 1).

When discrimination is related to ethnic groups, it is often a reaction of *ethnocentrism* and when it refers to outsiders it is called *xenophobia* (Hogg/Moreland 1993). Colonial history and economic dominance often induced white people to think of themselves as being superior (Hage 1998). Ethnic discrimination is reported from all continents, but less known in Africa.[14]

Indifference, neglect, and insensitivity help foster aversive racism which may not be unrecognized by the majority because it is so embedded in the social culture and structure. As this is the 'normal behaviour' it perceived the system as fair and equitable. It assumes that everyone is treated equally thus situations where prejudice and discrimination occur are denied. Discrimination is often an act of omission and governments use their small budgets to justify their non-intervention and neglect of discrimination. Minorities who are affected and have experienced discrimination hold a different perception. They see discrimination as both acts of omission and commission. They start and organize to denounce it.

Worldwide, this type of discrimination is related to the appropriation of collective land rights and natural resources by minorities. They use the lacking legal definitions or existing conflicts with the modern system of private property and resource exploitation for personal interests. But they can not deny the institutional discrimination. They frequently experience complex disaster situations as e.g. in Nigeria with its oil reserves (Women's Commission for Refugee, Women and Children 2006) or in Myanmar in May 2008 during Cyclone Nargis, where the military rulers did not launch an early warning and evacuation policy as a region where the guerrilla movement is active

13 Maughan-Brown (1985) looks critically at the "use that is made of fiction as an instrument of propaganda, the way race myths and stereotypes are embodied in fiction."

14 Muzangi Mbella Liliane, an indigenous from Congo insists: "There is a mistake to think that there were no indigenous people in Africa. The ancient migration of peoples and tribes had sparked clashes and formed segmented societies long before Western colonization. Therefore, for African indigenous and tribal communities access to traditional lands and resources should not be denied, particularly... the vast amounts of which are in high demand worldwide." Johnson Ole Kaung, the Director of the African Indigenous Movement for Peace Advancement and Conflict Transformation, said "African's indigenous populations and communities were identified outright as second-class citizens and were systematically marginalized on the basis of their cultural identities and the traditions they practiced, which were considered 'primitive' by some bureaucrats. The key issue for Africa's indigenous dealing with conflicts and natural disasters ... is the protection of their rights and resources, and ensuring the legal recognition of those rights" (UN 2006). And the Ogiek, a tribe from Kenya, argued that "all Africans are indigenous and our complicated, ancient history of human migration in Africa had produced tribal groups and communities as nomads, pastoralists, hunter-gatherers, whose way of life attachment to particular land and ecosystems, and social and political standing ... had resulted in their discrimination within modern African States" (UNDP 2004c).

would be hit. The case of Hurricane Katrina was similar, where Afro-Americans and elderly people in New Orleans who lived below the level of the river and lake neither received adequate early warning, transportation, financial support for evacuation, nor protection and attention during their stay in the Superdome.[15] Throughout the recovery phase, the low lying parts, mostly occupied before by Afro-Americans and Latinos, were not cleaned up and not prepared for reconstruction due to toxic substances that were diluted in both water and soil (Salinas 2006). This slowness was also triggered by institutional discrimination.[16]

To combat racism, neglect, and institutional mismanagement, policies and executive decisions must be taken to combat actively the underlying factors (Rocco 2000). The rational actor, the organizational behaviour, the governmental politics, or the cognitive model can be used (Allison 1971; Allison/Zelikow 1999). These models are based on the assumption that human behaviour is influenced by values, emotions, personal experiences and biases. Political and organizational decisions are not always rational or linear (Gribbin 2004) and create often a cognitive dissonance due to both conscious and subconscious factors influencing perceptions of reality that limit the perception (Gray 1992). Thus, any institutional behaviour must take into account (Nye/Brower 1996) and reflect on these individual perceptions of reality and combat systematically the bias avoiding greater equity and equality of race, ethnic groups, and social classes.

A survey about the institutional and ethnic discrimination in San Angelo, Texas, demonstrates:

> that different groups in San Angelo hold different and conflicting perceptions about personal and institutional discrimination. An effective democracy, however, depends upon the faith citizens have in their government and the expectation that their public officials will respond to their problems and concerns. The role of the public administrator is to assist in the creation and maintenance of authentic discourse though which the concerns of divergent populations can be heard and attended to. Trust, however, varies among the various groups. Those possessing high levels of trust spend less time calculating what might go wrong in a given situation and have faith that public policies are working well. Individuals and groups with lower levels of trust are less willing to accept public policies as fair and equitable. These groups tend to become disengaged from community participation developing an 'outsiders' view relying more on rumour and half-truths which allow misperceptions and misunderstandings to persist within the community (Barbour 2008: 14).

Bottom-up indigenous and feminist movements forced the *World Intellectual Property Organization* (WIPO) – a UN body that is specialized to reward creativity, innovation, and safeguard public interests – to defend the traditional knowledge from indigenous and women developed during thousands of years from transnational patenting. In 2000, the General Assembly of WIPO established an *Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore* (IGC) to defend intellectual property of traditional knowledge and cultural expressions of folklore (UNESCO 2007a). While more than 150 indigenous groups affiliated themselves, the UN with its bureaucratic approach for dealing with complex discrimination patterns is not the best bottom-up approach to protect traditional knowledge.

72.3.4 Class, Caste, and Other Socio-economic Conditions.

Ethnicity and race combined are still often the single most overarching issue of class status in some societies. However, a distinction should be made between causation and correlation when it comes to distin-

15 The death toll and displacement of these groups has shown that their financial capacity was too low to evacuate by themselves, and their capability for resilience-building was also limited. This case illustrates a complex discrimination process, where institutional racism, ethnocentrism, discrimination, and neglect challenged the bases of democratic society in the USA with severe negative outcomes. Detailed statistics on the victims and economic losses of discriminated groups – to the extent that they have been compiled for Hurricane Katrina in 2005 – show a much higher degree of vulnerability of Afro-Americans. According to a report in the *Times Picayune* (New Orleans) of 6 March 2006: "Of the 1,840 people still catalogued ... as missing from Louisiana, 30 were 5 or younger; 74 were 80 or older. Women comprised 910 of the total. The majority – 1,422 people – were from New Orleans. Of 1,590 people whose race was known, 1,352 were Afro-American [representing 85 per cent]".

16 The Governor of Louisiana, Kathleen Babineaux Blanco, said on 23 January 2007: "For eighteen months, the Washington Republicans have consistently punished and discriminated against our people, all for partisan political purposes. A state with 80 per cent of the storm damage from two hurricanes received barely 50 per cent of federal relief funds. Mississippi, with far less damage, received far more money proportionately and six months earlier.... Just one recent example is the Katrina cottages programme. We have over 64,000 people still living in trailers, yet we received money to help only 600 of those families. The Mississippi received $280 million dollars, nearly four times as much.".

Figure 72.1: Urban growth rate of Mexico City (in per cent by decades) 1910-2000. **Source:** INEGI (1950-2000).

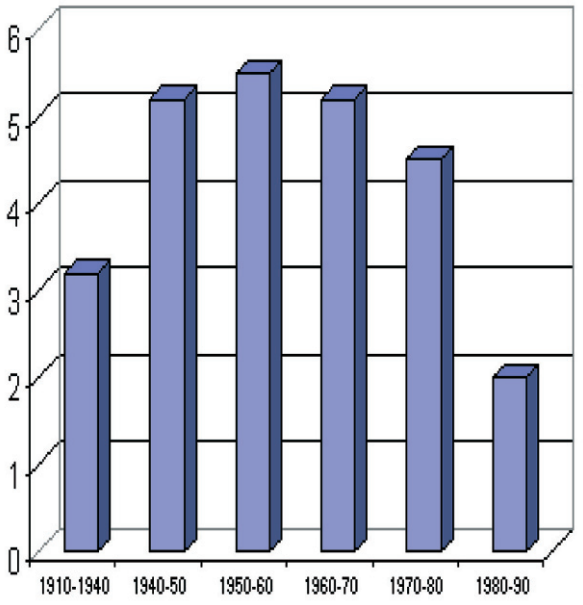
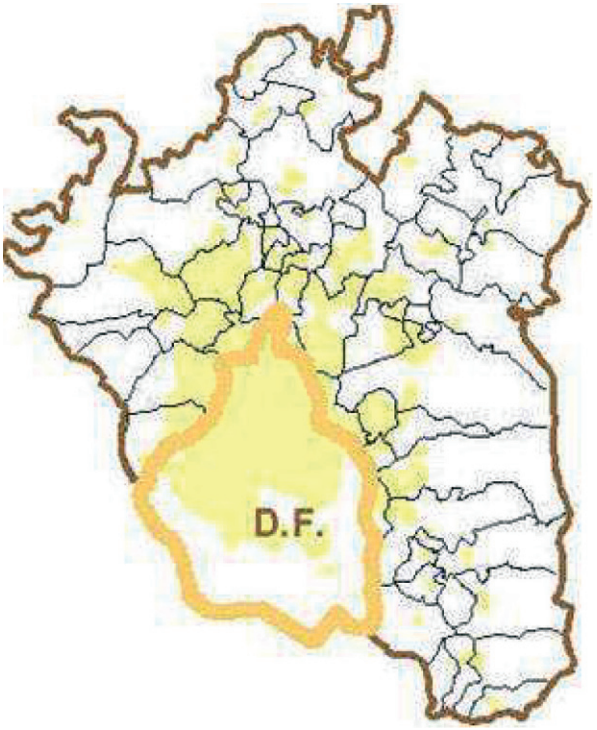


Figure 72.2: Urban growth into a megacity of the Mexican capital. **Source:** INEGI (2005).



guish between race and class. Some societies have a high correlation between particular classes and race, but this is not necessarily an indication that race is a factor in the determination of class

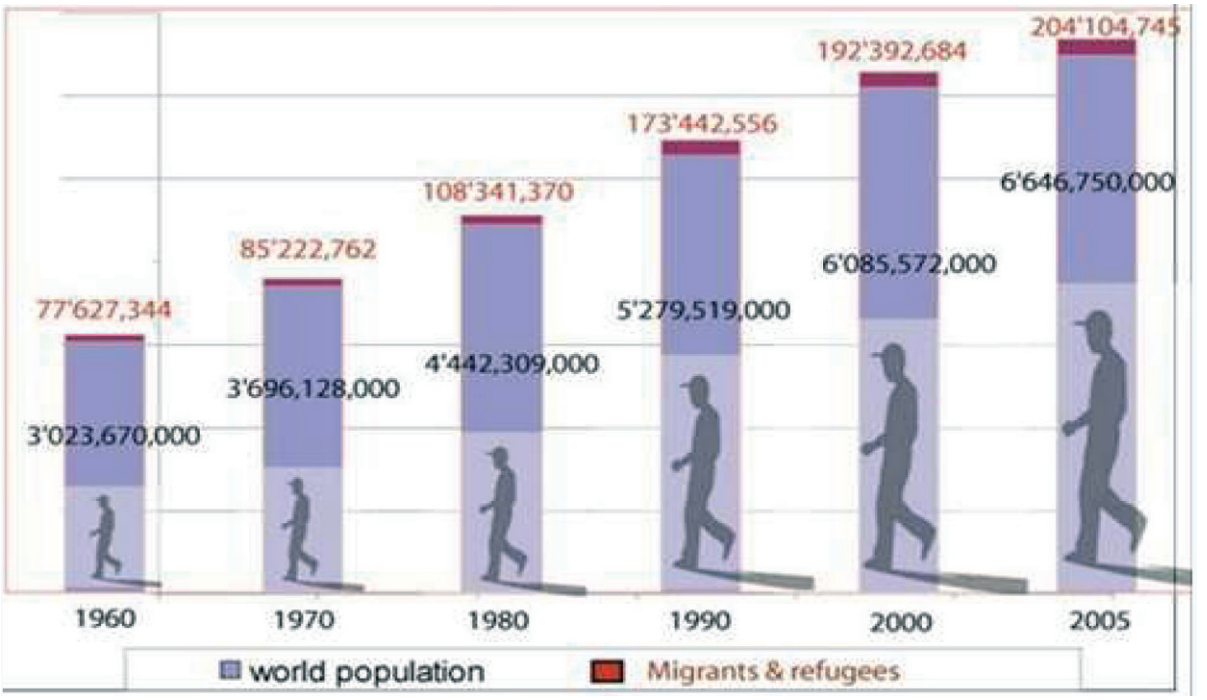
Social classes refer to a hierarchical distinction between social groups or individuals in a society depending on economic income and social status. Dennis Wrong (1998) defines class in a realist and nominalist way, where the realist definition relies on clear class boundaries and people adhering to social groupings. They identify themselves with a particular class and interact principally with people belonging to this class. The nominalist definition focuses on characteristics such as education and occupation. In the cast distinction individuals are grouped into a determinant cast based on their birth, and they belong to it during their whole life because in Hinduism it is their karma.

The Indian caste system is the oldest system of social rigidity lacking any upward and downward mobility. It divides society based on skill and qualification. Often it is understood as a social system but it must also be taken as a belief system consolidated with religious ceremonies. After independence, the Indian constitution tried to abolish the caste system with very little success. Therefore the *National Campaign for Dalit Human Rights* (NCDHR) claimed that they and tribal groups were discriminated by higher caste people from the same community. Thus, discrimination is often invisible and transformed into daily habits.[17]

In Latin America access to wealth and power is also related to ethnicity and race, and the *criollos* consider themselves as descendents of Spaniards born in America and therefore with access to the highest decision-making processes. Max Weber referred to the meritocratic society or the 'American Dream' where hard work, universalism, individualism, wealth, activ-

17 After the tsunami in 2004 in India conflicts raised between the behaviour of fishermen against *Dalits,* historically considered as 'without caste or untouchable'. The *Dalits* self-defence reaction was leaving the refugee camp when they were threatened by the higher caste. Often it is culturally so deeply ingrained that it appears as an unintentional or natural act. The *Indian Express* reported on 7 January 2005 that the fishing communities refused to share water and claimed 'that the *Dalits* would pollute the water'. But in the April 2009 elections an untouchable woman was elected as President of the Indian National Assembly.

Figure 72.3: World population, international migrants, and refugees (1960-2005). **Source:** Designed by Guillermo Peimberg of UNAM/CRIM based on data of UN Population Division (2007); at: <http://esa.un.org/unmigration/>.



ism, and rationality allow individuals to gain a higher social status and belonging to a certain class. In developing countries the system of family links dominates, based on birth and not on capacity. While social classes offer some social movement between lower and upper classes, in the caste system people belong to it for ever. Both distinctions establish a social hierarchy, where the structure of power privileges the upper class or caste, generate some social peace, and permits the exploitation of the lower classes and castes for their own benefit.

72.3.5 Forced Migration, Migrants, and Refugees

Climate change, economic crises (Bakker/Gill 2003), food scarcity, and high prices for basic goods, desertification, land degradation and drought (DLDD; Brauch/Oswald Spring 2009) and other climate related disasters have forced people to leave their communities and migrate to rural areas with better production potential. This process is creating greater tension on the land and the social structure, often aggravating DLDD processes, depletion of aquifers, and pollution.

A second process of migration is to urban areas, above all in poor countries to megacities. The case of Mexico City illustrates the earliest rural-urban migration process and created the biggest megalopolis in the South. Different phases can be distinguished, first from 1950 to 1970 the neglect of rural policies, a process of industrialization of import substitution and investments in industry induced a massive rural-urban migration. Between 1970 and 1990 import substitution, green revolution, economic crises, and subsidies concentrated in urban areas reinforced these migration processes, which is reflected in the growth rate in Mexico City (figure 72.1, 72.2) until 1980, when lack of land, high land prices, and saturated shanty towns forced the immigrants to settle in suburban areas. This spread the megalopolis to the municipalities in the states of Mexico and later to Hidalgo.

A third process is international migration in search of a better livelihood. The UNFPA (2007a) estimated more than 203 million migrants worldwide in 2005. India, China, and Mexico are among the nations with most emigrants due to the globalization process. After *the North American Free Trade Agreement* (NAFTA) between the USA, Canada, and Mexico entered into force in 1994, massive imports of cereals destroyed the peasant economy that was unable to compete with the subsidized cheap food prices. The lack of support by the government for basic crops and a drier and hotter climate forced many small farmers to

Figure 72.4: Native Mexican residents in the USA; **Source:** Estimations by CONAPO based on *Current Population Survey* 1994-2007, elaborated by F. Lozano, CRIM, 2009.

emigrate to the USA and look for better paid jobs (figure 72.3). Since 2005 more intense natural hazards but also a decline in public security and the consolidation of international organized crime on drugs, arms, and human trafficking increased international migration that dropped in 2009 due to the global financial crisis.

Today Latinos and especially Mexicans (figure 72.4) represent the first minority in the USA with an estimated 45 million people of which approximately 12 to 14 million do not hold legal documents. With the changes in the US immigration laws after 1987 about 85 per cent of new immigrants were illegal. Muñiz (2006) insists:

> This dramatic growth in the Latino population, accompanied by that of other groups stresses the importance of recognizing the ethnic, cultural, and economic make-up of a given region in order to asses the prospective needs and challenges of those in a potential disaster area.

Poverty and neglected governmental support at home obliged them to emigrate. They had learned self-protection[18] and imaginative threat-reduction throughout their whole life. Later, the illegal crossing of a dangerous and militarized border created experiences of how to deal with hazardous situations, and how to optimize marginal opportunities for achieving their goal. Furthermore, living in a permanent illegal status and facing continuous deportation risks created a habit for self-protection.

Besides economic migrants and those leaving after disasters, there are forced migrants and refugees[19] that left due to complex emergencies where natural disasters, famine, internal conflicts and destruction of their livelihood compelled people to abandon their homes (Newman/van Selm 2003). In 2008 the UN High Commissioner for Refugees estimated 11.4 million refugees and 26 million other internally displaced

18 In the three southern Gulf states that were affected by Hurricane Katrina, the growth rate of Latinos between 1990 and 2000 was between 148.4 and 207.9 per cent. Before Hurricane Katrina some 230,000 Latinos lived in the affected area, most of them were extremely vulnerable illegal immigrants. Being confronted with threats of deportation and with their low confidence in American institutions due to former experiences of discrimination, they evacuated themselves though their own social networks. An important number came from hurricane prone backgrounds. The Honduran Consulate in New Orleans spoke of 140,000 Hondurans who moved after Hurricane Mitch to New Orleans that had survived different types of disasters. This social learning has increased their resilience and helped most Latinos to save their lives. The post-disaster situation was mitigated with church support and solidarity among Latinos living in safer regions. After the disaster, the Latino community worked together and repaired what was repairable. For masons, carpenters, plumbers and cleaners, restoring damaged houses and buildings, above those which were badly insured, offered new job opportunities

persons due to conflict or persecution at the end of 2007 based a global annual survey (UNCCD 2007). This migration is expanding in Sub-Sahara Africa. More than half of the 13 million *internally displaced persons* (IDP's) live in 19 countries; alone 6 million in Sudan and 2.3 millions in DRC. Africa also accounted for the world's highest number of returning refugees. In the DRC, more than 1 million IDPs returned home in 2004 and after the end of civil war in Angola in 2002, some 900,000 started to return.[20]

In Africa, the Sahel zone, and recently Darfur, became an environmental hotspot for forced migration. A climate-induced decline in food production, violent conflicts between herders and farmers, due to lack of water for extensive livestock, arms trade, lacking negotiations for water for the herds, privately owned former communal land and the expansion of agriculture and livestock due to new demand, and a substantial decline in precipitation by 16–30 per cent, resulted in depleted aquifers. During the past 40 years the desert in northern Sudan advanced southward by 60 miles. All these developments produced a decline in local staple of up to 70 per cent. The armed conflict escalated into a civil war with 2.5 million internally and externally displaced people from Darfur and an estimated 225,000 killed people. UNCCD (2009) estimated that in 2050 drought and desertification will threaten the livelihood of over 1.3 billion people in more than 110 countries around the world. If other natural disasters and their socio-economic and political impacts are included, their number can increase substantially.

Globally urbanization and migration are overwhelming phenomena of the 21st century that may result in local conflicts. Migration creates social vulnerability and has complex roots. People flee from disasters, socio-economic crises, poverty, marginalization, public insecurity, personal problems, famines, internal conflicts, and wars. During the migration process people are highly vulnerable to be killed or women to be raped, and when they have to cross illegally borders, the situation is getting worse. In the new host community or country, they are often confronted with xenophobia that is sometimes aggravated by scarce resources that could generate new conflicts over land, water, jobs, food, and houses. Immigrants suffer simultaneously from discrimination in many ways and are often offered the least desirable, lowest-paid and most hazardous jobs. An extreme case occurred in May 2008 in South Africa, where mobs attacked and killed immigrants, arguing that they take away jobs.

As modern immigration from South to North is mostly illegal, several additional threats exist not only for these 'non-existent' persons, but also during an epidemic for the guest country and its people. The UN explores a legal status to protect this highly vulnerable group. At present, they must develop their own resilience and survival strategies.

72.3.6 The Elderly, Children, and Adolescents

Discrimination due to age is directed not only against the young in poor countries, but also against older people, and the situation is getting worse due to the economic crisis and high unemployment. In Asia, the number of people over 60 will grow from 9.4 per cent in the year 2000 to an estimated of 23.5 per cent in 2050, what equals 1.2 billion old people. Asia will then be home to 63 per cent of the world's elderly (UN 2006a).

During disasters and crises they are often neglected and threats are triggered by sex.[21] After the tsunami of 2004, in India, Indonesia, the Maldives and Sri Lanka, there was a similar discrimination. Old people in the camps suffered from their limited mobility due to a lack of wheelchairs, walking aids, and glasses. They had difficulty to sleep on the floor without mattresses. They suffered from lack of privacy and a noisy environment, as the shelters were taken over by the young. The dust from the open

19 UNHCHR defines a migrant as "a person who is living and/or working in a State of which s/he is not a national"; at: <http://www.coistine.ie/resources/resources-for-schools/6-migrants-and-refugees>. According to the United Nations Convention Relating to the Status of Refugees (1951), a refugee is a person who "owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group, or political opinion, is outside the country of their nationality, and is unable to or, owing to such fear, is unwilling to avail him/herself of the protection of that country."

20 See for details at: <http://www.forcedmigration.org> and UN [Economic and Social Council, HR/4892], 2006.

21 During the tsunami deaths in Matara, Sri Lanka of people aged over 60, 38 men vs. 91 women died; while below 10 the gender was less irrelevant: 31 boys vs. 41 girls. Old age also induced in the same place (Matara) multiple discriminations during disaster support and recovery: two weeks after the tsunami 1,507 elderly people had received very little or no relief assistance.

space increased their asthma or they lacked their special diets and medications.[22] Cases of institutional neglect worsened their situation of personal inability (WDR 2006). The question arose: is this neglect discriminatory and how does it limit the survival of the vulnerable? As this behaviour is based on deep-rooted social representations and learned behaviour, how can it be overcome by policy and resilience-building of the affected people?

Most old people in poor countries work due to missing pensions to maintain themselves and often a part of the family.[23] The 2004 tsunami, hurricanes Katrina and Stan, and other disasters severely affected people over 60 who made their living as fishermen, farmers, artisans, as waged or household support staff. After the disaster, but also during crisis situations when jobs are rare, older people worldwide are unable to get a job. This is a global phenomenon and in the USA a legal framework was established protecting them against discrimination.[24]

There is a structural discrimination related to the inequality among countries that is reflected by the life expectancy that is worldwide at 68 years but in Japan 83 years, while in Swaziland only 40; in Sierra Leone 42 years, where 58 per cent of children after 23 months are still only breastfed by undernourished mothers. Child mortality in Sierra Leone is 262; in Afghanistan 257, but in Sweden 3 for 1,000 children (UNICEF 2009: 118–121).

Population growth, megacities, and slum development represent permanent structural disaster problems that increase vulnerability among people in poor countries. World population is estimated to increase between 2007 and 2050 from 6.6 to 9.1 billion people. The industrialized countries will almost maintain their population with a total fertility rate of 0.2, while less developed countries will enlarge their population from 5.4 to 7.9 billion with a rate of 1.3. The poorest countries will have a population rise from 0.8 to 1.7 billion and a growth rate of 2.3, with the lowest urban development (UNFPA 2007a: 90). By 2025 India will have a population of 1.4 billion, overtaking China as the most populated country (Bos/Massiah/Bulato 1994; UNFPA 2007a; Visaria/Bath 1999; Natarajan/Jayachandran 2001; Dyson/Hanchate 2000).

Children are the future for the world, but 1.9 billion live in developing countries and one billion live in poverty and marginality: in East Asia and the Pacific there are 594 million, in South Asia 585 million, in Sub-Saharan Africa 340 million, in Latin America 197 million, in the Middle East and North Africa 153 million, and in Central and Eastern Europe 108 million children. About 640 million children do not have adequate shelter and 400 millions are without safe water, both phenomena are increasing child mortality and morbidity rates. Most of these children are born in Asia, in the region with the main population growth. During the tsunami disaster relief, the psychosocial services focused mostly on children and on the adolescent, especially orphans, to overcome losses, find family members, playgrounds and school facilities, while the old people were mostly forgotten. Nevertheless, older people often take care of both their own grandchildren and orphans.

Without doubt, to invest in reducing the stress of children is crucial. Quality and sufficient food in their critical growing process avoids a 'perverse poverty' syndrome (Oswald Spring 1990) that often causes brain damages before a child is born due to chronic malnutrition of the mother and child. These children with chronic undernourishment suffer for the rest of their life from lower intelligence and psycho-motoric limits (Álvarez/Oswald Spring 1993). In 2007, Stanford University published a *Post-Traumatic Stress Disorder* (PTSD) that affects the hypothalamic-pituitary-adrenal (HPA) axis due to an excess of cortisone in the blood of a child. This is a direct result of extreme and chronic stress. During disasters PTSD occurs in many children when a hazard is linked to loss of family members and sexual or emotional abuse. This brain damage is irreversible and negatively affects the future of these children, but also their capacity for adaptation and resilience-building.

22 The person in charge of the Memana Camp in India said "There should be special facilities for the health care of the older persons and there should be provision of special monetary assistance for them" (www.helpage.org).

23 Nagalingum, a 77 years old woman from Nagatttinam in India lost her daughter in law. "My son is unable to support his family and now, I have to take care of him as well as his two sons. I cannot manage it on the Rs 200 that I get as my pension. I need additional support." In Thailand an 85 year old man confirmed that he was doing unskilled work "packing fish, crabs and squid fishing wharfs". In India older peasants loss their plot of land for growing rice, groundnut, coconut, cashew, mango, banana, millet and vegetable, which were destroyed or land was salty.

24 In the USA since 1967, the Federal Age Discrimination in Employment Act has prohibited age discrimination in employment (hiring, termination, benefits, training and promotions), protecting employees from 40 to 65. In 1978, the US Congress raised the upper age limit to 70, and in 1986 the Act eliminated an upper age limit.

Contrary to the Malthusian prophesy, until today enough food is produced worldwide to feed all persons, including the projected increase. Hunger is not a problem of production, but of distribution. It is a result of missing access to food and of money to buy it. The present food crisis has not been a result of scarce basic food, but a problem of price speculation, the use of food items for biofuels and animal feeding, also due to an increase in the demand for food and animal proteins in China and India, and a structural poverty and mismanagement of agricultural policy in undemocratic countries. Climate change will impact more seriously on food production in poor countries with the highest population growth and lack of transparent governments, what may lead to famine and to forced migration and complex emergencies.

Finally, climate change and sea-level rise will impact above all on coastal areas, where today 10 per cent of the world population and 13 per cent of urban dwellers live on 2 per cent of the land. Asia may loose 18 per cent of its land with 13 per cent of its population, while small islands are estimated to loose 16 per cent of their land affecting 13 per cent of their population (UNPFA 2007: 62) if the sea-level rises by 50 cm. Thus, high demographic growth rates, marginality, discrimination by class, caste, age and sex, and global environmental change are presently triggering the multifaceted situation of poverty, slum dwellers, food scarcity, risky land and low life expectancy, and could induce in the future situations of complex emergencies.

72.3.7 Physically Handicapped (Disability, Illness, HIV/AIDS)

About 10 per cent of the world population is disabled; in developing countries often twice as many, or nearly 1.3 billion persons. Eighty per cent of them live in hazard-prone poor countries, often affected by conflicts, weak governance, and disasters. Limited capacity for early warning, weak laws, insufficient support for refugees, and mostly negligence for the handicapped prevails. An approach to give special attention and a policy of separation of the handicapped is criticized by disability mainstreaming.[25] They focus on a multisectoral approach to integrate these people. But often during a disaster their former social vulnerability and discrimination deteriorates, not only due to their highly vulnerable situation, but in refugee camps the disabled often lack support to cope with their fate.

During disasters the non-disabled are often confused, but people with handicaps are even more confused.[26] Helen Sullivan (2006) proposed that their education should start in normal daily life, preparing them for different eventualities and threats. Through this rising awareness, they increase their preparedness and with specialized training, concrete actions and effective communications, adapted to different disabilities, they could reduce their vulnerability and increase their survival prospects. This resilience-building is not limited to the disabled.

More than 39.5 million persons, or 37.2 million adults and 2.3 million children are living with HIV/AIDS. In sub-Saharan Africa, 5.9 per cent of the population is infected and in the Caribbean 1.2 per cent. This illness ranks as fourth among the leading causes of death worldwide (2.9 million) and as the first in sub-Saharan Africa (2.1 million). People living with HIV/AIDS are prone to develop other illnesses and infections due to their weak immune system (UNAIDS/WHO 2005). Frequently they get tuberculosis or pneumonia, and children under 5 years have a high mortality rate when they are infected. During normal times, HIV/AIDS is a highly stigmatized illness and during disasters the existing discrimination is worse. In an ambience of open space everybody recognizes

25 In 1990 the US Congress enacted the Americans with Disabilities Act, where 43 million disabled citizens have been "subjected to a history of purposeful unequal treatment", due to "stereotypic assumption not truly indicative" of their personal abilities "to participate in, and contribute to, society."

26 During the tsunami emergency, the handicapped male and female children were also victims of sexual harassment and abuse, not only during the rescue or when they stayed in camps or shelters, but even more during the reconstruction phase. In Sri Lanka activists warned tsunami survivors of rape and stated that trafficking of women and children existed in several Asian countries before the disaster and increased substantially after it. Macan-Markar (2006) noted that these networks continued to operate during the post-tsunami tragedy. In Asia Amnesty International denounced that "sexual abuse and exploitation, often extortion for food or roof must end and the handicapped must be specially protected in their dignity. Almost never rape and sexual abuse is reported, if there is no special report system or network, trained to attend theses cases." Thus, there are also complaints that in relief kits no anti-conceptive pills, condoms or medical attention is available, and precisely in a highly dangerous situation "the worst a woman wants is to get pregnant, when she has no roof, no income and no future. And pregnancy from a rape without knowing who is the father is the worst perspective", remarked a handicapped women in a refugee camp in Sri Lanka.

the HIV/AIDS illness and immediately discriminates the sufferer. Due to fears of potential contagion ill people are often forced to leave the shelter. They require also special medical care and retroviral medicines, which are difficult to get after disasters.

Homosexuality is erroneously identified with AIDS, but is often also perceived as a perversion or a psychological sickness. Thus, a different sexual preference is in many countries stigmatized as socially defective and often persecuted by intolerant social representation groups, and the stigmatized individuals are often victims of crimes. Dangerous 'homophobia' groups take upon themselves the right to monitor sexual preferences and assassinate those who hold sexual preferences different from their own. In machismo cultures, lesbians experience still greater persecution as their sexual behaviour challenges the established social representation of motherhood that cares for others. South Africa was the first country to give any person the freedom to decide on their sexual preference. Sexual discrimination is common enough during normal time, but increases during a disaster, as the emotional stability is lost and people try to reorganize their world with stereotypes, often affecting highly vulnerable groups. As these examples have shown, complex discrimination patterns exist that often reinforce each other.

72.4 Social Vulnerability Due to Identity Factors and Social Representation in Disaster Situations

Discrimination is the background of neglect and of violent behaviour before, during, and after any disaster that is reinforcing existing social vulnerability. Tajfel (1981: 31) argued that social identity means how "we live in a world in which processes of unification and diversification happen with gigantic steps and with a rapidity never ever before seen in history." Hogg and Abrams (1988: 78) added: "Persons have a basic need to simplify and to impose an order to their reality." This process induces them to categorize their social environment through social comparisons, where self-esteem is affirmed and maintained in a positive way. It explains also why this individual self-esteem depends on belonging to a group not necessarily within its own social system of reference.

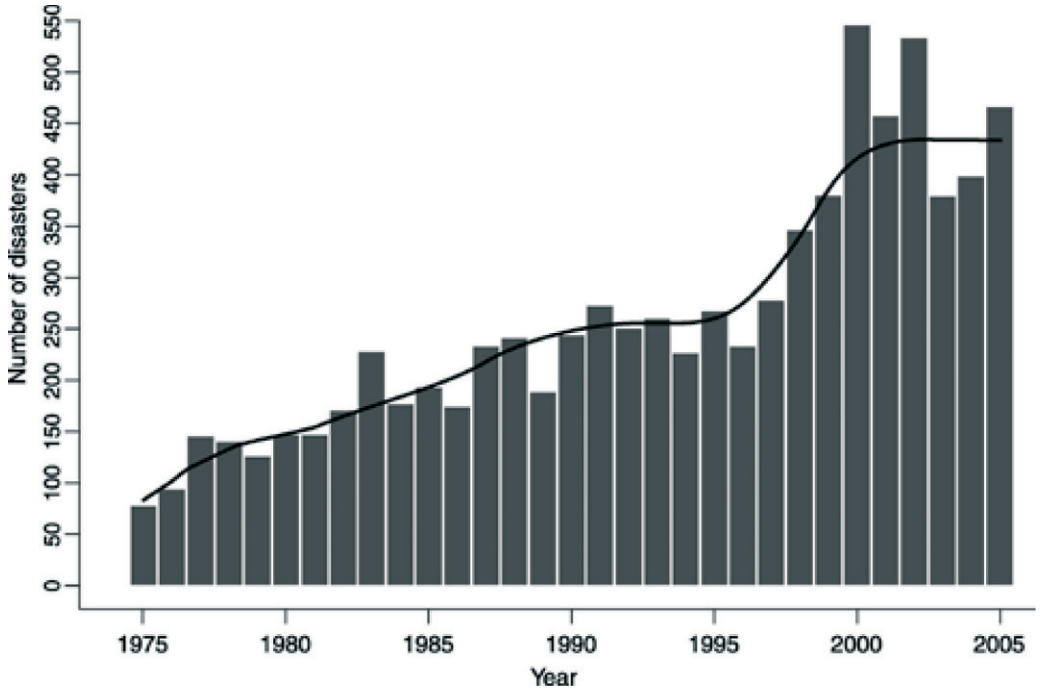
The "systems of value, ideas and practices ... establish an order that permits an individual to get familiarized and to arrange its material and social world" (Moscovici 1976: xiii). For this reason, social representations originate in daily life[27], where the society is the thinking system. Consequently, a continuum exists between personal and social identity; between inter-personal and inter-group behaviour. It includes social beliefs and social mobility, understood both as a result of personal efforts able to induce social changes (Tajfel, 1981; Haslam/Oakes/Turner/McGarty 1995, 1999; Béjar 2007). In this sense, the subjective dimension of identity is interrelated with the objective processes where identity is manifested and transformed (Serrano 2004).

The two basic processes of historical production of social knowledge are linked to anchoring and objectification. *Anchoring* is a process that permits to integrate the unknown situation within the existing representation (internalization); and *objectification* permits that these new representations are projected into the world as concrete objects (Duveen 1997: 87). These functions are *symbolic,* orienting and facilitating communication from the elaboration of attitudes, opinions, stereotypes, identity presentation of group relations, attributes of responsibility or control, narrative of original myths, ideological domination and illusions. But they are also *pragmatic*: motivation orients the activities, planning, social description, and norm-building. The acquisition of these control mechanisms (Maslow/Frager/Fadiman 1998) permits in independent situations to internalize in women several basic psychological processes: a) women *should be*: assigned identity (social facts); and b) women *should be for other*: self-identity (socialized) with interdependence to patriarchy. The results of these complex processes of identity and social representations are structural disadvantages and the discrimination of women worldwide.

Further, social vulnerability is also related to poverty, marginalization, illiteracy, sickness, unsatisfied human needs, and limited access to resources (Melillo/Suárez/ Rodríguez 2004), and therefore the loss of human security is understood as 'freedom from fear' (in the Canadian) and 'freedom from want' (in the sense of Ogata/Sen (2003). Bogardi and Brauch (2005; Brauch 2005a, 2005b, 2009b), who were concerned with issues of *global environmental change* (GEC), developed an additional pillar of human security as 'freedom from hazard impact'. The data indi-

27 These social representations could be reinterpreted as an equivalent for contemporary myths, rites (Eliade 1963, 1965; Graves 1985), and belief systems in primitive societies (Moscovici 1976, 1984: 181, 1990, 1998, 2000).

Figure 72.5: Long-term trend in the global number of natural disasters (1975-2005). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université de Louvain, Brussels, Belgium; at: <http://www.em-dat.net>.



cate that climate change increased the number and the intensity of disasters (figure 72.5). Thus, policy and institution-building should strengthen the links among these three pillars of 'freedom from fear', 'freedom from want', and 'freedom from hazard impact' to guarantee to its citizens a minimal access to basic resources, early warning, preventive evacuation in case of a serious threat, and effective reconstruction without discrimination and gender insecurity for the most vulnerable in a community[28].

72.5 Discrimination Affecting Human Lives and Wealth

The examples discussed above allow an understanding of how a combination of different types of discrimination exists in daily life. The outcome is social vulnerability, and human and gender insecurity as a result of historical inequity, inequality and exploitation, aggravated by all types of discrimination. The accumulation of these triggering factors threatens not only an already precarious lifestyle, but affects the future of children living in absolute poverty, badly nourished, without access to schooling, being officially and personally neglected. For the elderly it takes away their possible survival with dignity, causing dependence on public and family support.

Statistics on disasters and official reports from the World Bank, the International Federation of the Red Cross/Red Crescent Society, ISDR, CRED, the ProVention Consortium, as well as from CARE, UNDP, UNOCHA, UNEP, SwissRe and Munich Re offer in their compilations of disaster data only figures on human fatalities, on affected people, economic and insured losses, both globally and by country or region. So far, all available sources do not disaggregate demographic data (Bankoff/Frerks/Hilhorst 2004). There are no international statistics distinguishing between gender, social classes, race, ethnic groups, religion, handicapped and age, and there is a lack of data and policies on the so-called 'historical disasters' of extreme poverty, often exacerbated by physical and cultural violence, creating additional risks which could lead to complex emergencies.

28 Such a combined human security approach may reduce the unjust distribution system of food where over-consumption coexists with under-consumption among the socially vulnerable. A different system of distribution worldwide would satisfy the basic needs of the vulnerable in case of scarcity irrespective of geographical, social, age or gender status. A stable livelihood and policies for equity in all levels and sectors could also reduce discrimination, and accelerate the recovery process, and above all work preventively to avoid complex emergencies and massive migration.

In addition, hazards in and of their own do not discriminate between the various cleavages existing in society, e.g. between men and women, rich and poor, white and coloured, disabled, high and low social classes or castes, but the impacts of a disasters differs for each social group. Thus, hazards make existing historical and social vulnerabilities explicit. Social gaps reinforce existing inequity and increase threats and fatal outcomes. This can be further aggravated by political and institutional neglect and discrimination or racisms.

In most hazards the death toll for women is higher. Their social representations lead to social constructions, norms, and behaviour to save the life of others. To be identified and socially constituted as 'a man' or 'a woman' entails gender discrimination, violence, and power loss. Women are often confined in private spaces to reproduction and made dependent, what increases their social vulnerability. But also their self-identity to care as *homo donans* (Vaughan 1997, 2004) 'force' them in case of threats to save children, the elderly, and even animals, often risking their own lives (Yonder/Akcar/Gopalan 2005).

The fact that risks are not equally distributed, neither geographically nor socially requires addressing the root causes. More frequent and more serious hazards occur in the tropics and affect to a larger extent poor people due to their precarious life conditions and shelters. GEC is mainly caused in industrialized countries, thus these countries must assume their moral and historical responsibility to mitigate technically and financially the impacts of hazards in poor countries through transfer of technology for energy saving techniques and sustainable energy sources, but also integrating environmental forced migrants in their societies.

In socio-psychological terms, under normal conditions humans live in networks, trying to compensate and survive difficult socio-economic circumstances. However, during emergency situations these networks often break down, leaving individuals or small groups to fend for themselves alone. This loneliness is reinforced by a lack of coordination or even competition among government agencies, different aid organizations, and NGOs. Thus, assistance required to re-establish as soon as possible these lost networks, independent of the initial costs. They will be able to support the reconstruction and to return as soon as possible to normality, reduce corruption, discrimination and long-term effects. Apparently they seem to be expensive and funds are basically limited for emergencies and reconstruction, but they reduce substantially future costs and above all improve life quality for affected persons. It is a core reason while hazards turn into disasters and often increase social vulnerability and discrimination, where poor people have to find their own way to overcome their precarious situation.[29]

72.6 Conclusions

During disasters the trigger effects from different types of discrimination often generate a long list of failed actions that are aggravated by a lack of governmental sensibility and aid agencies for vulnerable situations. Efforts to overcome discrimination often result in long lists of recommendations, norms, and codes of behaviour, including global UN human rights pacts (IASC 2006). Discriminative practices are changing between cultural and social contexts. If these measures are applied mechanically, discrimination can even increase as the allocation of houses for widows in Sri Lanka has shown. Thus, a fragile balance exists between a general, comprehensive non-discriminative human behaviour and a culturally specific conduct. This requires sensitivity and special knowledge from institutions and aid workers involved and practice of equity in all governmental activities.

Thus a *first* conclusion is related to a mental shift and a new culture of care to better perceive and understand the underlying and invisible factors which create or reinforce disasters in social and physical terms. National and international priority should be given to consolidate institutional bases for DRR, but also citizen consciousness to be prepared and train for preventive disaster practices, mitigation, and resilience-building.

The *second* factor deals with a needed demographically and culturally differentiated data collection, and missed opportunities to prepare for non-discriminative strategies of disaster risk reduction (DRR). Risk analyses and assessments should be able

29 UNESCO estimated that at least 18 per cent of disaster costs could be saved with efficient preventive measures and learning, which represent less than 5 per cent of the initial costs. Normally budgets are tight, not accounting funds for preventive disaster management and resilience-building. Even UN organizations can dispose of only limited resources for preventive management and restoration of social networks. Often, privately raised money is given with clear indications for direct disaster relief; segregating support for war refugees, famine, and disasters prevention. These limits in aid avoid effective preparedness and awareness-building, able to reduce future damages, and to prevent further disasters and possible conflicts.

to identify regional differences and to train people to monitor and care about their own vulnerability. Together with modern systems of monitoring and regional and national coordination, the preparedness and an effective early warning is more efficient. Therefore permanent training, identification of vulnerable regions and their environmental restoration by reforestation and sustainable planning can reduce the risks for all citizens and negative economic impacts for the whole country.

Finally, there is an increasing uncertainty due to climate change and a growing number of hydro-meteorological hazards with more severe impacts for the most vulnerable communities (figure 72.3). This requires a new culture for sustainable safety and risk reduction, but also bottom-up adaptation and mitigation. The number of disasters and their local and regional impact has grown, affecting mostly the marginal, thus reinforcing discrimination. A holistic approach is needed for resilience-building aiming at human, gender (understood here in a wide sense, including all minority groups), and environmental security or HUGE (Oswald Spring 2007a, 2009) that can avoid more serious vulnerabilities worldwide and regionally. Knowledge of the socio-psychological mechanisms, preventive innovation, and permanent education are some of the core elements to increase the safety and HUGE for all. Efforts for bottom-up resilience-building combined with institutional reinforcement are stabilizing within a short time highly vulnerable groups and help them to develop proper tools to better deal with coming threats and dangers.

Vulnerability and discrimination are often the result of human, gender, and environmental threats and insecurities. Capacity-building and special training for governmental officers, humanitarian institutions, journalists, and other decision makers facilitate a change in the perception and action for eradication of discrimination (72.1, 72.2). Combined with preventive training of discriminated groups it can increase the resilience-building in hazard-prone communities. A healthier environment, an integral management of natural and social resources, and prevention and remediation practices are the keys for a sustainable environmental culture.

A central challenge for policy is to empower gender, the disabled and other vulnerable persons at home through economic improvement and active political participation. This reduces social vulnerability, improves resilience to crises, increases survival opportunities for communities and individuals, and reduces gender violence and insecurity. By strengthening their livelihood, the whole community is enhancing its survival prospects.

The lessons learnt are clear. There exists a traditional way to deal with the coming threats and dangers, but a different vision will deal systemically with unknown and complex emergencies (table 72.3). In the first vision, a missing participation and lack of transparency can destroy entire communities; in the second approach still the future of children can be limited due to the loss of livelihood, the emergence of a survival dilemma (Brauch 2008b) with migration, and later as refugees often experiencing 'perverse poverty'. The third option promotes an integral alternative with citizen control of relief institutions and DRR to overcome discrimination and corruption. Transparent and democratically elected governments respond to the needs of the people. They improve pre-disaster preparedness (evacuation training, safe shelters, food, water and drug provisions, conflict management, self-protection measures, etc.). They establish differentiated data banks with efficient early warning procedures, and special care and involvement of the socially vulnerable (Villagrán 2006). Regional risk mapping and disaster organizations headed by locally trained aid personnel should prepare the population for new hazards and for a fast return to normality. Thus, democratic governments that combine preventive training and disaster relief management with participative resilience-building will be able to reduce fatalities, mitigate economic crises, and speed up the recovery process.

Hazard-prone countries can only surmount their situation of risk when they concentrate their technical, economic, and human capacity in a preventive restoration of destroyed ecosystems and efficient institutional disaster organization together with exposed society. The reduction of social vulnerability requires a bottom-up resilience-building and a top-down institutional support, disaster funds, and specialized and trained entities. It implies also rapid and non-discriminative support for those regions and social groups affected by different kinds of disasters. These measures facilitate also the integration of external aid. They reduce existing social discrimination and the probabilities that natural hazards turn into societal disasters.

> As nonviolent conflict resolution is a central part of personal and social identity in a world with rapid changes and increasing risks, the upcoming system of values and practices enhances simultaneously participatory democracy and governance with peace-building efforts. In summary, all these efforts may result in a 'HUGE' solidarity process for sustainable and equal development, and peaceful conflict resolution without discrimination.

Table 72.3: Three alternative visions to understand and combat discrimination. **Source**: The author.

Perception/ social actors	Common vision	Different vision	Alternative vision
Perception of discrimination and its manifestations	Discrimination is a common problem in any society; it is a natural selection process where able persons lead the rest, getting personal and social recognition and benefits.	Discrimination is a common problem affecting more vulnerable groups, especially women, children, non-whites, poor and the elderly. It recognizes some types of discrimination and its social effects, but psychological, gender and sex is not understood nor included.	Discrimination is a common problem affecting more vulnerable groups, especially women, children, different races, the poor and elderly. It is a mechanism of control and power exercise to maintain the status quo. Multiple ways exist to discriminate: socio-economic, gender, age, race, ethnicity, colour, class, caste, language, religion, physical, disability, health, psychological, sexually, politically and culturally.
Perception of causes of discrimination during disasters	External factors: gender, poverty, unemployment, marital status, age, social classes, castes, religion, economic differences, political power, nature *Personal factors:* insecurity, fear, low self-esteem, intelligence, age, divine law, character.	Lack of communication and social compromise; all are in a traumatized situation and require support; negative attitudes of relief institutions & governments; historical and social contexts (it was always so); family pressure, traditions and culture; guilt, self-punishment, victimization of the discriminated.	Abuse and manipulation of power and control; inequality among social groups, age, race and gender as a result of social stigmatization; subordination of women, children and the elderly in a patriarchal culture. The free market does not need the old and handicapped, but exploits workers, women, and self-employed people in the informal economy, often children. Illegal activities (sex, prostitution child soldiers, drugs, human traffikkers, pornography, money laundering) prevail.
Social actors involved in maintaining discriminative behaviour	Different institutions, undemocratic governments, military and police forces; local and national privileged leaders (elite).	Some relief institutions, self-interested NGOs and undemocratic local authorities; global & local economic and political elites; organized illegal crime; some youth organizations (gangs).	Institutions and organizations interested in maintaining physical, structural and cultural discrimination; globalization; free-market and neo-liberal ideology; transnational mass media, fashion and mass diversion; criminals.
Perception of solutions against discrimination during disasters	*External:* laws, punishment, separation of discriminated persons and groups, reinforcement of tolerance and positive practices; abolition of undemocratic institutions. *Internal:* individual change of behaviour; economic activities and income; personal growth.	*External:* treaties and legal reinforcements; human rights strengthening; institutional support; training of personnel; change of behaviour by group dynamics; dialogue and common work experience; social pressure; education to overcome discrimination; promotion of democratic leadership; transparency. *Internal:* love of others and myself; caritas; family support; learning through errors and success; personal empowerment and self-confidence; training and psycho-physical stabilization.	*External:* rapid assessment tools; reduction of accumulative dissatisfactions, tensions, conflicts, violence and disaster-related problems; intervention of transparent and participative governments, agencies and society; reinforced laws, norms; risk reduction; resilience-building; improvement of formal democracy and real social justice with consolidation measures; promotion of cultural and social change; empowerment through social, ethnic, cultural and political diversity; democratic NGOs, political parties, churches, teachers; critical relief institutions; organized women and youth groups; social training against discrimination and for tolerance and diversity, HUGE; peaceful conflict resolution. *Internal:* growth in self-esteem; self-protection; modification of personal behaviour; overcome prejudices; empowerment; decision-making reinforcement; self-love; entrepreneur mentality, resilience.

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73 Coping with Global Environmental Change: Need for an Interdisciplinary and Integrated Approach

G.A. McBean

73.1 Introduction[1]

This chapter deals with three major issues confronting humankind, political leaders and the scientific community: climate change, disaster management and international development, as examples of the need for an interdisciplinary and integrated approach. These are major intersecting issues: natural disasters destroy or impede development and climate change will enhance their impacts. These relationships seem to be increasingly recognized, particularly in the international domain. However, better integration of these intersecting issues is needed in science and policy and global response. Sustainable development and an expanded climate change adaptation strategy to include disaster risk reduction may be the key to bringing them together.

Environmental change is now occurring due to the impact of human activities on the environment on local to global scales. Humans began impacting their local environments through pollution many centuries ago and as their activities expanded in scope and complexity the impacts spread beyond the local towards the global scale. The global environmental impacts have most clearly been seen for the past few decades, with increasing clarity, in their impacts on the global climate. These impacts on the environment have come back to influence human activities: it is very much a two-way interaction.

For environmental managers, the focus has been on managing the influence of people on the environment by, for example, controlling the emissions of pollutants into the environment, the hunting of species and the changes in the land use from forests to farming to urban sprawl, each of which contributes to changing the natural environment. Environmental management attempts to improve on this relationship by assessing and using regulations to reduce the impacts. Since regulation usually does not fully solve the problem, governments then have the role of informing and warning, when appropriate, people about the risks of a contaminated environment to their health and well-being. Environmental management, focusing on the negative impacts of humans on the environment, relies on scientific guidance from the global environmental change community.

Another side of the environment-people interactions is the impacts of weather-related (e.g., storms, floods, droughts) and geophysical hazards (e.g., earthquakes, volcanoes) on humans. There is need for services to advise and warn humans on how to reduce their vulnerability to hazards and how they can modify their influences on the environment, such as land-use change that reduce their vulnerability. This has been called disaster management and the more prevalent term today is disaster risk reduction.[2]

As our environment changes, locally to globally, humans need to be able to respond both to reduce their impacts on the environment and to reduce the impacts of the environment on them. Although clearly issues of human and natural resources with which to respond will limit or possibly preclude any effective response, one aspect that is essential to making our responses most effective is knowledge or information looking ahead to the future. This information can both shape and determine our response but also greatly influence the degree to which individuals and governments choose to act and the resources that they commit to those actions. It is the role of global

1 The author appreciates discussions with and assistance from his colleagues in the *Institute for Catastrophic Loss Reduction* (ICLR), The University of Western Ontario, London, Ontario, Canada. Preparation of the chapter was also greatly influenced by discussions with the members of the ICSU Planning Group for IRDR and colleagues on the UN ISDR S&TC.

2 See e.g., the *UN International Strategy for Disaster Reduction* (UN ISDR) at: <www.unisdr.org>.

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environmental change research to provide an informed basis for the responses by individuals, governments and, where appropriate, international organizations. "We have options, but the past is not one of them" (Sauchyn/Kulshreshtha 2008). The capacity to see the future depends on that research basis and there are very different capacities to predict natural and social phenomena (McBean 2008; Mesjasz 2005, 2008b).

Other chapters of this volume have laid out major environmental change issues as: climate change; soil and desertification; water management; and food and health. Natural and human-induced environmental disasters have also been identified and will be further expanded below. Addressing global environmental change, disasters and security threats and their challenges, vulnerabilities and risks demonstrates the very broad scope of the issue. This includes understanding of economic drivers and responses and the social dimensions of issues will often be paramount in determining the response. Vulnerabilities and risks are determined not only by the threat of the environmental change or the hazard happening, but also by the social capacity for response or recovery if and when it happens. Resilience of communities is very much a social, economic and political issue. These issues are also very much at the centre of development and particularly of sustainable development.

The agenda of most governments usually starts from the fundamental premise that: "providing security for the nation and for its citizens remains the most important responsibility of government."[3] This statement sums up one of the most basic roles for all governments, which has long been the basis for protective services like national defence, law enforcement and fire protection. However, as always, governments must balance a broad range of policy issues and make difficult decisions regarding how to allocate scarce public funds. Key priority areas for any government will need to include the economy, the environment and international development. Beginning in the 1990's many governments adopted sustainable development as a framework for reconciling economic development and environmental conservation, i.e., "to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission 1987: 8).

Another focus of many governments is addressing climate change. What are the linkages between management of natural hazards (disaster risk reduction), management of the environment, with a focus on climate change and long-term sustainable development? And how do these fit in the context of international development?

Although an interdisciplinary and integrated approach is clearly necessary across many environmental and related issues, this chapter will focus on three issues, as demonstrating the case. These are: climate change (73.3), natural hazards (73.4) and development (73.5). This chapter analyses these public policy issues related to disaster management, climate change and international development (73.2, 73.6) and argues that the science in support of providing good input into public policy decision-making needs to be interdisciplinary and integrated across these areas (73.7).

73.2 Linking Natural Hazards, Climate Change and International Development

Almost every day, some community around the globe is affected by a weather- or climate-related hazard, such as a flood, storm or drought, resulting in that community needing outside assistance – this is called a disaster. With the geophysical (earthquakes and possibly resulting tsunamis, volcanoes and landslides) and biological events, there are now about 470 disasters[4] per year with widespread impacts across the planet (chap. 40 by Guha-Sapir/Vos). These events result in great loss of human lives, livelihoods and economic assets in both developed and developing countries. The frequency of recorded disasters has been rising rapidly up to the present rate. From about 65 per year in the 1960's, 200 per year in the 1980's, almost 280 per year in the 1990's and about 470 per year for the

3 *The National Security Strategy of the United Kingdom, Security in an interdependent world.* Presented to Parliament by the Prime Minister, by command of Her Majesty (London: Cabinet Office, Cm 7291, March 2008).

4 Disaster statistics and summaries are available from: (i) *Centre for Research on the Epidemiology of Disasters* (CRED); at: <http://www.cred.be>; (ii) Munich Reinsurance; at: <http://www.munichre.com/ en/ts/ geo_ risks/ natcatservice/default.aspx>; (iii) UNISDR, at: <http://www.unisdr.org/disaster-statistics/introduction. htm>.

first part of this decade.[5] The economic costs of these disasters are also increasing.[6]

Most disaster losses, whether measured in terms of the number of events, the lives lost or material destruction, stem from extreme weather and climate related events such as hurricanes, cyclones, other major storms, floods, landslides, wildfires and drought (Berz/Kron/Loster/Rauch/Schimetschek/Schmieder/Siebert/Smolka/Wirtz 2001). Weather and weather-related events together make up more than three quarters of all natural disaster events, with floods (33 per cent), storms (23 per cent, including hurricanes, typhoons, tornadoes, mid-latitude winter storms) and droughts (15 per cent) coming in that order. Most avalanches and many landslides are also weather related. Hence, the obvious climate and climate change connection with disasters and disaster risk reduction. These events cannot, of course, be attributed solely to climate change, but they are in line with the pattern that we can expect in the long term: severe storms, more heavy rainfall and a greater tendency towards flooding[7].

The 2007 Report of the IPCC placed important, authoritative scientific assessments before the global community. Its *Fourth Assessment Report* (AR4) of Working Group I (IPCC 2007f) on the physical science basis reported that the planet has been warming with the linear rate of warming being 0.07 °C per decade over the past 100 years and that has now increased to 0.18 °C per decade over the past 25 years. Their analysis of global observations of the climate system led to the conclusion that the warming of the climate system was unequivocal and that this warming was *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations. They further concluded that the observed changes in heavy precipitation events (increased frequency) and increased incidence of drought and intense tropical cyclone was *more likely than not* to have a human contribution.

The 2007 IPCC Working Group II on impacts, adaptation and vulnerability (IPCC 2007d: 7–22) added to the concern with their report that observational evidence from all continents and most oceans showed many natural systems being affected by regional climate change. From their assessment of data since 1970: "it is likely that anthropogenic warming has had a discernible influence on many physical and biological systems." These reports made clear that climate changes are happening, human activities are the main cause and that climate change was affecting both humans and natural ecosystems. There is a clear signal between the increased frequency of weather-related disasters and the increased frequency of the trigger events. The linkages across global environmental change issues are very evident.

Societies across the globe have generally become more vulnerable. While these disaster events have had clear impacts on all countries, their impacts on developing countries are larger (Mirza 2003). The Global Assessment Report on *Disaster Risk Reduction-2009*[8] included in its key findings and recommendations:

- Global disaster risk is highly concentrated in poorer countries with weaker governance.
- Weather-related disaster risk is expanding rapidly both in terms of the territories affected, the losses reported and the frequency of events.
- Climate change is already changing the geographic distribution, frequency and intensity of weather-related hazards and threatens to undermine the resilience of poorer countries and their citizens to absorb and recover from disaster impacts.
- The governance arrangements for disaster risk reduction in many countries do not facilitate the integration of risk considerations in development.

Changing weather conditions play a significant role:

> The vulnerability of human societies and natural systems to climate extremes is demonstrated by the damage, hardship, and death caused by events such as droughts, floods, heat waves, avalanches, and windstorms. While there are uncertainties attached to estimates of such changes, some extreme events are projected to increase in frequency and/or severity during the 21st century due

5 Part of the increase in numbers of disasters reported in disaster statistics may be explained by the increasing numbers of smaller and medium-level events that are registered as being related to natural and human-induced or socio-natural phenomena (ISDR 2007) and by better reporting mechanisms.

6 MunichRe, 2007: *Topics Geo - Natural catastrophes 2006. Analyses, assessments, positions* (München: Münchener Rückversicherungs-Gesellschaft); at: <www.Munichre.com>.

7 MunichRe Group, Press Release: 2007_12_ 27 – quote from Prof. Peter Höppe, Head of Munich Re's Geo Risks Research Department. <http://www.munichre.com/en/press/press_releases/2007/2007_12_27_press_release.aspx.

8 ISDR (2009) Global Assessment Report on Disaster Risk Reduction. United Nations, Geneva, Switzerland. ISBN 978-92-1-132028-2 (Manama, Kingdom of Bahrain; Oriental Press), 2009: 2009 Global Assessment <http: www.preventionweb.net/gar09>.

> to changes in the mean and/or variability of climate, so it can be expected that the severity of their impacts will also increase in concert with global warming (IPCC 2001c: 225).

Besides a changing climate, there are several factors contributing to the increase in natural disaster losses referred to above. Global population has been increasing and there has generally been more exposure of people to hazards meaning more people and communities are at risk. People, living by choice or circumstances in more hazardous zones, along coasts, riverbanks and mountain slopes, have put more people and communities at risk, particularly in low-lying as well as northern areas. There has also been a growing inequality between societies' wealthier and poorer sectors with the latter being more vulnerable. Human interventions in the environment can also increase vulnerability to natural hazards. Examples include changes in land cover that increase risks of landslides or flooding and destruction of mangroves that increases the susceptibility of coastal areas to storm and tsunami damage. There is more expensive infrastructure being damaged. In urban regions (and particularly in very large cities), the complex infrastructure systems that make life and economic activity possible, increase the vulnerability of populations to disruptions caused by natural hazards. The density of buildings has been growing and most infrastructure is aging. Commercial activities have become more interdependent and vulnerable, including relying more on the transportation of people and goods.

In awarding the 2007 Nobel Peace Prize to the *Intergovernmental Panel on Climate Change* (IPCC) and Albert Gore, the Nobel Committee of the Norwegian Parliament stated that it

> is seeking to contribute to a sharper focus on the processes and decisions that appear to be necessary to protect the world's future climate, and thereby to reduce the threat to the security of mankind. Action is necessary now, before climate change moves beyond man's control.

In so doing, it emphasized the possible impacts of climate change on humankind and placed it in the context of global peace and security.

Although earthquakes and related tsunamis comprise only 7 per cent of all events but their impacts are horrific as was seen with the December 2004 Indian Ocean tsunami and the more recent earthquakes in China and Kashmir. In 2005, there was the largest number of hurricanes ever recorded and Hurricane Katrina has now entered the record books as being the costliest in U.S. history (chap. 71 by Warner). Hurricane Wilma, with sustained winds of more than 260 km/h, was the most intense Atlantic storm ever recorded.

73.3 Climate Change – The Increasing Threat in the Future

The objective (Art. 2) of the *United Nations Framework Convention on Climate Change* (UNFCCC)[9], which has been signed and ratified by almost every country, is

> ...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable *economic development* to proceed in a *sustainable* manner.

The italics has been added to emphasize the connection of climate change with sustainable development. Given the UNFCC's objective, how will the climate warm for the next decades? For realistic emissions scenarios (IPCC 2007f), the projected warming over the next few decades will be about 0.2°C per decade or a little larger than 0.18°C per decade observed over the past 25 years. By about 2040, the projected temperatures start to diverge with a lower emissions scenario leading to 1.8°C warming by 2100, with respect to the period 1980–99. A higher emissions scenario results in 3.4°C by 2100. There are uncertainties in the climate models of about +/- 1°C. For a range of scenarios and including the uncertainties, the warming by 2100 could be between 1°C and 6°C or about 1.5–7°C relative to the pre-industrial global temperature. For any of the scenarios, warming continues for centuries to follow. This range is what might be called the 'human choice' or 'our' impact.

Together with these temperature changes will come other changes in the climate system. Sea level rise is a critical parameter for the billions of people who live on or near the coasts. The IPCC projected a range of 0.2 m to 0.6 m rise by 2100. Due to larger uncertainties in projecting the melting rates of Greenland and Antarctic ice sheets, these were excluded from the projecttions. Post-IPCC 2007 results (Rahmstorf/Cazenave/Church/Hansen/Keeling/Parker/Somerville 2007) in-

9 See UNFCCC; at:<www.unfccc.int> for the Climate Change Convention (1992), the Kyoto Protocol (1997), the Bali Declaration (2007), and other information.

dicate that the sea level is rising along the upper limit of the 2001 IPCC projections, leading to estimates of closer to a metre rise by 2100. If the Greenland ice sheet were to melt, sea level would rise globally about 7 m, inundating many coastal zones. There are major uncertainties as to if, when and how this may happen.

The Global Carbon Project[10] reported on a comparison of projected global fossil fuel emissions and actual emissions up to 2007. Global carbon emissions have increased from 6.2 GtC per year (billions of tonnes carbon or carbon equivalents), in 1990 to 8.5 GtC in 2007, a 38 per cent increase from the Kyoto reference year of 1990. The growth rate of emissions was 3.5 per cent per year for the period of 2000–2007, an almost four-fold increase from 0.9 per cent per year in 1990–1999. Since 2004, global emissions have been about equal to or greater than the more pessimistic of the IPCC emission scenarios. Reflecting on the disaster loss statistics in the previous section, Munich Re (2007) reported that "in view of continued global warming, we anticipate a long-term increase in severe, weather-related natural catastrophes."

Approximately 20–30 per cent of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5–2.5°C. They also noted that poor communities can be especially vulnerable since they tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies. Are these changes "dangerous"? These examples of scientific analysis and discovery also demonstrate the need for effective interdisciplinary approaches across the physical, biological, chemical, as well as socio-economic sciences.

Article 3 laid out some principles, including that sustainable development was a principle of the Convention and resulting actions. The linkages between climate change and sustainable development have been explored in several papers (e.g. by Beg/Corfee Morlot/Davidson/Afrane-Okesse/Tyani/Denton/Sokona/Thomas/Lèbre La Rovere/Parikh/Parikh/Atiq Rahman 2002). The IPCC recognizes the clear connections between climate change, adaptation and sustainable development with a full chapter (IPCC 2007d) devoted to these linkages. The connections with extreme events are also clear in the IPCC reports.

In light of these future projections and already observed increases in costs related to weather-climate hazards, policies and programmes are necessary to both mitigate climate change (e.g., through emissions reductions) and to adapt to the inevitable effects of a changing climate. Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts and involves efforts to both reduce the negative impacts of climate change and to capitalize on its benefits (IPCC 2007e). The key features of climate change for vulnerability and adaptation are those related to variability and extremes, not simply changed average conditions. Enhancing adaptive capacity and providing better means to cope can simultaneously address issues of climate change and natural hazards while contributing to development. This is the natural means of connecting these intersecting issues. Adapting to climate change and mitigation strategies for natural hazards are essentially the same in concept and approach and they both link to sustaining development. Again an interdisciplinary and integrated approach is needed in addressing these challenges.

73.4 Disaster Management and Hazard Mitigation

In January 2005, the Government of Japan hosted the *World Conference on Disaster Reduction* (WCDR) as a review of the Yokohama Strategy and Plan of Action for a Safer World (1994) and to commemorate the 10th anniversary of the Kobe earthquake.[11] As the international community noted recently, "...we are deeply concerned that communities continue to experience excessive losses of precious human lives and valuable property as well as serious injuries and major displacements due to various disasters worldwide."[12] In light of this, it is increasingly important that governments at all levels acknowledge the impact of natural disasters and implement better policies and programmes for their management.

The *United Nations International Strategy for Disaster Reduction* (ISDR) was created to follow and

10 See Global Carbon Project, 2008: *Carbon budget and trends 2007* (Canberra: Global Carbon Project); at: <www.globalcarbonproject.org/carbonbudget/07/index.htm>.

11 World Conference on Disaster Reduction, Kobe, Hyogo, Japan, 18–22 January 2005, paper A/CONF. 206/L.1; at: <www.unisdr.org>.

12 Hyogo Declaration, World Conference on Disaster Reduction, Kobe, Hyogo, Japan. 18–22 January 2005.

build upon the *United Nations International Decade for Disaster Reduction* (IDNDR). The UN ISDR has identified climate change as one of the issues related to disaster management. The ISDR has also provided formal definitions that are important in communications and working across countries and disciplines.

A hazard is a "potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation"[13]. The vulnerability is determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. Disasters result when there is the intersection of a hazard and vulnerabilities. Hence to understand the factors involved in disasters it is important to understand both the hazards with their occurrence and characteristics and the factors that make communities vulnerable.

Disaster management refers to policies and practices developed and implemented to manage the impacts of disasters. Effective disaster management requires extensive planning before a disaster, targeted at four elements: *preparedness* (policies and procedures designed to facilitate effective response); *response* (actions taken immediately before, during and after a disaster to protect people and property and to enhance recovery); *recovery* (actions taken after a disaster to restore critical systems and return a community to pre-disaster conditions); and *mitigation* (actions taken before or after a disaster to reduce the impacts on people and property of future hazards; see Godschalk 1991). Mitigation with its focus on preventing natural hazards from becoming natural disasters, includes policies and actions such as building public awareness and support; development of local and regional plans for land use to prevent inappropriate development in hazardous areas; changing building codes and standards to protect people, property and infrastructure from 'reasonable' extremes; structural engineering to increase resistance; and forecasting and warning systems which provide information to citizens and advise them regarding an appropriate response strategy (Godschalk/Beatley/Berke/Brower/Kaiser 1999).

Although hazard researchers generally agree that investment in mitigation is cost effective in that the savings in disaster recovery costs are larger than the mitigation investments (Mileti 1999), most government expenditures in Canada (Henstra/McBean 2005) and other countries (Mileti 1999) remain targeted at the recovery side of disaster management, for various reasons.

First, public demand for mitigation is generally weak. Many people continue to view natural disasters as 'acts of God' and thus conclude that there is little that an individual can do to prevent losses. In other cases, people may be disinterested in loss prevention because they believe they are covered by insurance. From a political perspective, hazard mitigation is less appealing than other public investments because, while the costs of mitigation are immediate and often substantial, the benefits are only realized in the case of another disaster, which may never occur. In a political system predicated on a four-year election cycle, investment costs borne by one government (and set of taxpayers) may only be realized by benefits to a future government and a different set of taxpayers. The costs are readily apparent while the benefits are not immediately obvious. Local governments are equipped to play an instrumental role in hazard mitigation, due to their close proximity to hazards and because they control many of the most effective tools to achieve this objective (e.g., land use regulation, building code enforcement; see: Prater/Lindell 2000). However, disasters in any particular community are statistically rare, local citizen demand for disaster mitigation is minimal and most of the burden for disaster recovery assistance is shouldered by central governments, so local governments have little economic or political incentive to invest in mitigation (Berke/Kartez/Wenger 1993). To shift this paradigm to one dealing most effectively with disasters requires an interdisciplinary and integrated approach.

73.5 International Development

Around the world natural hazards are another issue facing development. Poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women continue to be major concerns. Within the broad range of commitments in human rights, good governance and democracy, world leaders, at the 2000 Millennium Summit, passed a Declaration which formally established a series of *Millennium Development Goals* (MDG) that provided a comprehensive and multi-dimensional development framework and set clear quantifiable targets to be achieved in all countries by 2015[14]. The important

13 UN International Strategy for Disaster Reduction, 2009: "UNISDR Terminology on Disaster Risk Reduction"; available in the five UN languages at: <http://www.unisdr.org/eng/terminology/terminology-2009-eng.html>.

goals include: halve extreme poverty and hunger; achieve universal primary education; reduce under-five mortality by two thirds and maternal mortality by three quarters; and ensure environmental sustainability. The latter MDG has four elements:

> Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources; reduce by half the proportion of people without sustainable access to safe drinking water; and achieve significant improvement in lives of at least 100 million slum dwellers, by 2020.

The linkage between sustainable development and development is clear in this objective. Although the MDGs do not explicitly address climate change, the action plan of the WSSD (see next paragraph) does call for action on assessing impacts of climate change.

In 2002, participants of the *World Summit on Sustainable Development* (WSSD) in Johannesburg, South Africa adopted a Summit Plan of Implementation as part of the strategy to meet the Millennium Development Goals.[15] The signatories agreed on a series of actions, one of which included protecting and managing the natural resource base of economic and social development. In the report which followed the Summit, strong connections were drawn between international development and natural hazards, which called for action, including:

> 37. An integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, ..., is an essential element of a safer world in the twenty-first century. Actions are required at all levels to:
>
> (e) Improve techniques and methodologies for assessing the effects of climate change,
>
> (h) Develop and strengthen early warning systems and information networks in disaster management,
>
> (j) Promote cooperation for ... in order to enhance the capabilities of affected countries to cope with such situations.

Furthermore, the report drew connections between international development and climate change:

> 38. Change in the Earth's climate and its adverse affects are a common concern of humankind. We remain deeply concerned that all countries, particularly developing countries, including the least developed countries and small island developing States, face increased risks of negative impacts of climate change and recognize that, in this context, the problems of poverty, land degradation, access to water and food and human health remain at the centre of global attention.

Both the Millennium Summit Declaration and the World Summit report demonstrate explicit connections between natural hazards, climate change and the Millennium Development Goals. The call for integrated, interdisciplinary and multi-hazard approaches is clear.

Although all countries have been impacted by natural disasters, the relative impacts usually are larger in direct impacts on human lives in developing countries and larger in economic costs in developed countries (Mileti 1999). In highly developed countries, the average number of deaths per disaster is 23, while the number increases dramatically to about 150 deaths per disaster in medium and to over 1000 deaths per disaster in less developed countries (Mutter 2005: 164–165). While the absolute dollar costs of disasters in highly-developed countries are large they are usually less or much less than the *Gross Domestic Production* (GDP) of the country. Although the consequences of Hurricane Katrina were huge in economic terms, the costs were a small fraction of the US GDP. In comparison, the 1999 earthquake in Turkey had an economic impact of 8 per cent of its GDP and the hurricane in 1998 in Honduras amounted to over 75 per cent of its GDP. Losses from natural disasters are substantial and in some countries represent a major fraction of national GDP (Handmer 2003). In some places, natural disasters have turned back the clock on development by years or even decades. Development is then not sustainable. Part of sustainable development needs to be the consideration of decisions being made now, including decisions to invest or not, and how they will alter societies' exposure to the risk and occurrence of natural hazards.

In response, participants of the 2005 World Conference on Disaster Reduction agreed to the following declaration:

> 1. ... Disasters have a tremendous detrimental impact on efforts at all levels to eradicate global poverty; the impact of disasters remains a significant challenge to sustainable development.
>
> 2. We recognize the intrinsic relationship between disaster reduction, sustainable development and poverty eradication, ...

Again, an explicit link is drawn between disaster reduction and the achievement of international development goals.

14 Millennium Declaration and Goals (A/57/270); at: <www.un.org/ millenniumgoals>.

15 Report of the World Summit for Sustainable Development, Johannesburg, South Africa, 26 August–4 September 2002 (A/CONF.199/20); at: <www.un.org>.

73.6 Responding to the Need for Integrated and Interdisciplinary Research on Hazards

In 2004, the *International Council for Science* (ICSU) Panel on the Priority Area Assessment on Environment and its relation to Sustainable Development[16] recommended that an ICSU-led "Natural and Human-induced Hazards Research Programme" be created. Subsequently, after a planning process, the 29th ICSU General Assembly[17] in 2008 endorsed the scientific plan for the new research initiative, now called *Integrated Research on Disaster Risk* (IRDR) addressing the challenge of natural and human-induced environmental hazards. The title was chosen on the basis of the rationale of integration, risk and disasters. ICSU, the *International Social Sciences Council* (ISSC)[18] and the *United Nations International Strategy for Disaster Reduction* (ISDR)[19] are the IRDR co-sponsors, reflecting the needs for integrated approaches of the global natural and social sciences communities and governments and UN agencies as represented by the UN ISDR. The IRDR Science Programme is an integrated approach to natural and human-induced environmental hazards through a combination of natural, socio-economic, health and engineering sciences, including socio-economic analysis, understanding the role of communications, and public and political response to reduce the risk. It will build upon and collaborate with the Earth System Sciences Partnership and its research agenda (chap. 74 by Leemans, Rice, Henderson-Sellers and Noone).

The focus of the research programme is on disaster risk reduction. In order to reduce risk, there needs to be integrated risk analysis, including consideration of relevant human behaviour, its motivations, constraints and consequences, and decision-making processes in face of risks. The physical events themselves can sometimes be directly attributable to human agency (i.e. are 'human-induced'), as with many cases of small- and medium-scale flooding, landslides, land subsidence and drought in rural and urban settings related to environmental degradation and human intervention in ecosystems, as well as global climate change. These human-induced or socio-natural hazards are created at the interface of natural and human processes. In addition, human actions determine whether or not an event beyond human control (e.g. heavy rain or an earthquake) will lead to disastrous flooding (e.g. through construction on a flood plain) or building collapse (through inadequate building specifications and techniques). The seriousness of the consequences of any disaster will depend also on how many people choose (or feel they have no choice but) to live and work in areas at higher risk, as well as on organizational factors relating to protection and emergency planning, and on fundamental aspects of social equity.

The IRDR is guided by three broad research objectives that will lead to understanding of hazards, risk and vulnerability and enhanced capacity to model and project risk into the future; to the understanding of the decision-making choices that lead to risk and how they may be influenced; and how this knowledge can better lead to disaster risk reduction. The first objective is: 1. Characterization of hazards, vulnerability and risk; with three sub-objectives: 1.1: identifying hazards and vulnerabilities leading to risks; 1.2: forecasting hazards and assessing risks; and 1.3: dynamic modelling of risk. A challenge is the broad range of time- and space-scales for hazards and disasters. The response to these varying types of hazards leads to many challenges, and an objective of this research programme is to provide integrated, interdis-ciplinary understanding of these connections in ways that will lead to reductions in losses.

Over the past several decades, human knowledge and understanding of natural hazards has grown dramatically. Yet despite this growth in knowledge, losses associated with environmental hazards have risen during past decades. There is a great shortfall in current research activities on how science is used to shape social and political decision-making in the context of hazards and disasters, leading to the second objective: 2. Understanding decision-making in complex and changing risk contexts; with three sub-objectives: 2.1: identifying relevant decision-making systems and their interactions; 2.2: understanding decision-making in the context of environmental hazards; and 2.3: im-

16 International Council for Science, 2003: *ICSU Report of the CSPR Assessment Panel on Environment and its Relation to Sustainable Development* (Paris: ICSU); at: <www.icsu.org/2_resourcecentre/Resource.php4?rub=8&id=28>.

17 International Council for Science, 2008: *A Science Plan for Integrated Research on Disaster Risk: Addressing the challenge of natural and human-induced environmental hazards* (Paris: ICSU); at: <www.icsu.org/2_resourcecentre/Resource.php4?rub=8&id=274>.

18 See International Social Sciences Council; at: <www.unesco.org/ngo/issc/>.

19 See International Strategy for Disaster Reduction; at: <www.unisdr.org>.

proving the quality of decision-making practice. In focusing on understanding effective decision-making in the context of risk management, analysis will lead to improvements. In linking with the other objectives, the emphasis is on how human decisions and the pragmatic factors that constrain or facilitate such decisions can contribute to hazards becoming disasters and/or may mitigate their effects.

The third objective is: 3. Reducing risk and curbing losses through knowledge-based actions, where the 'reduction of risk' refers to all the factors that are contributing to the growing hazard and disaster losses and is an overall objective of the research programme. Objective 3 integrates outputs from objectives 1 and 2. The task of characterizing risk involves identification of hazards and exposure and vulnerabilities of places and people, and hence, assessing the level of risk and understanding how the risk can, may or will change with time. Risk identification requires a multi-hazards approach, since communities are commonly threatened by several different hazards that may be linked to one another.

The central thrust of research towards objective 3 will be to use the combined understanding from many different fields of expertise into an integrated approach to the understanding of the causes of disaster in order to provide practical guidance on the reduction of risk and the curbing of losses. The approaches suggested may be described as diagnostic or forensic. At a superficial or anecdotal level many of the reasons for past failures to reduce risks and curb losses are known. What is not well understood is how these factors work together in different ways and in different places to produce the adverse consequences with which we are more and more familiar. Over the first three years of IRDR the Scientific Committee will commission and encourage case studies to identify major research needs and gaps at the interface of the natural and social sciences.

There will be three cross-cutting themes and approaches: capacity building; case studies and demonstration projects; and assessment, data management and monitoring. Capacity or capability can be defined as a combination of all the strengths and resources available within a community, nation or region that can reduce the level of risk, or the effects of a disaster. It includes physical, institutional, social or economic means such as financial, political and technological resources, as well as skilled personal or collective attributes such as leadership and management at different levels and sectors of the society. Capacity building aims to develop human skills and societal infrastructures within a community, nation or region in order to reduce the level of risk.

The IRDR will draw upon the expertise and scientific outputs of many partners in research as it adopts an interdisciplinary, integrated approach to research on and risk reduction to hazards. The *Global Change System for Analysis Research and Training* (START)[20] will be the capacity-building partner and many of the other partners are described in other chapters of this book.[21]

The Hyogo Framework for Action calls for all-hazards approaches, people-centred systems and overall risk assessment. The IRDR Programme responds to that imperative for a research programme, sustained for a decade or more, that is integrated across the hazards, the disciplines and the geographical regions, wherein would lie its value-added nature. The coupling of the natural sciences' examination of hazards with the socio-economic analysis of vulnerability and mechanisms for engaging policy decision-making processes will be a major value added.

The legacy of IRDR will be an enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts. The legacy will also be the development of science and development of broadly-based capacity and the repository of information and data that have been acquired and that will be of continuing availability and value to the global community.

73.7 The Intersection of Issues and Barriers to Change

Because of conflicting agendas and pressures, it has been difficult for governments to develop programmes across a wide range of themes in a consistent way. This chapter dealt with three scientific and policy issues, disaster management, climate change and international development. Each is linked to the other and also to sustainable development. In each case there is also an element of uncertainty and risk – when will the next disaster happen; how will the climate actually change; and will other events, such as

20 See on *Global Change System for Analysis Research and Training* (START); at: <www.start.org>.

21 See chap. by Church, Asrar, Busalacchi and Arndt on the *World Climate Research Programme* (WCRP); See chap. 75 von Falkenhayn, Rechkemmer and Young on the *International Human Dimensions Programme on Global Environmental Change* (IHDP); at: <see at: <www.ihdp.unu.edu/>

war or revolution overwhelm international development.

In consideration of the linkages of disaster risk reduction and adaptation to climate change, Birkman, Tetzlaff and Zentel (2009) looked at the challenges and barriers that have to be addressed when developing integrative strategies for linking disaster risk reduction and climate change adaptation. One issue is the mismatch of scales – temporal, spatial and functional. Disaster risk reduction, particularly the response and recovery aspects are usually related to events of short-term duration while the climate change community is mostly focused on longer-term perspectives which go far beyond any political cycle of elections. While the disaster risk community is usually dealing with local issues, the climate community has mostly worked on the global scale and the prediction of events down to the local scale is still problematic. A functional scale challenge refers to the mismatch of organizations for the management of disaster crises and climate change adaptation. The different institutions will have different encompassing rules, norms and rights as well as the organizations that enforce their regulations. The lack of coordination between different agencies and ministries involved is factor that often leads to mismatches in addressing the problem and appropriate solutions.

Climate change is no longer and should not be seen as a pure environmental problem but as a risk that affects environmental systems and society alike, thus necessitating the involvement of natural and social processes and hence a communication and cooperation between natural and social scientists as well as the development community, with an increasing and appropriate emphasis on the economic dimensions (Stern 2007). Hulme (2009) in his provocatively titled book "Why We Disagree About Climate Change" discusses the various constraints and viewpoints that have led to controversy and inaction on climate change. Hulme reflects on issues and concerns such as: values; beliefs and fears of people; the challenges of development; and approaches to governance. The diversity of views, beliefs, cultures and approaches to an issue as complex as climate change make it very difficult to make progress and can lead to disagreements that may be interpreted as disagreeing with the scientific assessments but in reality more reflect some other fundamental belief that make it difficult to accept or undertake the necessary actions.

The normative dimension, such as legislative, cultural or behavioural norms, influences the functioning of human society in that individuals, organizations and societies are guided by certain rules and follow certain standards as they work to find solutions. For climate change this has evolved and become more complex as new actors get involved in finding solutions. But, as of yet, these actors are still different from those in disaster management. An issue is then the lack of clear norms when applying vulnerability and capacity assessment and when designing and implementing adaptation measures. There are opportunities after disasters, to build back in an adaptive way considering future climate change but these are in most cases not taken. Another challenge is the still different use of terms and definitions by both communities and the weak links between the different types of knowledge and work of both communities. This results in barriers for communication, joint programming and collaboration.

Some other barriers in the design and implementation of policies across integrated fields of disaster management, climate change and international development (e.g, Henstra/McBean, 2005) include how priorities should be set, what role each level of government should play, how strategies should be coordinated and how outcomes should be evaluated. Clearly it is important to have good governance recalling the assessment of the Global Assessment Report on Disaster Risk Reduction-2009[22] that disaster risk is "highly concentrated in poorer countries with weaker governance." Even with good governance a barrier is uncertainty regarding hazards and vulnerabilities; which are the most important and which are the most pressing, not necessarily the same thing. For hazards, Burton, Kates and White (1993) identify at least seven distinct characteristics of a hazard, each of which add to the complexity of the disaster problem and complicates policy-making. Common difficulties in dealing with climate change, disaster management and international development are issues of time scale and risk. In each case, investments are needed now and in the near term for benefits that will accrue later. Predictions of the future must play a major role in planning these strategies and investments (McBean 2000; Sarewitz/Pielke/Byerly 2000; McBean 2008). There is always uncertainty in predictions of forthcoming events. Risk analysis can lead to the optimum decisions but the setting of priorities is still difficult. The political, institutional cultural and economic aspects of decision-making and behaviour are also important and need to be explored. Many of the problems in de-

22 2009 Global Assessment Report on Disaster Risk Reduction. Available at www.preventionweb.net/gar09

cision-making are also political and social problems in that they involve divergent interpretations of what the problems and response options really are. There are often conflicting values and interests at work, and strikingly different opportunities to influence developments. The salience of strategic societal choices, and of competing rationalities, which cannot be subsumed within the language of risk and risk management, is recognized, so this broader context needs to be addressed as the research moves to the complexity of the political and social challenges encountered. These uncertainties are the raison d'être for an integrated disaster research program necessitating the building across disciplines and institutional boundaries.

The impacts of a changing climate or disaster events are largely determined by a society's or community's vulnerability, which is a function of its exposure to climate and other hazards, its sensitivity to the stresses they impose, and its capacity to adapt to these stresses (Henstra/McBean, 2009). That vulnerability can be reduced through actions to minimize exposure, reduce the sensitivity of people and systems, and strengthen the community's adaptive capacity. Each of these requires approaches that transcend issues and their implementation will necessitate surmounting barriers and constraints. For example, there are four factors important towards adaptive capacity; these are: access to information, expertise with information, analyses and translation information into policy, fiscal capacity, and political will to act, which cover a range of issues and organizations. Designing policies for adaptation to climate change and disaster risk reduction and sustainable development all require: assessments of the effectiveness, costs and feasibility of measures to reduce vulnerability; stakeholder analyses to identify targets and beneficiaries of interventions; analyses of the consequences of inaction; and other factors. One difficulty with regard to the fiscal capacity is that at least some level of public expenditure will be needed and that will be limited by competing demands on scarce economic resources. In the end, a critical issue will be generation of the political will to act which will most likely come with more general recognition that adaptation and disaster risk reduction are necessary and possible and that they are not only desirable but necessary towards sustaining development.

Implementation of a research program usually requires support from national scientific funding agencies. Putting aside for the moment the complexities of support across usually-disciplinary funding agencies, there is the question of costs and benefits – what will be the quantifiable benefits of the costs of investment in a research programme and a resulting policy initiative. Many policies are increasingly decided at sub-national levels of government and there is difficulty especially at those levels to ascertain the local benefits (Wolensky/Wolensky 1990). For example the decision to invest in preventative measures, to reduce the impacts of a hazard or to adapt to future climate change and gain financial benefits at some future time, must be weighed against immediate and potentially significant costs (Godschalk/Brower 1985). Related to this issue of costs and benefits is the political perception that there is a lack of public demand and hence political motivation to take action (Tierney/Lindell/Perry 2001). As people fail to engage or disengage from the issue, the interest of political actors wanes and integrated approaches at prevention are relegated down the policy agenda. Intergovernmental collaboration is considered essential for the development and implementation of policies for integrated approaches but this is difficult to do due to the lack of common interests. This requires the consideration of these issues in the context of risk management. Governments need to bring these issues together in a coherent and integrated policy development and implementation.

A continuing difficulty in taking integrated interdisciplinary approaches are the traditional structures of academic institutions, with faculties of natural, social, engineering and health sciences all separated. The "reward" systems of selection for honours to, for example, national academies and the competitions for research funds are still largely based on disciplinary criteria which put less merit for work across or within another discipline. These barriers are being lowered but still are a significant obstacle.

These issues represent a challenge and also an opportunity. Scientists need to make the case to governments of the importance of interdisciplinary and integrated science as a basis for action. This is in the best interests of citizens for their safety, social benefits and economic competitiveness.

73.8 Summary

This chapter has identified and discussed the issues of the need for interdisciplinary and integrated approaches to coping with environmental change, by looking at the intersection of three issues: hazard management, climate change and international development. Sustainable development provides possible frameworks for this integration. There is evidence

that this convergence or intersection is starting to happen

The Intergovernmental Panel on Climate Change[23], at its 30th session in spring 2009, decided to prepare an IPCC Special Report on *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* which will bring a scientific focus on the linkages between the two issues. There has also been a recent focus on integrating disaster risk reduction and climate change adaptation in terms of international policy – both under the auspices of the UN ISDR and of the UNFCCC.[24] At the 2009 Global Platform of the UN ISDR, J. Holmes, the UN Under-Secretary-General for Humanitarian Affairs and Chair of the Second Session of the Global Platform, underlined overarching themes of the meeting: the linkages between disasters, poverty and vulnerability, as well as the connection between disaster risk reduction and climate change. His summary highlighted the following areas to be considered critical for future progress:

- *Climate change*: DRR must be a concrete part of the climate change negotiations at the UN climate meeting in Copenhagen in December 2009;
- *Reduced risk*: Success in reducing disaster risk and adapting to climate change will depend on the development of innovative partnerships that recognize the mutual dependence of actions undertaken by central and local governments and civil society;
- *Financing DRR:* Proposals included a variety of innovations, such as incentives for retrofitting, risk transfer tools, risk-sensitive development, private sector involvement, debt swap to finance disaster reduction measures and linkages with adaptation financing; and
- *Setting DRR targets*: UN Secretary-General Ban Ki-moon called for a target to halve the losses of lives from disasters by 2015.

The Organization for Economic Cooperation and Development (2009) has provided policy guidance on integrating climate change adaptation into development cooperation. These links of disaster risk reduction, climate change adaptation and development are thus moving ahead but the 'silos' of governmental agencies, including science funding agencies, will continue to be a challenge. There is a clear need for leadership to make it happen for the benefit of all, in this generation and the next ones.

23 See *the Intergovernmental Panel on Climate Change* (IPCC); at: <www.ipcc.ch>.

24 IISD [International Institute for Sustainable Development], 2009: "A Summary Report of the Second Session of the Global Platform for Disaster Risk Reduction", in: *Earth Negotiations Bulletin*; 141,2 (22 June): at: <www.iisd.ca/ymb/gpdr2/>.

74 Research Agenda and Policy Input of the Earth System Science Partnership for Coping with Global Environmental Change

Rik Leemans, Martin Rice, Ann Henderson-Sellers and Kevin Noone

74.1 The Science of Global Environmental Change[1]

Human activities now match (and often exceed) the natural forces of the Earth System (Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004). Recent ice core data show that current levels of *carbon dioxide* (CO_2) and methane are well outside the range of natural variability over the last 800,000 years (Luthi/Le Floch/Bereiter/Blunier/Barnola/Siegenthaler/Raynaud/Jouzel/Fischer/Kawamura/Stocker 2008). Roughly half of the world's ice-free land surface has been altered by human actions. Humans now fix more nitrogen than does nature. Particles emitted by human activities alter the energy balance of the planet, as well as having adverse effects on human health. Human choices about how we use resources are at the heart of many of these changes. These may seem to be unrelated issues; however, over the last decades, we have gained a deeper understanding of the degree to which all of these separate issues are linked. The Earth System is a very complex coupled system with myriad feedbacks, and it has and inevitably can still exhibit rapid, global-scale responses to changes in environmental conditions (Costanza/Graumlich/Steffen/Crumley/Dearing/Hibbard/Leemans/Redman/Schimel 2007).

The kinds of questions now being asked of the research community have changed over the last decades reflecting the increasing appreciation of the interconnectedness of the Earth System (Noone 2006). As humans tackled scientific questions of societal importance initial investigations were by individuals; later some of the harder questions could be successfully addressed by concentrating on either individual or a small number of the components of the Earth System, although answering such questions required international, interdisciplinary collaboration. For example, establishing the cause-effect relationships of the Antarctic ozone hole required international collaboration among atmospheric chemists and meteorologists. Understanding the causes and consequences of acid rain required collaboration between atmospheric scientists and terrestrial ecologists. This innovative interdisciplinary research increased the understanding and helped to develop adequate solutions to these problems.

Now, however, the kinds of questions being asked of the scientific community increasingly underline the need for a more holistic or integrated approach. These emergent questions include, for example:

- How do urban-industrial emissions, land cover changes and global warming influence the Asian Monsoon circulation?
- How will changes in precipitation patterns caused by global warming, influence water management policies on regional and local scales?
- What will be the consequences of large-scale land use and ecosystem changes caused by moving towards large-scale biofuel use?
- What are the impacts of the predicted climate changes on food production and human security?
- What role does urbanization play in the health effects of air pollution?
- Do mega cities play a role in affecting the energy balance of the planet and in the hydrological cycle?
- What form of carbon sequestration scheme will have the smallest negative impact on the Earth System?

These questions cannot be answered without a close coupling of approaches from both the natural sciences, social sciences and humanities. Answering them will also require new observational and model-

1 The authors would like to thank Anne Larigauderie (Executive Director, DIVERSITAS), Kathy Hibbard (Executive Officer, AIMES) and John Ingram (Executive Officer, GECAFS) for providing invaluable input to this chapter.

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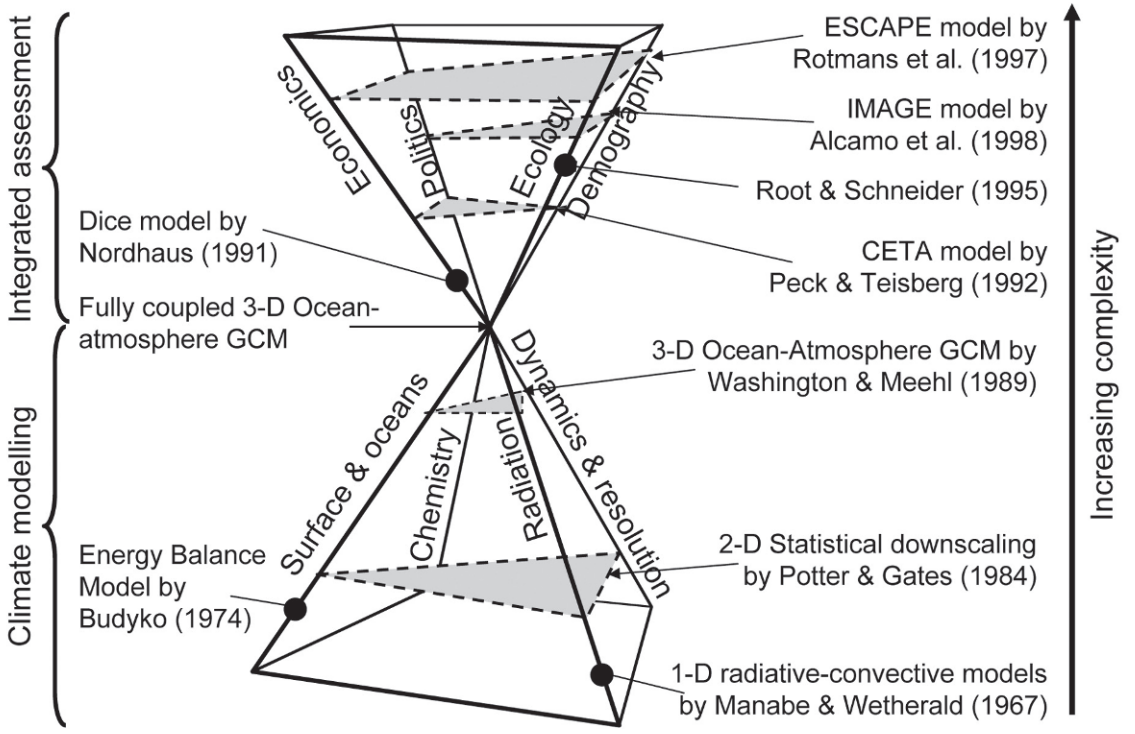
Figure 74.1: The top-down integrated assessment pyramid balances on the apex of the bottom-up climate modelling pyramid. **Sources:** After McGuffie/Henderson Sellers (2005) based on models developed by: Budyko (1974); Nordhaus (1991); Manabe/Wetherald (1967); Washington/Meehl (1989); Peck/Teisberg (1992); Root/Schneider (1995); Rotmans/de Vries (1997); Alcamo/Leemans/Kreileman (1998); Potter/Gates (1984).



ling tools that to a much larger extent have to integrate the many different dimensions of the biosphere, the pedosphere, the atmosphere and the anthroposphere (Leemans 2009a). In addition, the *global environmental change* (GEC) research community faces an increasing challenge to present research results in more accessible and informative ways to stakeholders – particularly those concerned with mitigation of greenhouse gas emissions and other pollutants, adaptation to climate change and sustainable development of people, societies and their natural resources.

In response to all these challenges and questions the .*Earth System Science Partnership* (ESSP) was established, in which the four international global change research programmes (DIVERSITAS, IGBP, IHDP, WCRP)[2] collaborate to address such highly integrative and interdisciplinary questions, and communicate the answers in a timely manner to society. ESSP thus aims to address complex Earth system questions that are important to society and that require problem-solving skills from a range of natural and social sciences. In this chapter we aim to provide the philosophy behind the ESSP, present its major activities and discuss some of its preliminary successes.

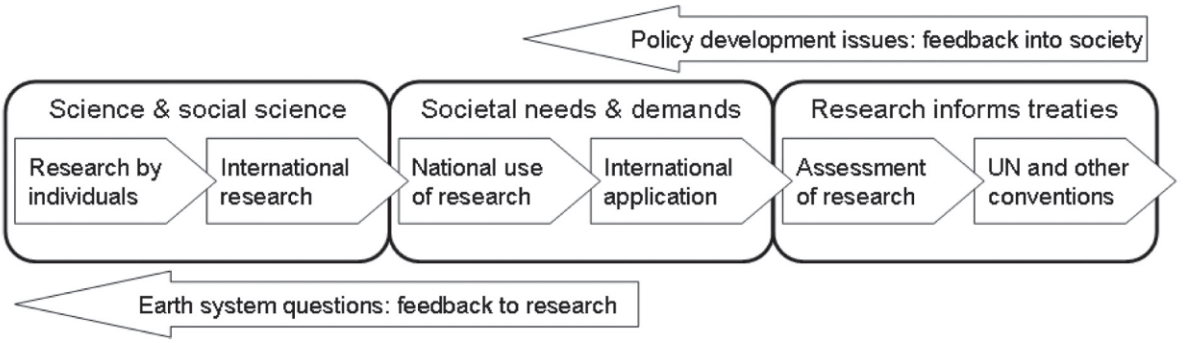
The presentation and discussion of ESSP in this chapter is structured as follows. First, we present a concise history of global change research, resulting in the Amsterdam Declaration that led to the establishment of ESSP (74.2). Then we present the different elements of the ESSP that have been developed so that ESSP can achieve its goals (74.3). We show that this is research in progress but that major contributions to prominent assessments have been made, that capacity building efforts are mounting and that a different kind of outreach is being developed (74.4).

74.2 Supporting Structures for Global Environmental Change Research

Stakeholders seek local strategies to cope with ongoing and future environmental change. The research

2 See DIVERSITAS chap. X.Y Walther/Larigauderie/Loreau; IGBP, chap. X.Y Noone/Nobre/Seitzinger; IHDP, chap. X.Y von Falkenhayn/Rechkemmer/Young; and WCRP, chap. X.Y Church/Asrar/Busalacchi/Arndt.

Figure 74.2: The information flow from individual and international research to societies, assessments and international agreements and some of the higher order feedbacks. **Source**: The authors.



community is therefore expected to address detailed questions on the effects of *global environmental change* (GEC) on regional and even local scales, while the tools to accomplish this are not robust enough. This dilemma has been illustrated using a double pyramid (figure 74.1). Here the convergence of a single scientific effort (in this case climate modelling) is overlaid by a rapidly diverging set of societal questions. Clearly the single disciplinary endeavour cannot ever provide answers to the myriad of questions arising from all aspects of societies' need for information and analysis.

Human interaction with and adaptation to a changing environment (including mitigation) can take many forms, and can have both positive and negative environmental impacts. Small-scale measures could include increased use of air conditioning as temperature increases, architectural changes for more efficient heating and cooling, better forecasting and warning systems for extreme events, and increased water usage. Larger-scale issues could vary from switching to renewable energy sources to attempts at geo-engineering (Leemans/Agrawala/Edmonds/MacCracken/Moss/Ramakrishnan 1996). The large-scale movement of people away from areas adversely affected by climate change and by other environmental and socio-economic stresses is also a form of adaptation. Each of these options has environmental consequences that must be carefully evaluated before they are implemented. The larger the adaptation scheme, the greater care needs to be taken in considering its impact before implementation. A fundamental outcome of adaptation schemes is that they will modify equity across the globe. The projections recently released by the *Intergovernmental Panel on Climate Change* (IPCC) (Parry/Canziani/ Palutikof/Hanson/Van der Linden 2007; chap. 79 by Parry/Canziani/Palutikof/Hanson) show that in many cases the areas facing the largest changes in climate are not only located in countries that have contributed the least to the atmospheric build-up of greenhouse gases, but also those that have the least ability to adapt to them. Clearly, the basic science research needed to support decisions about adaptation needs a tightly coupled natural-social science support structure. The flow of research into societal applications is not one-way nor is it linear. However, it may be helpful to schematize the exchanges at least to underline where research and assessments differ and how they tend to be separated by a societal needs segment (figure 74.2).

The need to understand how individual aspects of and processes in the natural and social domains work has not diminished but, in fact, underpins the answers to questions of sustainable development and adaptation. We still must concentrate on first class science involving the interactions and feedbacks between biological, chemical and physical processes and human systems. However, scientists, resource managers and policy makers require a common understanding in order for their interactions to be mutually beneficial.

The need for an international, multidisciplinary approach to aspects of global environmental change research is not entirely new. The *World Climate Research Programme* (WCRP) was established in 1980 in response to the need for a framework within which to organize and facilitate international climate research (chap. 78 by Church/Asrar/Busalacchi/Arndt). The *International Geosphere-Biosphere Programme* (IGBP) was initiated in 1987 with the intention to better link the biological and physical sciences and research communities (chap. 77 by Noone/Nobre/Seitzinger). The *International Human Dimensions Programme on Global Environmental Change* (IHDP) was started in 1996 to build a support structure for international multidisciplinary research in the social sciences (chap. 75 by von Falkenhayn/Rechkemmer/Young). DIVER-

SITAS was launched in its current structure in 2001 to build a global programme in biodiversity science (chap. 76 by Walther/Larigauderie/Loreau). Each of these international programmes is itself highly international and multidisciplinary in scope and are sponsored by the *International Council for Science* (ICSU), which congregates most national academies and international scientific unions.[3] However, it became apparent in the late 1990s that even these programmes could not individually address the new kinds of Earth System-level questions that were being asked. There was recognition at the time that the Earth System did not behave in a way that was easily understood by 'conventional' scientific approaches. Another kind of structure was needed. Such a need was further addressed by the Amsterdam Declaration on Global Change, which resulted from a thorough discussion among all programmes on future research issues at IIGBP's 2001 *Challenges of a Changing Earth: Global Change* open science meeting in Amsterdam. The scientific analysis and arguments on which the declaration is based are also carefully documented (Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004).

74.2.1 The Amsterdam Declaration on Global Change

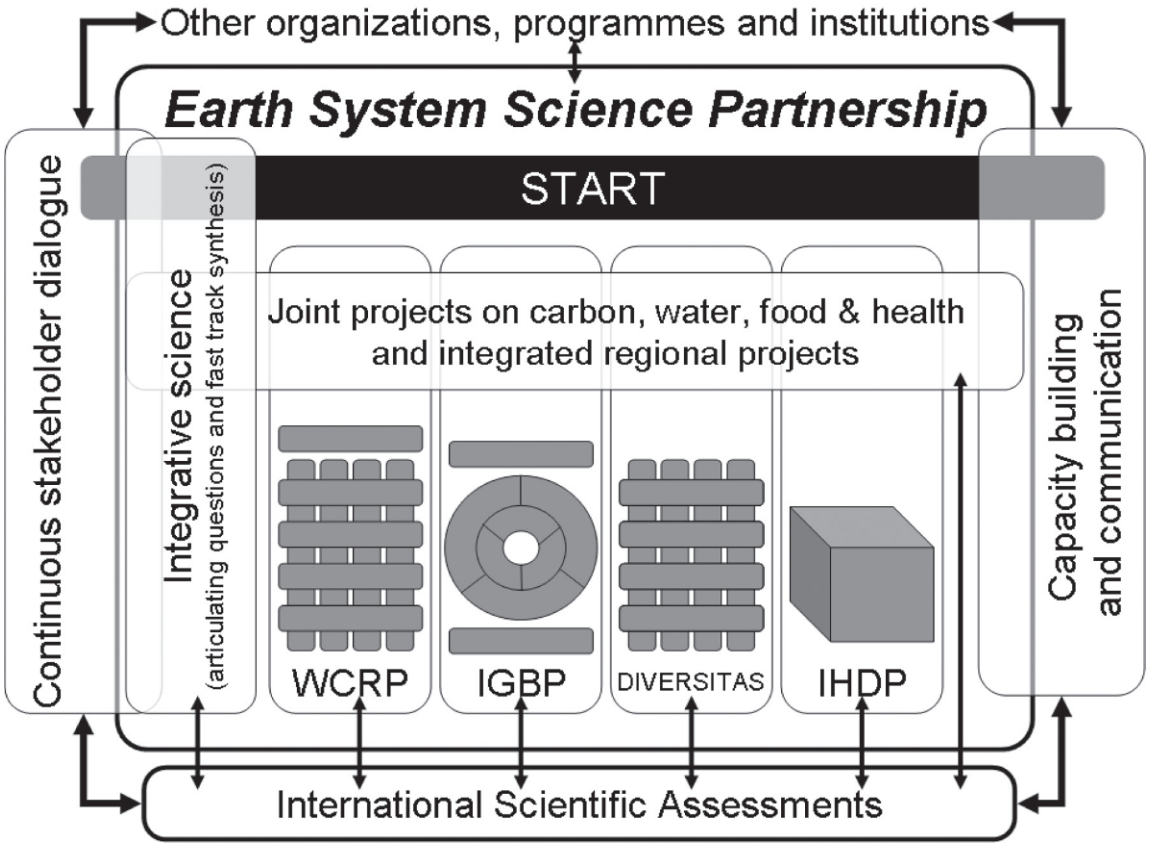
The scientific communities of four international global change research programmes - the *International Geosphere-Biosphere Programme* (IGBP), the *International Human Dimensions Programme on Global Environmental Change* (IHDP), the *World Climate Research Programme* (WCRP) and the international biodiversity programme DIVERSITAS - recognize that, in addition to the threat of significant climate change, there is growing concern over the ever-increasing human modification of other aspects of the global environment and the consequent implications for human well-being. Basic goods and services supplied by the planetary life support system, such as food, water, clean air and an environment conducive to human health, are being affected increasingly by global change.

Research carried out over the past decade under the auspices of the four programmes to address these concerns has shown that:

- The Earth System behaves as a single, self-regulating system comprised of physical, chemical, biological and human components. The interactions and feedbacks between the component parts are complex and exhibit multi-scale temporal and spatial variability. The understanding of the natural dynamics of the Earth System has advanced greatly in recent years and provides a sound basis for evaluating the effects and consequences of human-driven change.
- Human activities are significantly influencing Earth's environment in many ways in addition to greenhouse gas emissions and climate change. Anthropogenic changes to Earth's land surface, oceans, coasts and atmosphere and to biological diversity, the water cycle and biogeochemical cycles are clearly identifiable beyond natural variability. They are equal to some of the great forces of nature in their extent and impact. Many are accelerating. Global change is real and is happening *now*.
- Global change cannot be understood in terms of a simple cause-effect paradigm. Human-driven changes cause multiple effects that cascade through the Earth System in complex ways. These effects interact with each other and with local- and regional-scale changes in multidimensional patterns that are difficult to understand and even more difficult to predict. Surprises abound.
- Earth System dynamics are characterized by critical thresholds and abrupt changes. Human activities could inadvertently trigger such changes with severe consequences for the Earth's environment and inhabitants. The Earth System has operated in different states over the last half million years, with abrupt transitions (a decade or less) sometimes occurring between them. Human activities have the potential to switch the Earth System to alternative modes of operation that may prove irreversible and less hospitable to humans and other life. The probability of a human-driven abrupt change in the Earth's environment has yet to be quantified but is not negligible.
- In terms of some key environmental parameters, the Earth System has moved well outside the range of the natural variability exhibited over at least the last half million years. The nature of changes now occurring simultaneously in the Earth System, their magnitudes and rates of

3 ICSU (www.icsu.org) has officially endorsed the programmes together with other international sponsors, such as the World Meteorological Organization, UNESCO, the International Social Science Council and the United Nations University.

Figure 74.3: The activities of the ESSP as a partnership of the four global environmental change research programmes.



change are unprecedented. The Earth is currently operating in a no-analogue state.

On this basis the international global change programmes urge governments, public and private institutions and people of the world to agree that:

- An ethical framework for global stewardship and strategies for Earth System management are urgently needed. The accelerating human transformation of the Earth's environment is not sustainable. Therefore, the business-as-usual way of dealing with the Earth System is not an option. It has to be replaced – as soon as possible – by deliberate strategies of good management that sustain the Earth's environment while meeting social and economic development objectives.
- A new system of global environmental science is required. This is beginning to evolve from complementary approaches of the international global change research programmes and needs strengthening and further development. It will draw strongly on the existing and expanding disciplinary base of global change science; integrate across disciplines, environment and development issues and the natural and social sciences; collaborate across national boundaries on the basis of shared and secure infrastructure; intensify efforts to enable the full involvement of developing country scientists; and employ the complementary strengths of nations and regions to build an efficient international system of global environmental science.

The global change programmes are committed to working closely with other sectors of society and across all nations and cultures to meet the challenge of a changing Earth. New partnerships are forming among university, industrial and governmental research institutions. Dialogues are increasing between the scientific community and policymakers at a number of levels. Action is required to formalize, consolidate and strengthen the initiatives being developed. The common goal must be to develop the essential knowledge base needed to respond effectively and quickly to the great challenge of global change.

Table 74.1: The activities and achievements of the ESSP as a partnership of the four global environmental change research programmes. **Source:** Compiled by the authors.

Activity (acronym)	Website	Major objectives and achievements
Programmes		
An international programme of biodiversity science (DIVERSITAS)	<www.diversitas-international.org>	DIVERSITAS was launched in its current structure in 2001 to address the complex scientific questions posed by the loss of and change in global biodiversity.
International Geosphere-Biosphere Programme (IGBP)	<www.igbp.net>	IGBP was established in 1987 and addresses the overarching scientific questions that reflect the three major Earth System components (land, ocean and atmosphere) and the interfaces between them.
International Human Dimensions Programme on Global Environmental Change (IHDP)	<www.ihdp.org>	IHDP was founded in 1996 and generates scientific knowledge on coupled human-environment systems, achieves comprehensive understanding of global environmental change processes and their consequences for sustainable development.
World Climate Research Programme (WCRP)	<wcrp.wmo.int>	The WCRP was established in 1980 and integrates observations, experiments and modelling that provide the scientific breakthroughs essential to advance understanding of the processes that determine climate.
Joint Projects		
Global Carbon Project (GCP)	<www.globalcarbonproject.org>	GCP was established in 2001 in recognition of the enormous scientific challenge and fundamentally critical nature of the carbon cycle for Earth sustainability. The scientific goal of the project is to develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them.
Global Environmental Change and Food Systems (GECAFS)	<www.gecafs.org>	GECAFS was launched in 2001 as a comprehensive interdisciplinary programme to study the links between food security and global environmental change. GECAFS improved the understanding of changes in food systems, its environmental consequences and possible adaptation strategies.
Global Water System Project (GWSP)	<www.gwsp.org>	GWSP was established in 2004 and addresses how humans are changing the global water cycle and the associated biogeochemical cycles and biological components. This also to understand the social feedbacks arising from these changes. Main achievements are the digital water atlas, the global water system lexicon and global reservoir and dam database.
Global Environmental Change and Human Health (GECHH)	<www.essp.org>	GECHH was launched in 2006 at the ESSP OSC in Beijing, in partnership with the World Health Organization (WHO). GECHH aims to identify and quantify current and future health risks posed by GEC, describe spatial and temporal differences in health risks to understand vulnerabilities and priorities for interventions, and develop cost-effective adaptation strategies for reducing health risks.

Activity (acronym)	Website	Major objectives and achievements
Capacity Building		
Global Change System for Analysis, Research, and Training (START)	<www.start.org>	START provides an international framework for capacity building. Its mission is to develop regional networks of collaboration between scientists and institutions to enhance scientific capacity in developing countries. START has trained many global change scientists and provided them with improved enhanced access to data, communication technology, and research skills.
Integrated Regional Studies		
Monsoon Asia Integrated Regional Study (MAIRS)	<www.mairs-essp.org>	MAIRS was established in 2006 and studies human interactions with the monsoon system. MAIRS assesses to what extent the human activities alter the monsoon climate and how this impacts the social and economic development of Asia. MAIRS also studies to what extent adaptation and mitigation are possible through policies, law and institutions.
African Network for Earth System Science (AfricanNESS)	<www.igbp.net/page.php?pid=412>	The AfricanNESS science plan and implementation strategy (published in 2008) focuses on four top-level issues: food and nutritional security, water resources, health and ecosystem integrity. The plan also outlines options to implement and organize a network of Earth system scientists in Africa, connecting them to scientists around the world.
Open Science Conferences		
The Open Science Conference 'Challenges of a Changing Earth' in Amsterdam, July 2001		All GEC programmes participated in this meeting and provided a smorgasbord of GEC science. Ongoing research was synthesized and this resulted in the Amsterdam Declaration and ESSP's establishment.
ESSP Open Science Conference in Beijing, November 2006.	<www.essp.org/index.php?id=42>	The conference showed that ESSP is actually improving the understanding of the modifications of the Earth system. Participants were concerned for the continuing adverse affects on the global environment and the resulting serious threats to sustainable development of human society.
IARU 'Climate Change: global risks challenges and decisions' Conference in Copenhagen, March 2009	<climatecongress.ku.dk>	The congress was organized by the *International Alliance of Research Universities* (IARU). The congress provided a synthesis of existing and emerging scientific knowledge necessary to make intelligent societal decisions concerning application of mitigation and adaptation strategies in response to climate change.
Collaborative Programmes		
CGIAR Challenge Program '*Climate Change, Agriculture and Food Security*' (CCAFS)	<www.essp.org/index.php?id=76>	CCAFS is a major collaborative endeavour between the *Consultative Group on International Agriculture Research* (CGIAR) and ESSP. It is aimed at overcoming the additional threats posed by a changing climate to achieving food security, enhancing livelihoods and improving environmental management in the developing world.

74.3 Earth System Science Partnership (ESSP)

The *Earth System Science Partnership* (ESSP) formed as a result of the Amsterdam Declaration in 2001 and is a partnership for the integrated study of the Earth System, the ways that it is changing, and the implications for global and regional sustainability (Canadell/Carson/Craswell/Göbel/Ingram/Larigauderie/Steffen/Virji 2004). The ESSP contributes to this endeavour through a number of activities, including joint projects, capacity building, integrated regional studies and open science conferences. The ESSP also conducts community-wide research, such as the recently established Earth system analysis of biofuels and the contributions and advice to the environmental assessments and international conventions (figure 74.3). ESSP's activities are summarized in table 1 and will be shortly discussed below.

74.3.1 Joint Projects

The aim of the *Joint Projects* is to build a GEC-oriented research agenda of direct relevance for societies, with particular emphasis on four fundamentally important issues. In brief, these projects aim to elucidate the additional challenges caused by GEC for carbon dynamics, food systems, water and health, and to understand the implications of human-driven changes in these issues for the functioning of the Earth System. The joint projects should capitalize on the comparative strengths of the parent programmes and link these to other, national and international efforts relating to science, development and policy. The joint projects are, therefore, designed to directly address the two-way interaction between GEC and global sustainability issues.

The need for *International Project Offices* (IPOs) for each joint project was foreseen to coordinate planning, implementation and reporting, and ideally funded by multi-donor support. Indeed the scientific administrative support that the IPOs provide (backstopped by the secretariats of the four global change research programmes) is in essence the backbone of international ESSP efforts. Without them ESSP would not be in a position to ensure quality standards and global consistency, and to identify key links and gaps, and collaborate with national programmes, which are often disconnected from each other. The development of coordinated, international science agendas, which the IPOs and Secretariats of the joint projects help facilitate, are perhaps one of the single most important added values of the global programmes, and is of great benefit to regional and national initiatives. These agendas often become a reference point for developing national agendas and are a reminder of the scale at which some of the questions need to be answered. Typically these are larger than national or regional and so cannot be effected without international core funding, the so called 'glue money'.

A recent example is where the *Global Environmental Change and Food Systems* (GECAFS) IPO has been instrumental in bringing together the ESSP and the *Consultative Group on International Agricultural Research* (CGIAR), each with their respective research partners. These two large international organizations have now jointly developed a "Challenge Program" designed to enable agricultural and global change researchers to benefit from the best agricultural, climate change and related environmental science (figure 74.4; CGIAR Alliance/ESSP 2008). The objective of this challenge program is to overcome the additional threats posed by a changing climate to attaining food security, enhancing livelihoods and improving environmental management.

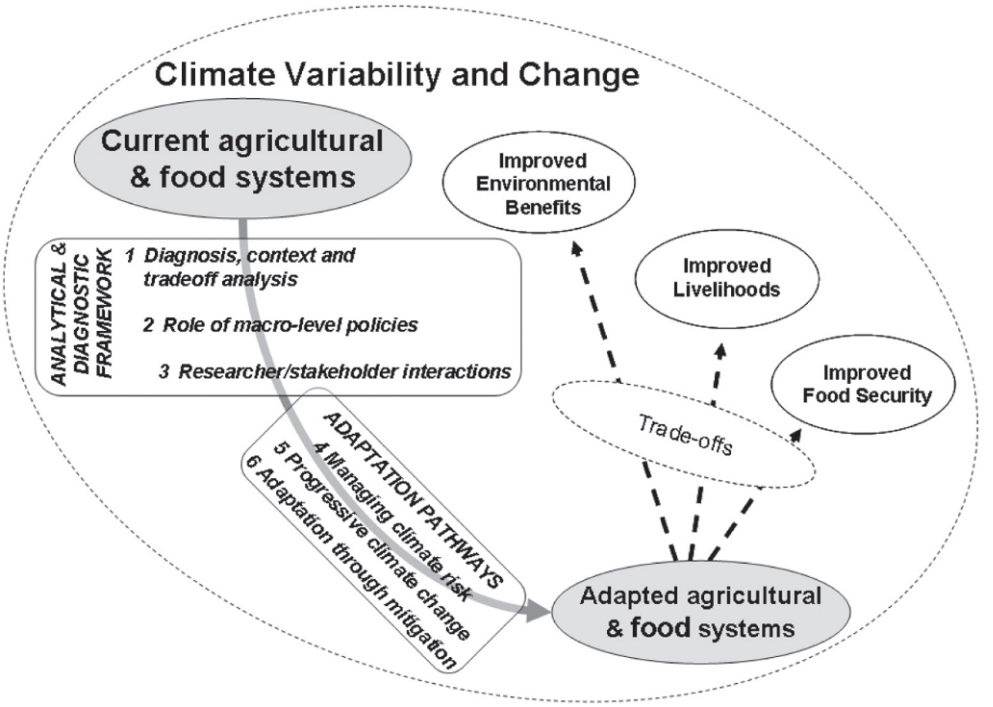
74.3.2 Capacity Building

> "Insufficient human capacity is a – if not the – major factor limiting Earth System Science research to achieve its full multidisciplinary breadth. A major accomplishment of the programmes of the ESSP has been the education of a new generation of scientists capable of making significant contributions to the integrated multidisciplinary science effort. An increased and sustained effort is needed however" (ESF 2002).

Capacity building and development is an essential function of the ESSP. Clearly, all the individual programmes and their core and joint projects do this already. At the ESSP chairs and directors meeting in 2006 a major capacity building and research activity called *SysTem for Analysis Research and Training* (START) was also incorporated into the ESSP (START has been co-sponsored by IGBP, IHDP and WCRP since its inception in the 1990's).

Building capacity of people and institutions capable of creative, integrative work is not a simple matter, and will not happen in business-as-usual. The ESSP should look at capacity development in a much larger, strategic manner. Capacity development will, therefore, be a comprehensive strategy towards the objective of having the people and institutions in place that can enable the promotion and catalyze of high quality and highly integrated Earth System science and facili-

Figure 74.4: Schematic representation of the structure and activities of the Challenge Program on Climate Change, Agriculture and Food Security (CCAFS). **Source**: CGIAR Alliance/ESSP (2008).



tate the application of its findings for the benefit of society and sustainability.

The ESSP is, therefore, developing integrative strategies for capacity development leading to:

- Active stakeholder engagement from the beginning and throughout the development and implementation to derive the benefits from the ESSP and expand support for ESSP;
- Enhanced capacity to conceive, plan and conduct future Earth System science activities;
- Effective internal and external communications; and
- A lasting legacy for Earth System science.

74.3.3 Integrated Regional Studies

The ESSP is developing a small set of *Integrated Regional Studies*, designed to contribute sound scientific understanding in support of sustainable development at the local level. These studies will also improve overall knowledge of regional-global linkages in the context of Earth System dynamics. The first such study is in *Monsoon Asia* (MAIRS). One of the most important issues that need to be addressed by these integrated regional studies, is the need to deliver regionalized climate and impact predictions that serve the questions being raised by policy developers and impact scientists.

74.3.4 Open Science Conferences

ESSP recognizes the importance of broad interaction amongst the many scientists that contribute to its activities. As such, the Partnership is committed to hosting major international science meetings. The *Open Science Conference – Challenges of a Changing Earth* - held in Amsterdam in July 2001 resulted in the Amsterdam Declaration (see 74.2.1) and led to the creation of the ESSP. In November 2006, the first ESSP Open Science Conference on *Global Environmental Change: Regional Challenges* was held in Beijing. The conference was preceded by a two-day meeting dedicated to the research of young scientists. START provided scholarships for many international students to participate. The quality of presentations and discussions was outstanding and awards for best young scientist presentations were given at the ESSP Open Science Conference closing plenary. At the ESSP OSC, the timely update of the global carbon budget by the GCP attracted major press attention. Their analysis showed that global growth in carbon dioxide emissions from fossil fuels was four times greater in the pe-

riod between 2000 to 2005 than in the preceding 10 years. Despite efforts to reduce carbon emissions, the global growth rate in CO_2 was 3.2 per cent in the five years to 2005 compared to 0.8 per cent in the period 1990 to 1999. This analysis was later published in the renowned Proceedings of the National Academy of Science (Canadell/Le Quere/Raupach/Field/Buitenhuis/Ciais/Conway/Gillett/Houghton/Marland 2007). In 2009, *International Alliance of Research Universities* (IARU) and ESSP organized the *Climate Change: global risks challenges and decisions* Congress in Copenhagen in March 2009. The congress synthesized existing and emerging scientific knowledge necessary to make intelligent societal decisions concerning application of mitigation and adaptation strategies in response to climate change. It attracted over 1500 scientists, who discussed and presented their latest results. As the congress synthesized three years of new research since IPCC's fourth assessment report (IPCC 2007c), the synthesis report of the congress (Richardson/Steffen/Schellnhuber/Alcamo/Barker/Kammen/Leemans/Liverman/Monasinghe/Osman-Elasha/Stern/Wæver 2009) will provide essential information to the UNFCCC negotiators that assemble in December 2009 to discuss and agree upon future steps in the *UN Framework Convention on Climate Change* (UNFCCC). This report stressed the increasing level of irreversible impacts at higher levels of changes in ocean acidification, atmospheric composition and climate, the likely limits to adaptation, the most vulnerable regions, people and systems, and the technical and biological possibilities for adequate mitigation efforts.

74.3.5 ESSP Interactions with the International Conventions and Assessments .

One role of the ESSP and its parent programmes is to inform and provide input to international conventions and assessments. Scientific assessments apply the judgment of experts to existing knowledge to provide scientifically credible answers to policy relevant questions (Leemans 2008). The assessments, such as the IPCC and the *Millennium Ecosystem Assessment* (MA), were instrumental in gathering and synthesizing scientific information for the use of policy processes. Both the IPCC and the MA were critically dependent on the science in the GEC programmes and ESSP.

74.3.5.1 The Intergovernmental Panel on Climate Change

WCRP's activities contributed significantly to the scientific basis for the landmark findings in IPCC's *Fourth Assessment Report* (AR4, IPCC 2007c), each one of which represents a major advancement in knowledge, including: "observed warming of the climate system is unequivocal"; "there is a very high confidence that the globally-averaged net effect of human activities since 1750 has been one of warming"; "most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increases in greenhouse gas concentrations"; improved quantification of and confidence in the Earth's climate sensitivity provides "increased confidence in the understanding of the climate system response to radiative forcing"; model projections of future climate change indicate that "continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century"; and there is now "higher confidence in projected patterns of warming and other regional-scale features".

A second very important feature of the IPCC's AR4 was the sheer number of WCRP scientists involved as coordinating, lead and contributing authors and reviewers of the various chapters in the Working Group I report (Solomon/Qin/Manning/Chen/Marquis/Averyt/Tignor/Miller 2007). Over 90 per cent of the coordinating authors, half of the contributors and some 70 per cent of the reviewers are scientists associated with WCRP, IGBP and the ESSP Global Carbon Project. The majority of these contributors were climate modellers, carbon cycle experts, diagnosticians and cryospheric scientists.[4] These contributions facilitated the discussion that led to a much more uniform and consistent application of the phrasings of uncertainties across all chapters on Working Group I.

IGBP, IHDP and DIVERSITAS science contributed to Working Group II on impacts and adaptation. IHDP scientists were engaged with Working Group

4 For the purpose of the statistics, we considered those climate researchers as 'GEC programme-associated' that are or were (at some stage of their career) active in any of the working groups, panels, core projects or crosscuts of the GEC programmes or that are/were sponsored by the GEC programmes to participate in workshops, seminars and conferences.

III on mitigation, amongst which where about five lead authors including two past IHDP chairs. START also stimulated contributions to IPCC's AR4. Its *Assessments of Impacts and Adaptations to Climate Change* (AIACC) in Multiple Regions and Sectors project supplied thirty contributing authors and more than a hundred citations of AIACC publications were cited in the last IPCC reports.

One of the fixtures of all the four IPCC assessment reports has been the consistent method through which climate model experiments have been carried out. The central approach here is the use of a series of scenarios of plausible future emission and climate change levels. As illustrated in the upper panel of figure 74.5 (taken from Hibbard/Meehl/Cox/Friedlingstein 2007), the traditional process starts with a number of storylines for socio-economic development, from which various emissions patterns are estimated. These emissions are then fed into climate models, and future concentrations of greenhouse gases, and climate parameters like surface temperature, precipitation are calculated. Two drawbacks with this approach are 1) uncertainties increase in each step of the process, and 2) it does not lend itself to comprehensive connections between research communities looking at *integrated assessment modelling* (IAM), *climate modelling* (CM), and *impacts, adaptation, and vulnerability* (IAV). This method has served its purpose very well through the first four reports, but along the way the climate research community realized that perhaps a different approach may help address some of the drawbacks. [5]

Through a series of meetings, the climate research community came up with a suggestion for an entirely new approach to scenarios. This approach, illustrated in the lower panel of figure 74.5, effectively starts in the middle. The process initially assumes a number of 'reference concentration pathways' for greenhouse gases. The process would then go in two directions simultaneously. One direction would be to calculate the changes in climate parameters and their impacts, which would arise given these concentration pathways. The other direction would be to calculate the emissions necessary to produce the given concentration pathway, and the socio-economic development and choices that are consistent with these emissions profiles. By starting in the middle, uncertainties are propagated through fewer sequential steps, An additional advantage is that this process also better connects the various research communities earlier on in the process and at a deeper level than the traditional method.

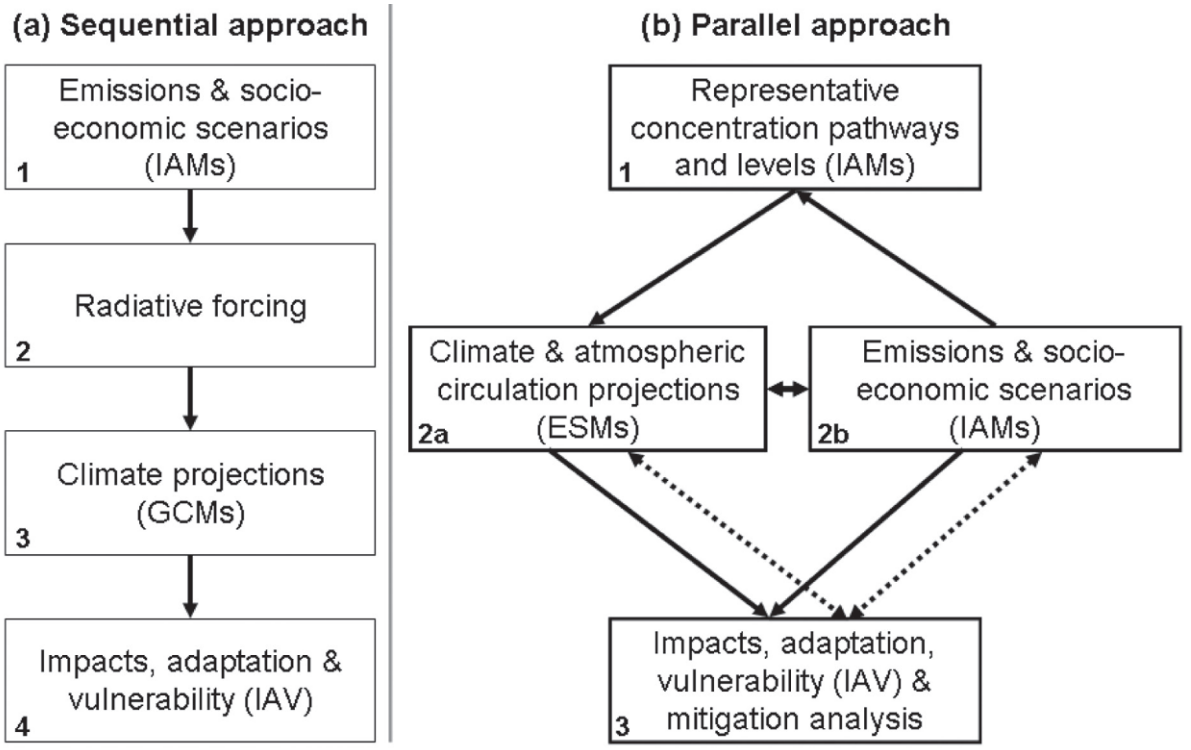
This new scenarios approach was proposed to the 28th IPCC's plenary meeting in Budapest, Hungary in April 2008 (IPCC-XXVIII/Doc.8, 19.III.2008). The suggestion was subsequently adopted by the IPCC. This is an excellent example of how the research community (particularly IGBP-AIMES and WCRP Working Group on Coupled Modelling (WGCM)) have a direct and collaborative influence on the IPCC process. This was also clearly expressed by Solomon and Manning (2008):

> The IPCC does not plan or carry out research, and this separation between research and assessment is essential if the IPCC is to be an objective assessor. The mandate of the IPCC is to evaluate information that must be independently documented, primarily as peer-reviewed literature. The planning and coordination of international research are best carried out by organizations such as the World Climate Research Programme, the International Geosphere-Biosphere Programme, and the International Human Dimensions Programme on global environmental change. These bodies often consider IPCC assessments and help provide the means for the scientific community to produce related research.

Overall, there is an excellent relationship and good communication between IPCC and the GEC programmes and ESSP. WCRP and IGBP, for example, held a workshop in Sydney in October 2007 to define the future research and observation agenda by learning from IPCC's AR4 (GCOS/WCRP/IGBP 2008). The workshop was jointly organized by WCRP, IGBP, the *Global Climate Observing System* (GCOS) and IPCC. The ESSP was also represented. The workshop aimed especially to bridge the climate research community and the climate modelling, and the impacts, adaptation, and vulnerability communities. A new framework was developed to accomplish this (figure 74.6). The observation and research requirements that lead to better climate change risk analyses and adaptation measures, and that result in lower vulnerability and impacts to a changing climate must be identified and the research to address them must be developed. This will lead to clear priorities for new observations and research expected to be needed in support of future IPCC assessments. Furthermore, the ESSP and IPCC are planning a joint workshop on critical gaps and knowledge needed from the social and economic

5 See Hibbard/Meehl/Cox/Friedlingstein 2007; Moss/Babiker/Brinkman/Calvo/Carter/Edmonds/Elgizouli/Emori/Erda/Hibbard/Jones/Kainuma/Kelleher/Lamarque/Manning/Matthews/Meehl/Meyer/Mitchell/Nakicenovic/O'Neill/Pichs/Riahi/Rose/Runci/Stouffer/van Vuuren/Weyant/Wilbanks/van Ypersele/Zurek 2007).

Figure 74.5: Approaches to the development of global scenarios: (a) traditional sequential approach; and (b) proposed parallel approach. Numbers indicate analytical steps (2a and 2b proceed concurrently). Solid arrows indicate transfers of information. Dotted arrows indicate integration of information (IAM: *integrated assessment model*; GCM *general circulation model*; ESM *Earth system model*; IAV *Impact, adaptation and vulnerability assessment*). **Source:** Moss/Babiker/Brinkman/Calvo/ Carter/Edmonds/Elgizouli/Emori/Erda/ Hibbard/Jones/Kainuma/Kelleher/Lamarque/Manning/Matthews/Meehl/Meyer/Mitchell/Nakicenovic/ O'Neill/Pichs/Riahi/Rose/Runci/Stouffer/van Vuuren/Weyant/Wilbanks/van Ypersele/Zurek 2007).



sciences to take place in January 2009, with support from The Netherlands. This workshop further integrated adaptation and vulnerability research into the broader climate change research agenda.

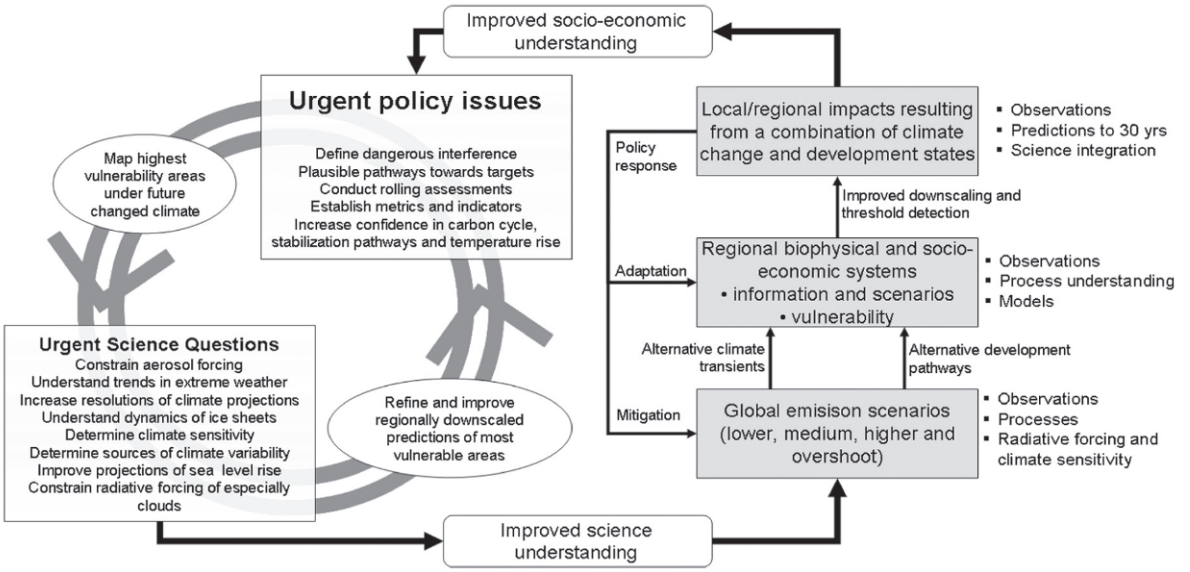
While there is an excellent relationship with IPCC, ESSP's organization is such that its contribution is not always recognized. The WCRP Working WGCM, for example, organized the provision of essentially all of the modelling results that are central to IPCC's Working Group I and Working Group II reports but these results are persistently referred to as IPCC results despite their official name of WCRP-CMIP3. ESSP thus needs to continue taking responsibility for tracking and heralding contributions from its programmes and projects to these policy relevant assessments.

Another example of ESSP interaction is the 2007 conference on *Integrating Analysis of Regional Climate Change Response Options*, in Nadi, Fiji, which was co-sponsored by IPCC, START and the Pacific Center for Environment and Sustainable Development. This conference explored innovative research approaches for addressing multi-scale and multidisciplinary challenges associated with climate change impacts, adaptation, vulnerability and mitigation. Participants included scientists active in ESSP, including a keynote presentation from the ESSP joint project on GEC and Food Systems.

74.3.5.2 Millennium Ecosystem Assessment

Many of the scientists involved in DIVERSITAS have been also contributing to the work of the *Millennium Ecosystem Assessment* (MA 2005; Leemans 2009b). For example, DIVERSITAS' Global Mountain Biodiversity Assessment was charged with drafting the mountain chapter of the MA. The structure adopted for the new DIVERSITAS in 2002 matches the framework of the MA. One of the most brilliant conceptual innovations brought about by the MA was the idea of ecosystem services. Again, this concept allowed for broader engagement of scientists from various disciplines in the natural and social sciences, economists

Figure 74.6: New framework for interactive and transdisciplinary research designed to deliver on societal demands for climate change. **Source:** GCOS/WCRP/IGBP (2008).



and the humanities. Talks have been launched recently to look into the possibility of a new incarnation of the MA, which would then hopefully have the potential to make the array of scientific input even broader, and hence pose a huge opportunity for ESSP to engage strategically.

74.3.5.3 The UN Framework Convention on Climate Change (UNFCCC)

The ESSP and its parent programmes have participated in recent informal discussion sessions of UNFCCC's *Subsidiary Body for Scientific and Technological Advice* (SBSTA) on how to improve communication between the Parties and the Research Programmes. These meetings have proved to be a great success and invaluable with presentations on emerging science and enhanced dialogue between the research community and the Parties. The ESSP regional inter-governmental research partners, the *Asia-Pacific Network for Global Change Research* (APN) and the *Inter-American Institute for Global Change Research* (IAI) have been involved in these SBSTA sessions, as has the IPCC. The ESSP and its parent programmes have also convened in-session workshops at UNFCCC-SBSTA on, for example, climate modelling, scenarios, downscaling, and on vulnerability, adaptation and resilience. The workshops provide the cutting-edge science for informed decisions.

WCRP and START have also responded to various calls for submissions arising from the *Nairobi Work Programme* on *Impacts, Vulnerability and Adaptation to Climate Change*. IHDP as well has embarked on talks with the UNFCCC Secretariat regarding the *Nairobi Work Programme* and the IHDP was well represented at the Conference of Parties in Bali (December 2007).

74.3.5.4 UN Convention on Biological Diversity (CBD)

DIVERSITAS signed a Memorandum of Understanding with the CBD in 1997. The Secretary General of the CBD Secretariat is represented on DIVERSITAS' Scientific Committee. Over the years, DIVERSITAS has been called upon by the CBD and its *Subsidiary Body on Scientific, Technical and Technological Advice* (SBSTTA) on a number of occasions to provide scientific advice. This included expertise on the *Global Taxonomy Initiative*, Assessment of knowledge on key species groups, Invasive Alien Species, Mountain biodiversity, and the valuation of ecosystem services (on-going). DIVERSITAS has regularly held side events at SBSTTAs or CoPs on various topics including invasive species, mountain biodiversity and the *International Mechanism of Scientific Expertise on Biodiversity* (IMoSEB).

At CoP9 (Bonn, May 2008), DIVERSITAS with the *International Union of Biological Sciences* (IUBS) sponsored a pre-CoP scientific biodiversity summit. This is a formal part of the CBD-CoP process and a scientific statement was communicated to delegates. The first of such events successfully took place at

CoP8 in Curitiba, Brazil in 2006. IHDP also held side events during CoP9 focusing on human and societal dimensions of biodiversity.

74.3.5.5 UN Convention to Combat Desertification (UNCCD)

A new scientific assessment on climate change and desertification is urgently needed. The results of a recent WCRP-sponsored workshop on "*Climate Change and Desertification: monitoring, modelling and forecasting*"[6] in 2007 and an earlier IGBP/IHDP sponsored Dahlem Workshop on *Integrated assessment of desertification* (Stafford Smith/Reynolds 2002), demonstrated that scientific knowledge about desertification and climate change is scattered in the literature of many disciplines and that there is an urgent need to establish a policy-relevant scientific assessment (Vlek 2005). The results of these meetings also highlighted that the processes and implications of desertification are of great and widespread concern, as well as affecting particularly the poorer segments of the global population.

The most recent IPCC and MA projections indicate that dryland areas may be expanding. Although research related to desertification is on-going, recent results have underscored a number of challenges to policy and a lack of a consolidated intellectual understanding of the underlying causes and effects (Hein/De Ridder 2006, Reynolds/Stafford-Smith/Lambin/Turner/Mortimore/Batterbury/Downing/Dowlatabadi/Fernandez/Herrick/Huber-Sannwald/Jiang/Leemans/Lynam/Maestre/Ayarza/Walker 2007). The development of a special assessment report and a better integration between climate change and desertification research results would establish synergy and provide a unique opportunity to examine future impacts of climate change and assess the consequences for the livelihoods of people in arid regions. The rate of climate change projected by IPCC echoes the rate of environmental change in the Sahel experienced in the past three or four decades, providing a test case of how humans have had to respond and adapt. Adaptation has already occurred to some extent in the Sahel, while massive dislocations and adjustments have taken place in central Asia after the collapse of the Soviet Union and associated institutions. Areas facing the future risk of reduced precipitation, and drylands in particular, host numerous inhabitants, who may not have been severely affected yet, and thus may not have built the necessary expertise or conducted sufficient preparatory actions. These examples provide opportunities to examine, inter alia, the relationship between science and policy under projected climate change. Exactly how this relationship can be strengthened is less clear but the ESSP clearly links research and scientific progress with both the assessment and policy communities and other users (figure 74.3).

The WCRP workshop in September 2007 also highlighted the relationships between climate change and desertification processes, which include many feedbacks at different scales. To understand these complex relationships, both global, regional and local assessments and accessible data sets are needed. It is particularly urgent to consider vulnerability as well as food and environmental security. Tackling desertification by means of ecosystem restoration and sustainable land management can positively influence micro and meso-climates, as well as the land surface energy and moisture budgets at landscape levels. Last but not least, sustainable land management and ecosystem restoration can and is being used to sequestrate additional carbon.

The 2007 workshop participants strongly supported a recommendation for IPCC to issue a *Special Report on Climate Change and Desertification*. Additionally, IHDP has also engaged in an ongoing dialogue with the UNCCD Secretariat and will come up with a joint work programme, which results from strong UNCCD interests for interdisciplinary input from the social and economic sciences.

74.3.5.6 Meeting the UN's Millennium Development Goals

The UN *Millennium Development Goals* (MDGs) are an inspiring and formidable challenge for society (UNDP 2003b). Within a decade we must aim to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat deadly diseases; ensure environmental sustainability; and construct a global partnership for development. At the same time, society is faced with other challenges such as global climate change, air pollution, declines in global biodiversity, changes in food resources and the ways in which all of these issues tie into global security.

Some have argued that it is not feasible to address all of these issues at once, and that we should simply use some sort of cost-benefit analysis to choose one or two on which to concentrate. This view may be

6 See at: <www.unige.ch/climate/Workshops/wengen07.html>.

appealing, but it is fundamentally misguided. It would be a tragedy if, for instance, we were able to completely eradicate HIV/AIDS only to discover that by ignoring *global environmental change* (GEC) issues, malaria had become even more widespread or fresh water resources even scarcer. We do not have the luxury of solving these problems one at a time; they need to be tackled together (Wall/Rabbinge/Galopin/Khoday/Lewis/Lubchenco/Melillo/Schmidt-Traub/Sombilla/Cimarrusti 2005). Understanding the coupled human-environmental system – how the natural Earth System works, and how we humans influence (and are influenced by) it – is at the very heart of addressing these issues, and achieving the MDGs.

74.4 Concluding Remarks

Achieving the MDGs strongly resonates with the recent international review of the ESSP, which stated that the Amsterdam Declaration, which launched the ESSP "is even more valid today than seven years ago. There is a clear need for an internationally coordinated and holistic approach to Earth System science that integrates natural and social sciences from regional to the global scale. In principle, the ESSP should be able to assume this role" (Fresco/Brito/Bremauntz/Gruber/Hydén/Reid/Rockström/Williams/Schellnhuber/Conway 2008: 7). The ESSP is now rapidly evolving into an alliance to initialize and catalyze highly integrative studies of the Earth System including its human dimensions, to enhance capacity building and to facilitate dialogue between science and society. ESSP, therefore, aims to integrate and communicate high quality Earth System Science for the benefit of society, including providing the necessary guidance towards sustainable futures.

The ESSP plans to address emerging science challenges (e.g. international trade in the Earth System; globalized land use competition; global environmental change and development; and the dynamics of sustainability transitions, transformations and thresholds) in concert with ESSP fora to further articulate the societal environmental challenges by involving top-level stakeholders, by advising on research and policy agendas, and by evaluating and communicating the consequences of recent findings. This interactive process must make the GEC research timelier and more relevant to society. It will involve stakeholder engagement early on and during the entire process. This should enable an open and continuous dialogue, mutual learning and the delivery of information in a timely manner. All this in an internationally coupled network in which renowned and young scientists can contribute independent of location, culture or institutional background.

The evolving dynamic agenda and high quality, integrative science of the ESSP and its parent programmes places us on the front line working with the research and policy communities and society at large. We still need, however, to enhance this effort and instil a greater sense of urgency. Coping with global environmental change is an enormous challenge, and one that the world must face up to now.

Since its establishment in 2001, ESSP has made substantial progress. The ESSP has put into place a structure that enabled joint research projects on global environmental change and the carbon cycle, food systems, water systems and (more recently) human health. All these joint projects aim to bridge the global, regional and local levels. These activities actually are the first elements of a system of global environmental science and construct the essential knowledge base needed to respond effectively and quickly to the great challenge of global change. More importantly perhaps even than these successes is the fact that ESSP and its Joint Projects offer a genuine home base for the new type of interdisciplinary (and transdisciplinary) researcher, who is so urgently needed to tackle today's global change and sustainability challenges (e.g. Schmidt/Moyer 2008).

In the short time that they have been in operation, the *Global Carbon Project* (GCP), *Global Water System Project* (GWSP) and *Global Environmental Change and Food Systems* (GECAFS) have each in their own way and with their own different methodologies and approaches gone about building the scientific infrastructure that allows us to take a more integrated approach to global environmental change science. The annual updates on the global carbon budget (Canadell/Le Quere/Raupach/Field/Buitenhuis/Ciais/Conway/Gillett/Houghton/Marland 2007), for example, have received a large media attention. We now also have established the new *Global Environmental Change and Human Health* (GECHH) project that will tackle global environmental change from again a different perspective. Capacity building is integrated throughout the ESSP, most notably through START, but also to differing degrees in all Joint Projects and MAIRS.

The ESSP and its parent GEC programmes (DIVERSITAS, IGBP, IHDP and WCRP) have also contributed greatly to the international scientific assessments and have provided policy relevant information to numerous UN conventions, governments,

NGOs and the private sector. These interactions have further emphasized the need for a well coordinated international GEC research effort, which helps to shape adequate policy strategies on climate change, biodiversity, desertification and sustainability. In essence, this sums up one of most important added values of ESSP.

75 The International Human Dimensions Programme on Global Environmental Change – Taking Stock and Moving Forward

Louise von Falkenhayn, Andreas Rechkemmer and Oran R. Young

75.1 Introduction[1]

Human actions dominate the Earth's great biophysical and geochemical cycles and consequently lie at the very heart of every effort to come to terms with the phenomenology of global environmental change. Research on the so-called human dimensions of global change concerns human activities that alter the Earth's natural environment, the sources or causes of those activities, the consequences of *global environmental change* (GEC) for societies and economies, and the responses of humans to the experience or expectation of global change. Human interferences with the Earth's system are so significant that the recent era has been suitably named the 'Anthropocene'. Human activity continues to intensify sharply and increases pressures on the Earth's resources and, for instance, on the planet's capability to assimilate/absorb wastes (e.g. Crutzen 2002). Thus, climate change is the most prominent, but only one of the various changes that humanity presently faces and which threaten social welfare. Global environmental change also encompasses changes in terrestrial and aquatic ecosystems, and its full extent and complexity is only now being realized. Global environmental change research in recent years has increasingly recognized the importance of humans as the central elements of the Earth System and its cycles. This has given rise to the concept of socio-ecological systems, a frame of reference that serves as a model for all human dimensions research.

Global Environmental Change, a phenomenon that is occurring at an ever increasing rate, encompasses the set of biophysical transformations of land, oceans and atmosphere, driven both by human activities and natural processes. These transformations take place at the local, regional and global scale, and affect the quality of human well-being, social and economic welfare, and sustainable development worldwide. Advanced research on the human dimensions of global environmental change puts people, their actions and responses – both at the individual as well as the societal or aggregate level – into the very centre of the analysis of environmental changes. It also takes into account that global environmental change is driven by and influences processes of socio-economic, political, and cultural globalization. Whether we are interested in reducing *greenhouse gas emissions* (GHG), sequestering carbon dioxide already in the Earth's atmosphere, or adapting to the impacts of climate change, it is important if not critical to find ways and means to influence the actions of humans from the lifestyle and behaviour of individual energy consumers to collective choices about GHG emissions control policies. The same goes for issues of land degradation and the destruction of habitat and ecosystems vital to endangered species as well as the depletion of marine life arising from overfishing and the spread of dead zones in the oceans. More often than not, we know what human actions or combinations of actions are implicated in these large-scale environmental problems. Research on the human causes of global environmental change has shown that human activities, such as deforestation, urbanization or energy consumption, are determined by factors such as population growth, economic and technological development, cultural forces, values and beliefs, institutions and policies, and interactions among them. When examining the human dimensions of environmental change, the study of ecosystem services illustrates the strong interlinkages existing between both socio-ecological sys-

1 Of this chapter, sections 75.4.1 to 75.5. heavily rely on Rechkemmer, A.; von Falkenhayn, L. 2009: "The human dimensions of global environmental change: Ecosystem services, resilience and governance", in: *European Physical Journal. Special Topics,* 167, 3–17. The permission to reuse this material was granted by Springer Rights and Permissions; Springer-Verlag Heidelberg, 3 May 2010.

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tems and global change. Ecosystem services are inextricably linked to human well-being and play a central role in sustainable adaptation strategies. Environmental impact of global change can both add to social vulnerability and change resilience by altering the supply of ecosystem services and the trade-offs that can occur. It is when examining such phenomena that the importance and abilities of governance systems to shape change and responses are seen.

Growing knowledge and rising awareness of the critical importance of humans and their societies both in causing and in addressing environmental changes have led scientists, governments, and international organizations to become increasingly interested in understanding the role of human interaction with the natural environment, and in implementing policies designed to promote sustainable interaction between human societies and their environmental resources. One of the most pressing challenges is the need to establish the scientific foundations for sustainable livelihoods. Scientists worldwide are studying the causes and consequences of such changes, as well as the possible responses. Natural, life, and environmental sciences constantly add to our understanding of the dynamics of environmental change processes. However, traditionally, research on these processes has focused mainly on the biophysical elements, which are just one part of these complex and dynamic systems. Research was previously widely based on the assumption that anthropogenic actions are basically of little influence on the workings of these systems or represent only sporadic disturbances that can be discounted for purposes of analysis. To better understand and to respond more effectively to the manifold challenges of global environmental change major inputs from the social and behavioural sciences are required to provide crucial insights into the human and social dynamics of global environmental change. It is only when the social element is linked with the environmental elements that ecosystem change and successful implementation of coping strategies can be achieved. Hence, understanding these global environmental changes requires coordinated contributions from natural scientists (e.g. ecologists, climatologists and oceanographers) and social scientists (e.g. economists, anthropologists, political scientists and sociologists). This stream of research requires an interdisciplinary approach together with combined inputs from scholars in developed and developing countries, focusing on local, regional, and global scales.

Towards this end human dimensions research plays an important role in both co-producing with the natural sciences in order to achieve a deeper understanding of the very nature of the global change challenge and in informing responsible and sustainable policy and practice making at all levels. In this connection, the scientific community has organized itself to study these complex issues and provide science-based solutions using interdisciplinary and global research networks. This is the rationale for the establishment of the *International Human Dimensions Programme on Global Environmental Change* (IHDP). The programme's overall goal is to provide leadership in framing, developing, coordinating, and integrating social science research on global change and promoting the application of key findings to help address environmental challenges.

75.2 IHDP's First Decade: Establishing the Programme

IHDP, in its current form, was established in 1996. But its origins date back to 1990 when the *International Social Science Council* (ISSC) created the *Human Dimension of Global Environmental Change Programme* (HDP) as the social science counterpart to other Global Change Programmes that were at the time focused on the natural sciences. At the time, the sciences were changing rapidly, the effects of global change were becoming more and more visible, and there was a growing realization that human actions both contributed to the generation of and were impacted by these changes. In 1996, the *International Council for Science* (ICSU) joined ISSC as a co-sponsor, and the name of the programme was changed to the *International Human Dimensions Programme on Global Environmental Change* (IHDP). The Secretariat was relocated from Geneva to Bonn with a major infusion of funding from the German government.

During this first phase, which ended in 2006, IHDP contributed significantly to the mobilization of both researchers and resources at a time when few scholars and even fewer national and international policy-makers were making an explicit link between societal relations and major changes in the global environment. The decade 1996 to 2006 was dedicated to the establishment and the branding of human dimensions research as a distinctive entity through the development of a number of core scientific projects addressing global environmental changes from a

social science perspective. The first of four initial core projects was the *Land-Use and Land-Cover Change* (LUCC) Project, co-sponsored with the *International Geosphere Biosphere Programme* (IGBP). In addition to LUCC, IHDP established projects on the *Institutional Dimensions of Global Environmental Change* (IDGEC), *Global Environmental Change and Human Security* (GECHS), and *Industrial Transformation* (IT). With project life cycles of approximately 10 years, each project made important contributions to our understanding of global environmental change, to the formulation of economically, socially, and culturally feasible adaptation and mitigation strategies, and to the pursuit of global sustainability.

75.2.1 Land-Use and Land-Cover Change (LUCC)

The *Land-Use and Land-Cover Change* (LUCC) Project completed its research activities in October 2005. It produced a synthesis volume (Lambin/Geist 2006) and a large number of other publications dealing with global change themes ranging from desertification and drought to land-use changes in the tropics. LUCC developed statistical methods for analysis of patterns of land use, inventoried mapping activities of major crops, developed a form of meta-analysis to compare the results of many existing case studies, and organized the development of a number of new case studies on critical zones in the world. LUCC established a worldwide community and network of leading scholars interested in issues of land use and cover change.[2]

75.2.2 Institutional Dimensions of Global Environmental Change (IDGEC)

Focusing on the roles that institutions play both in causing and addressing large-scale environmental problems, IDGEC was launched in 1998 and completed its work with a major synthesis conference in December 2006. This was followed by the publication of a synthesis volume on the scientific legacy of the project (Young/King/Schroeder 2008). IDGEC brought the intellectual capital of the 'new institutionalism' to bear on environmental issues and contributed to our general understanding of the causal role of institutions and the prospects for institutional design. A particular focus of the project was an emphasis on the analytical themes of fit, interplay, and scale involving the match between institutions and ecosystems, interactions among institutions, and the generalizability of findings about institutions across levels of social organization.[3]

75.2.3 Global Environmental Change and Human Security (GECHS)

GECHS has sought to place environmental changes within larger socio-economic and political contexts by examining how these shifts shape the capacity of communities to cope with and respond to change. The GECHS research agenda focuses on the way diverse social processes such as globalization, poverty, disease, and conflict combine with global environmental change to affect human security (GECHS 1999). Broadly defined by the United Nations as 'freedom from fear' and 'freedom from want' (UNDP 1994), human security encompasses many elements of human well-being. GECHS addresses the literature on environmental security but seeks to broaden its focus to understand the interactive character of the range of elements encompassed in the concept of human security. GECHS organized a synthesis conference in June 2009.[4]

75.2.4 Industrial Transformation (IT)

Launched in 1999, the IT core project tackles the challenging task of improving the understanding of the

2 See for a documentation of its major activities at: < http://www.ihdp.uni-bonn.de/html/projects/i-lucc.html> and at: <http://www.igbp.net/page.php?pid=250> and for its publication at: < http://www.ihdp.uni-bonn.de/html/publications/reports/report10/luccisindex.htm>. The LUCC International Project office was first hosted by the Clark University, USA from 1994 to 1996, by the Institute Cartografic de Catalunya (ICC) in Barcelona, Spain (1997–1999), and finally by the Université Catholique de Louvain, Belgium (2000–2005) with generous support from the Belgian Federal Science Policy Office.

3 See for a documentation of its major activities at: < http://www2.bren.ucsb.edu/~idgec/>; ifs publications at: <http://www2.bren.ucsb.edu/~idgec/publications/newpub.html> and for the presentations at its synthesis conference are at: <http://www2.bren.ucsb.edu/~idgec/abstracts.php>. An IDGEC International Project Office (IPO) was established in 1999 at Dartmouth College with funding provided by the US National Science Foundation. The IPO was later located at UCSB and played a critical role with the identification of issues ripe for systematic analysis and continuing through to the presentation and publication of findings.

ways in which societies can combine economic and social development to reduce pressures on the environment and facilitate transformation of the industrial system towards sustainability. Its particular emphasis is on processes of macro-economic change that determine the impacts of human activities of large-scale biophysical systems. Having gone through a phase of community building, IT has begun in recent years to focus its work on the way transformations to sustainability unfold and how ongoing changes can be influenced so that they lead to sustainable development. IT is expected to go through a synthesis process in 2010.[5]

Towards the end of the first decade, IHDP added a number of new projects to the original four core projects. These included the project on *Urbanization and Global Environmental Change* (UGEC) and, in collaboration with IGBP, two joint projects, the *new Land Ocean Interactions in the Coastal Zone Project* (LOICZ) and the *Global Land Project* (GLP).

75.2.5 Urbanization and Global Environmental Change (UGEC)

UGEC seeks to provide a better understanding of the bidirectional interactions and feedbacks between global environmental change and urbanization at the local, regional, and global scales through an innovative conceptual and methodological framework. To capture the benefits of urbanization and mitigate and adapt to negative environmental and socio-economic impacts, a stronger collaboration between academics, policy-makers and practitioners is encouraged by the project. As urbanization represents a topic of special policy relevance today, the UGEC core project provides an unrivalled opportunity to address critical issues of worldwide importance that have so far not received adequate attention.[6]

75.2.6 Land Ocean Interactions in the Coastal Zone Project (LOICZ)

Based on the outcomes of its first ten years of activity, the 'new' LOICZ project (which became a joint core IHDP project in 2004), features an expansion of its predecessor to analyse the world's coastal zones as heterogeneous, relatively small but highly productive, dynamic and sensitive systems that provide a significant proportion of the life support systems for most human societies. The project aims to provide an integrated framework to address the primary issues of sustainable human use of coastal systems. Issues relating to the vulnerability of coasts and risks for human uses play a key role. An important underlying principle of LOICZ is the need to engage continuously in a science-policy-public dialogue addressing needs for scientific information in achieving sustainable development in the coastal zones.[7]

75.2.7 Global Land Project (GLP)

The *Global Land Project* (GLP) is a successor both to the jointly sponsored IGBP/IHDP core project LUCC and the IGBP core project on *Global Change and Terrestrial Ecosystems* (GCTE). GLP focuses on the interactions of people, biota, and natural resources of terrestrial and aquatic systems. The GLP Science Plan (2005) emphasizes the study of changes

4 See for a documentation of its major activities at: <http://www.gechs.org/> and for its publication at: <http://www. gechs.org/publications/> and a summary on the synthesis conference in June 2009 in Oslo is at: <http://www.gechs.org/downloads/GECHS_kompendie.pdf>. GECHS is overseen by a scientific steering committee <http://www.gechs.org/science-committee/>, enriched by the contributions of associates <http://www.gechs.org/associates/>, and coordinated from an international project office (IPO) located in the Department of Sociology and Human Geography at the University of Oslo that was supported financially by the Norwegian Research Council.

5 See for a documentation of its major activities at: <http://www.ihdp-it.org/ > and for links to its projects at: <http://www.ihdp-it.org/index.php?option=com_content&task=view&id=10&Itemid=29>. It is coordinated by the IHDP - Industrial Transformation International Project Office, c/o Institute for Environmental Studies (IVM), Vrije Universiteit, De Boelelaan 1087, 1081 HV Amsterdam, the Netherlands.

6 See for a documentation of its major activities at: <http://www.ugec.org/> and at: http://www.ihdp.unu.edu/article/ UGEC> and for its publication at: <http://www.ugec.org/tiki-index.php?page=UGECPubs>; and its science plan at: <http://www.ugec.org/files/UrbanizationSciencePlan.pdf>. Its International Project Office is at: Arizona State University, P.O. Box 875402, Tempe, AZ 85282-5402, USA.

7 See for a documentation of its major activities at: <http://www.loicz.org/> and for its products at: <http://www.loicz. org/products/index.html.en> and publication <http://www.loicz.org/products/publication/index.html.en>. The LOICZ International Project Office is based at the Institute for Coastal Research at the GKSS-Research Center, Max-Planck- Str. 1, 21502 Geesthacht, Germany.

in the coupled human-environmental system at local to regional scales. Changes in coupled systems affect the rates of cycling of energy, water and biota at the global level, while global-level political and economic changes, such as international treaties and market liberalization, in turn affect decisions about resources at local and regional levels. The goal of GLP is to measure, model, and understand the coupled human-environmental system ('land system') as part of broader efforts to address changes in Earth processes and subsequent social, economic, and political consequences.[8]

75.2.8 Results of the Four Initial IHDP Core Projects

The four initial IHDP core projects made important contributions to understanding global environmental changes, to the formulation of economically, socially, and culturally feasible adaptation and mitigation strategies, and to the pursuit of global sustainability. During the first decade, IHDP made substantial progress in widening research networks and building capacity. The publication of the Science Plans for IDGEC, GECHS and IT, and the LUCC Implementation Strategy was one visible step, as were the various international conferences and meetings held during these years, including the 1999, 2001, 2003, 2005 and 2009 Open Meetings of the Human Dimensions of Global Change Research Community. The development of networks and capacity development activities, especially in the developing countries, led to the establishment of the *International Human Dimensions Workshops* (IHDW) as a biennial event, and the organization of the first Science-Policy Dialogue held in Berne, Switzerland in 2006.

Another important step occurred when IHDP joined the newly established *Earth System Science Partnership* (ESSP, chap. 74 by Leemans/Rice/Henderson-Sellers/Noone) in 2001, recognizing the close links between human dimensions and other areas of Earth System changes. This partnership includes the International Programme on Biodiversity (DIVERSITAS, chap. 76 by Walther/Larigauderie/Loreau), the *International Geosphere-Biosphere Programme* (IGBP, chap xy by Noone/Nobre/Seitzinger), and the *World Climate Research Programme* (WCRP, chap. 78 by Church/Asrar/Busalacchi/Arndt) as well as IHDP. ESSP works towards an integrated study of the Earth System, with particular attention to large-scale changes and the implications of these changes for global and regional sustainability. The ESSP addresses this concern through a number of distinct activities, such as the joint research projects on food, carbon, water, and health:

- *Global Environmental Change and Food Systems* (GECAFS);
- *Global Carbon Project* (GCP);
- *Global Water System Project* (GWSP);
- *Global Environmental Change and Human Health* (GECHH).

IHDP contributes to the joint projects on carbon, water, food and health, and actively facilitates the establishment of the *Monsoon Asia Integrated Regional Study* (MAIRS). IHDP also cooperates closely with START (*Global Change System for Analysis, Research and Training*), which is the capacity building and regional research component of ESSP.

75.3 The Second Decade: Innovative Science

In 2005–2006, IHDP underwent an external review organized by ICSU and IGFA (*International Group of Funding Agencies*). This review noted the programme's accomplishments but also offered a number of recommendations for strengthening the programme in the next phase. In response, the IHDP Scientific Committee (SC) embarked upon the development of a new IHDP Strategic Plan (2007) to guide the programme for the period from 2007 through to 2015. In addition to responding to the external review, the Strategic Plan identifies areas of innovative and cutting-edge science in the realm of human dimensions research. With the recognition of the importance of coupled systems or socio-ecological systems, IHDP moved into a new and important scientific phase. The experience of the initial core projects demonstrated the need to broaden views further and to ask even more holistic questions. At the beginning of 2007, the *United Nations University* (UNU) joined ICSU and ISSC as a third institutional sponsor for IHDP.

As we move deeper into the era of the Anthropocene (Crutzen 2002), there is a need to raise the profile of the social sciences concerning matters such

8 See for a documentation of its major activities at: <http://www.globallandproject.org/> and for its documents are at: <http://www.globallandproject.org/documents.shtml>, The GLP International Project Office is funded and hosted by the University of Copenhagen.

as climate adaptation and mitigation. A new brand of social science is needed, one that addresses the roots of human actions affecting the Earth System and explores possible applications of its findings to efforts to avoid the most serious impacts of developments like climate change and to facilitate adaptation to these impacts once they become unavoidable. There has been an increasing realization that human-environment interactions give rise to complex and dynamic socio-ecological systems in which anthropogenic and biophysical drivers play central roles and interact with one another. The current challenge is to understand the dynamics of these coupled socio-ecological systems well enough to anticipate large-scale changes and to take steps either to reduce their likelihood or to minimize their impact once they occur. IHDP plays a significant role in this effort, providing intellectual leadership and offering a means to facilitate research and interaction between scientists and policy-makers.

The IHDP Strategic Plan 2007–2015 (2007) developed four major propositions intended to provide general guidance for the work of researchers and policy-makers concerned with the human and societal dimensions of global environmental change:

1. Social science must take centre stage during the next round of efforts to understand and come to grips with global environmental changes;
2. Understanding the dynamics of socio-ecological systems must receive top priority;
3. A portfolio approach to the development of methods suitable for understanding global environmental changes is needed;
4. A rich dialogue between scientists and policy-makers or practitioners more generally at all stages in the process of framing and conducting research on large-scale environmental changes is beneficial.

Human societies define the boundaries and character of their environments, frame their environmental problems, and devise solutions to them, based on their perceptions of what constitutes the environment, what drives and constrains its dynamics, what creates environmental challenges, and what may be done to deal with them. The 'Human Dimensions Science's' approach is to place the society at the centre of the global environmental change debate, a perspective that frames current global problems as social and societal challenges. Research on the human dimensions of global environmental change poses a number of methodological challenges. Many associated concepts like ecosystem services, sustainable development or human security are difficult to measure, especially in a manner that permits comparisons across space and time. Another barrier is the interaction of numerous variables with one another to form causal clusters whose constituent elements are hard to separate. These new challenges have also contributed to the pronounced tendency in this recently established study field to engage in methodological innovation and trans-disciplinary cross-fertilization.

75.4 Scientific Agenda of IHDP

75.4.1 Mission and Structure

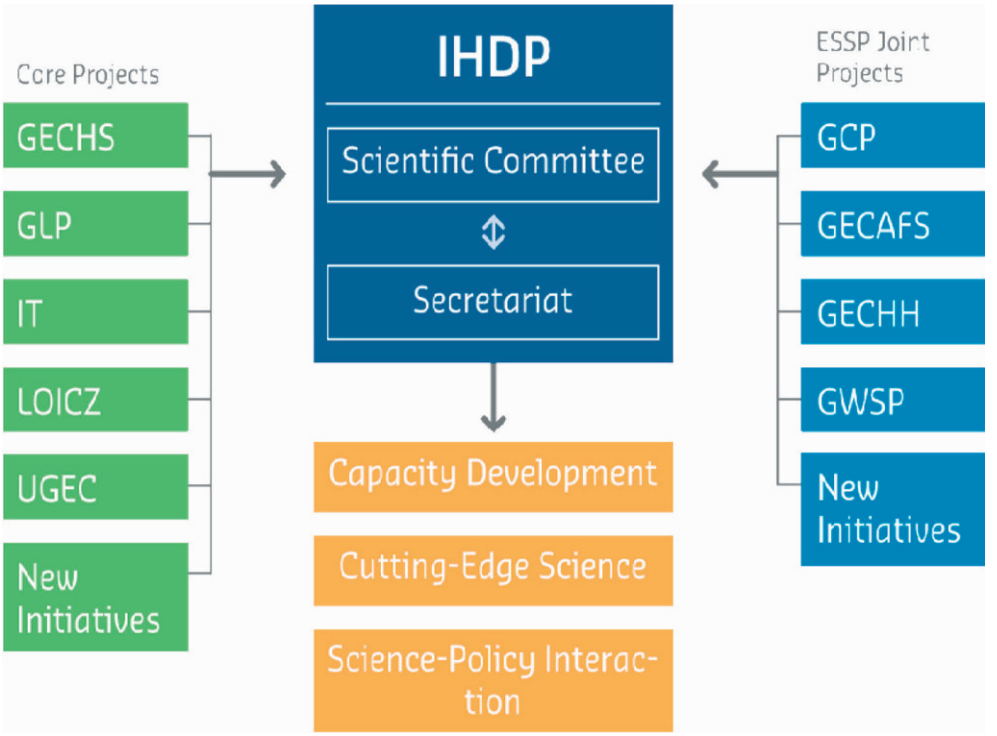
Following publication of its Strategic Plan 2007–2015 (2007), IHDP has implemented its mission through core projects, joint projects, and cross-cutting themes together with its three pillars of cutting-edge science, capacity development, and science-policy interaction. The programme's aim is to generate state-of-the-art scientific knowledge on coupled socio-ecological systems, achieve comprehensive understanding of global environmental change (GEC) processes and their consequences for sustainable development, and make scientific contributions to explore the impact of global environmental change on human welfare, the anthropogenic drivers of global environmental change and societal responses to mitigate and adapt to global environmental change. This output of knowledge should be relevant and produced in a way so that it can feed into scientific assessments and ultimately into the policy process at local, national, regional, and global levels.

The IHDP's mission is:

- To foster, coordinate, and conduct social science research that helps to understand and address the challenges of global environmental change and improve societal responses.
- To contribute to the interdisciplinary attempts to understand the interactions of humans with the natural environment that cause global environmental change.
- To strengthen the capacities of research and policy communities toward a shared understanding of the social issues and implications of global changes.
- To facilitate dialogue between science and policy.

To achieve these goals, IHDP has a number of strategies. New knowledge is created by framing the social science of global environmental change in conjunction with a variety of stakeholders; creating new con-

Figure 75.1: IHDP's programmatic structure. **Source:** IHDP.



ceptual frameworks and methods; bringing together people to create new research networks and collaborations. New generations of researchers are encouraged by: training scientists; networking; providing research and career opportunities. Knowledge and practice is linked by: providing for science-practitioner interactions and developing science digests for academia and policy-making. Communication is promoted by stimulating scientific outputs and publishing outputs targeted at broad and diverse audiences. Funding is mobilized by identifying and liaising with funding sources, and building partnerships with funders. With both a comprehensive vision and strategies in place, IHDP's vision is to provide international leadership in framing, developing, and integrating social science research on global change, and to promote the application of the key findings of this research to help address environmental challenges.

IHDP has developed an effective programmatic structure (figure 75.1) over the course of the last decade. This structure features a set of core projects operating as relatively autonomous activities, a number of joint projects managed on a collaborative basis with the other global change research programmes and the *Earth System Science Partnership*, and several cross-cutting themes of particular interest to the members of the IHDP scientific community. To support these efforts, the programme has added a growing engagement in capacity development. The pattern of project development is now well established. Individual core projects have a life cycle of approximately 10 years, ending with a synthesis process.

75.4.2 Current Synthesis Projects and New Core Research Themes

Two of IHDP's core projects, *Global Environmental Change and Human Security* (GECHS) and *Industrial Transformation* (IT) have reached their synthesis phase, a phase where the projects collate their results. GECHS has inspired a new area of research that, back in the late 1990's, was not well understood or structured. In bringing people into the centre of the security agenda, GECHS played a central role in identifying the social challenges of global change. Discussions about people's vulnerability, systems' resilience or adaptive capacity emerged from this process (Barnett/Matthew/O'Brien 2008). IT has strengthened our understanding of transition pathways, particularly towards industrial sustainability. With its recent focus on the developing countries of Asia, IT contributes to a debate that is regional in scope but of global importance (Wieczorek 2006). The development pathways

of Asia will shape the face of the world in the 21st century.

Responding to emerging human dimension themes a number of new projects were initiated in the last two years, for instance *Earth System Governance* (ESG) and *Integrated Risk Governance* (IRG).

Earth System Governance is a project that builds on the accomplishments of IDGEC but brings a number of new scientific elements to the analysis of efforts to guide or steer human-environment interactions. Central to the project is an emphasis on the role of non-state actors and the development of governance systems in which multinational corporations and elements of civil society play prominent roles. Priority themes for ESG include: architecture, agency, allocation, accountability, and adaptation (Biermann/Betsill/Gupta/Kanie/Lebel/Liverman/Schroeder/Siebenhüner 2009). ESG has made a prompt start to build cooperative efforts with other projects, including the ESSP joint projects, that will illuminate issues of governance in a number of substantive areas while, at the same time, producing insights about the nature of governance that are generic in character.

The IRG pilot project was initiated in response to the growing intensity and frequency of natural disasters in recent years. Societies face risks not only from extreme weather conditions, but also from negative effects on the normal operation of social infrastructure and the service capacity of the Earth's ecological system. International frameworks, governance bodies at all levels, and national governments have expressed strong interest in improved risk governance, such as reflected in the *United Nations International Strategy on Disaster Reduction* (UN/ISDR). The stress on governance in this initiative is meant to direct attention to a number of concerns, including policies designed to reduce the vulnerability of individuals and communities to the impacts of extreme events, decision-making processes relating to the establishment and deployment of response capabilities, and institutional arrangements (e.g. insurance schemes) capable of protecting individuals from the worst impacts of extreme events, while avoiding the problem of moral hazard.

75.4.3 Cross-cutting Themes

An important feature of IHDP's second decade is the development of four cross-cutting themes (figure 75.2) that address issues that arise in one form or another in all of IHDP's core and joint projects. The emergence of these themes reflects the desire of the IHDP Scientific Committee to engage in challenging scientific efforts crucial for the whole programme. Each cross-cutting theme is multi-dimensional and multi-scalar. Together, they offer an opportunity to link scientific knowledge to concrete practices designed to mitigate and adapt to the negative consequences of global environmental change. Four cross-cutting themes have emerged:

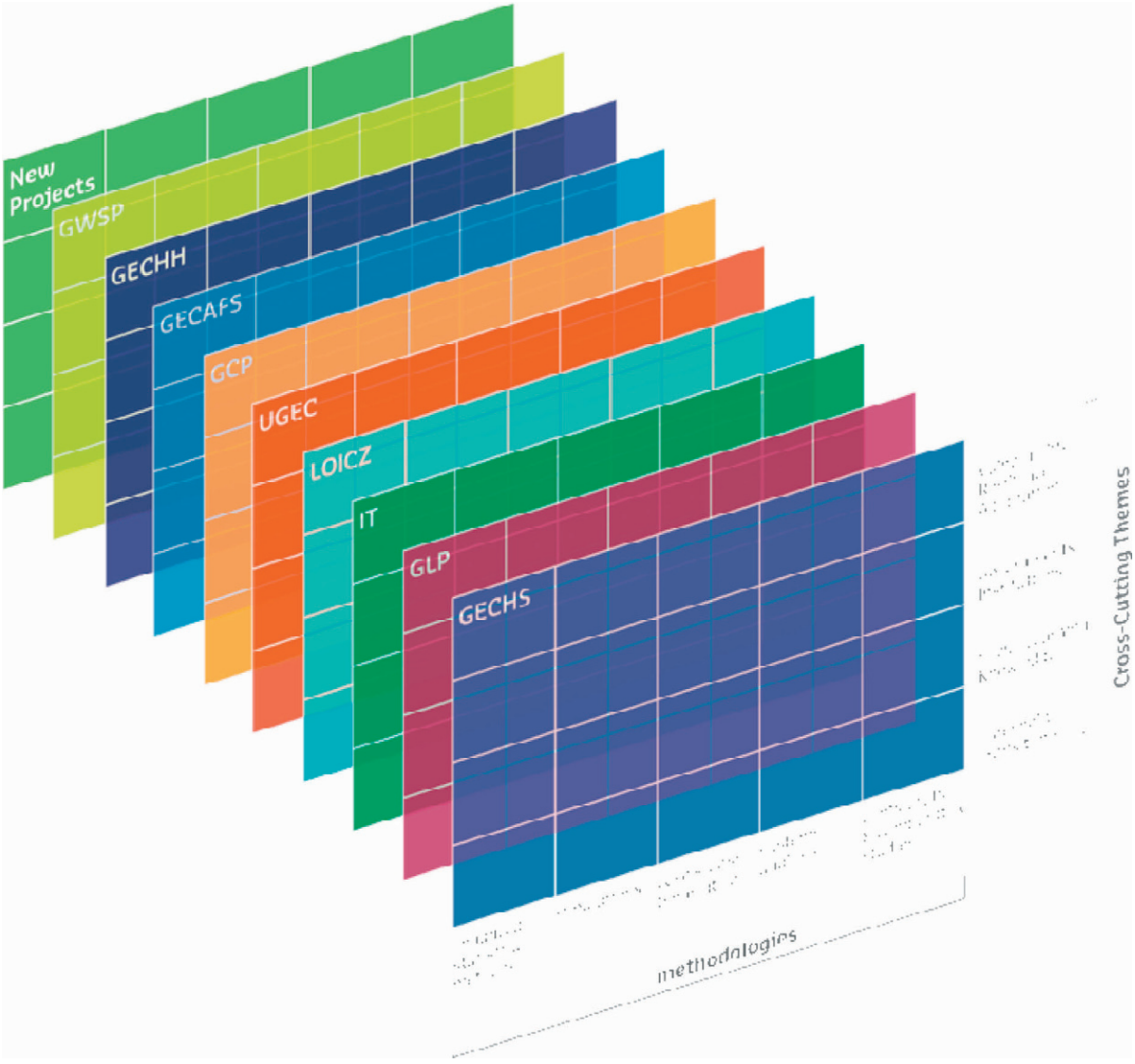
- *Vulnerability, Resilience and Adaptation* (VRA) (Janssen/Ostrom 2006). How can we build the capacity of socio-ecological systems to maintain resilience in the face of growing and often interacting stresses?
- *Thresholds and Transitions*: How can we recognize long-term trends in forcing functions and ensure orderly transitions when thresholds are passed?
- *Governments and Institutions*: How can we steer tightly coupled systems towards desired goals or away from undesired outcomes?
- *Knowledge, Learning and Societal change*: How can we stimulate social learning in the interest of managing the dynamics of tightly coupled systems?

75.4.4 The IHDP Cube

Integrating these elements of IHDP's work programme produces what has become known as the IHDP cube (figure 75.2). The Programme has a portfolio of core and joint project that are subject to analysis using a variety of methodologies as well as to comparative study on the part of those concerned with cross-cutting themes (e.g. resilience or thresholds). The goal is to strengthen the bonds linking members of the broader community of producers and consumers of knowledge who make up the IHDP family. Some members of this community will focus on particular core projects using a variety of methods; others will seek to use a particularly promising method to study issues relating to more than one core project; still others will use a number of methods in an effort to compare work carried out under the various core projects in the interests of gaining insights relating to one of the cross-cutting themes. The goal here is to transform the collection of people associated with IHDP into a close-knit community pursuing common concerns in contrast to a loosely related set of researchers who, for the most part, go their separate ways.

In figure 75.2 the three-dimensional framework of research on the human dimensions of global environ-

Figure 75.2: The IHDP Cube. **Source:** IHDP.



mental change is displayed, consisting of the predominant research areas, cross-cutting themes, and the main methodologies employed. The main research areas include human security, land-use and land-cover change, industrial transformation, governance and food systems. A key feature of the framework is the cross-cutting themes that are of essential importance and relevance for each of the research areas. Finally, the mentioned methodologies are often innovative as they must address trans-disciplinary challenges. For example, enhanced statistical methods or the ever growing field of simulation and modelling is one of the crucial factors that have helped lift global change science into a new realm of importance.

75.4.5 IHDP Cross-cutting Research Areas and Approaches

75.4.5.1 Ecosystem Change, Vulnerability, and Resilience

Climate change has been occurring naturally for millions of years and the Earth's biosphere has been exposed to large variability and extremes of CO_2 and climate. However, anthropogenic climate change has occurred over a much smaller time scale and has had a greater magnitude of change. Ecosystems are sensitive to climate change. For instance, significant biological changes, such as species extinctions, have accompanied large climatic perturbations of the past (Overpeck/Cole/Bartlein 2005). More recently, dis-

ruptions in precipitation regimes in the Pacific region, such as those in Australia during *El Niño/Southern Oscillation* (ENSO) events, can disrupt vegetation cover and composition through drought, heat stress, spread of parasites and disease (Diaz/Markgraf 1992). However, ecosystems are not only sensitive to climate change but also to anthropogenic changes such as land use, pollution and invasive species. While climate change has been estimated to be a major driver of biodiversity loss in tropical and cool conifer forests, and coral reefs[9], in other ecosystems land-use changes may be a stronger driver of biodiversity loss, especially in the short term (Fischlin/Midgley/Price/Leemans/Gopal/Turley/Rounsevell/Dube/Tarazona/Velichko 2007). Land-use change and related habitat loss and fragmentation have long been recognized as important drivers of past and present ecosystem change, particularly biodiversity loss (Heywood/Watson 1995). Additional, prevalent examples of drivers of ecosystem change are changes in fire regimes and exotic species. Fire influences community structure by favouring species which are fire tolerant and consequently change the biodiversity of a region. Introduction by humans of invasive exotic species represents a major threat to endemic or native biodiversity in both terrestrial and aquatic systems (Scavia/Field/Boesch/Buddemeier/Burkett/Cayan/Fogarty/Harwell/Howarth/Mason/Reed/Royer/Sallenger/Titus 2002). Overall, ongoing shifts in anthropogenic disturbances such as fire regimes are important in altering ecosystem structure, diversity, and function (Timoney 2003).

These environmental changes will of course then also affect the provision of an ecosystem service. Consequently, it is important to be aware of the synergistic effects of these multiple drivers, both natural and anthropogenic, climatic and non-climatic. This is difficult, however, due to non-linear, rapid, threshold type responses in ecological systems (Burkett/Wilcox/Stottlemyer/Barrow/Fagre/Baron/Price/Nielsen/Allen/Peterson/Ruggerone/Doyle 2005) and, despite the importance of multiple drivers of ecosystem change, they are rarely included in climate and ecosystem models used for assessing climate change impacts on ecosystems and their services (Hansen/Neilson/Dale/Flather/Iverson/Currie/Shafer/Cook/Bartlein 2001; Zebisch/Wechsung/Kenneweg 2004; Feddema/Oleson/Bonan/Mearns/Buja/Meehl/Washington 2005).

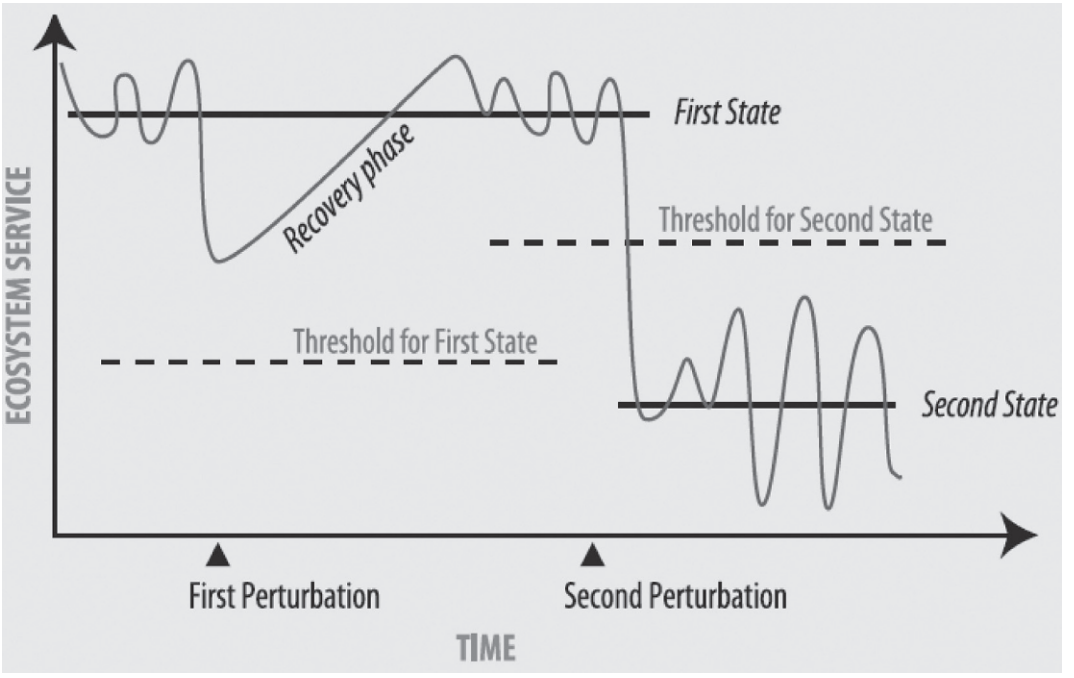
There are multiple drivers of ecosystem change which impact on the production, quantity, and quality of services. An ecosystem response to impacts depends not only on the increasing magnitude of the driver of change but also on the threshold of a system. Many ecosystems do not respond to changes in a linear fashion but rather thresholds are reached and surpassed, and rapid, non-linear changes follow. Ecosystems may have more than one state with a self-stabilizing mechanism, so that a shift between states does not occur frequently and is not readily reversible (Genkai-Kato 2007).

If thresholds in magnitude or rate of change are surpassed then transitions between ecosystem states may be triggered to a less desired state (Folke/Carpenter/Elmqvist/Gunderson/Holling/Walker 2002), or the ecosystem may even collapse to a much less productive and/or species poor assemblage with lower biomass and other impairments. Passing a threshold marks a sudden change in feedbacks in the ecosystem, which can bring about sudden, sharp and dramatic change in the responding state variables, for example, the shift from clear to turbid water in lake systems (Carpenter 2003). These large changes are termed regime shifts (illustrated in figure 75.3). Regime shifts are increasingly reported in natural environments (Scheffer/Carpenter/Foley/Folke/Walker 2001) and are large system changes that are beyond the normal range seen at the microscopic scale (e.g. stable points and limit cycles) (Genkai-Kato 2007).

Regime shifts are difficult to predict in part because there is a dearth of knowledge about capacities and vulnerabilities. The theoretical basis for regime shifts has been described by such researchers as Beisner, Haydon and Cuddington (2003), Carpenter (2003) and Scheffer, Carpenter, Foley, Folke and Walker (2001). Figure 75.3 illustrates the level of provisioning of an ecosystem service that has been perturbed twice. The dashed lines represent the two thresholds. The natural variation of an ecosystem service is represented during its initial state, before and after the first perturbation. It is evident that the ecosystem service is resilient to the first perturbation and recovers to a stable state. However, the service has become vulnerable to change and this is indicated by the lower threshold for the second state. The second perturbation causes the service to cross the second threshold, which leads to a regime shift and to an alternative stable state.

9 See Thomas, Cameron, Green, Bakkenes, Beaumont, Collingham, Erasmus, de Siqueira, Grainger, Hannah, Hughes, Huntley, van Jaarsveld, Midgley, Miles, Ortega, Peterson, Phillips and Williams (2004); Malcolm, Liu, Neilson, Hansen and Hannah (2006).

Figure 75.3: Dynamics and Stability in Ecosystem Services. **Source:** Millennium Ecosystem Assessment (2005).



Undesired shifts between ecosystem states are caused by a combination of the magnitudes of external forces and the internal resilience of the system. As resilience declines the ecosystem becomes more vulnerable, and progressively smaller external events can cause shifts. Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity, and feedback (Walker/Holling/Carpenter/ Kinzig 2004). Alterations to ecosystems in many cases change the natural self-stabilizing mechanisms inherent in ecosystems such as those that resist daily and seasonal changes in temperature and light conditions (Genhai-Kato 2007), increasing ecosystems vulnerability. Consequently, regime shifts in ecosystems are increasingly common as a result of external forces such as human activities that erode resilience for example through the exploitation, pollution and land-use change, climate change impact, and altered disturbance regimes.

These impacts, which have increased in intensity since the industrial revolution, have reduced the capacity of ecosystems to cope with change. Triggers for regime shifts are often slow variables such as global warming and nutrient loading (Carpenter 2003) which originate from anthropogenic impacts as emissions of CO_2 and polluted water from industrial and agricultural activities. When these impacts exceed the internal resilience and threshold of a system, a regime shift may manifest itself in ecological surprises such as rapid and abrupt changes in temperature and precipitation, leading to an increase in extreme events such as floods and fires and the irreversible loss of ecosystem services which were dependant on the previous state (MA 2005). Although studies on regime shifts have just begun and there are many unknown issues to be addressed, such as the prediction of threshold points, there are many examples of regime shifts in ecosystems and their consequences for humans.

A continental scale example of an irreversible shift occurred in Australia where the over-hunting and use of fire by Aborigines approximately 30,000 to 40,000 year ago removed large marsupial herbivores. Without these animals to prevent fire and fragment vegetation, an ecosystem of fire and fire-dominant plants expanded and irreversibly changed the ecosystem from a state dependent on rapid nutrient cycling to a less productive state with slower cycling (Flannery 1994). This has consequently impacted the agricultural productivity of the land and the magnitude and quality of ecosystem services available to the present society. Society then becomes less resilient to change as it has less resources and variety of resources from which to draw from. At a local scale, for example, the initial pockets of deforestation in a large tropical forest may have little or no impact on the number of species of animals or birds. However, as the forest becomes more fragmented, the rate of species loss can increase

sharply (Noss 1996). As humans continue to impact the global environmental, regime shifts in ecosystems are not just ecological problems causing changes in ecosystems services, but they also become economic problems leading to changes in human well-being.

75.4.5.2 The Missing Links

How do ecosystem services interact and work together? What are the thresholds and resilience of an ecosystem and its services? How can governance facilitate sustainable management of ecosystem services, manage the effects of trade-offs between services, and consequently decrease their vulnerability? Each of these questions illustrates just a few of the current knowledge gaps when tackling the global problem of addressing and adapting to changes in ecosystems services. Effective response depends on knowledge of regional climate and ecological changes and their interactions with society.

Current ecosystem models can translate climate and land changes into changes in ecosystem service supply (Schröter 2005). However, ecosystem models need a transdisciplinary collaborative approach, for instance prediction models are needed which take into account climate change, ecosystems at all levels, and human impact such as poverty. However, this is not possible while we have an incomplete understanding of the socio-ecological system. Coupled with this, monitoring environmental change including climate and associated ecosystem responses is vital to allow for adjustments in management strategies.

Consequently, one of the first aims should be to raise social, political, and scientific awareness of the importance of ecosystems and the services they provide and the complexity which exists between them. The Millennium Assessment has done this to a good extent. But many more studies are needed to identify services, to understand how services interact and to quantify such things as the supply of services and thresholds. Additionally, the awareness of the importance of ecosystems and services should be promoted at all societal levels as human well-being is inextricably linked to ecosystem services. Scientific and political awareness alone is not enough, local awareness is just as important especially in developing countries where the local communities often alone manage the impact on ecosystems and especially their provisional services. For societies to adapt and respond to change, 'the public' needs to become more informed and engaged, and scientists and policy-makers must also take on the responsibility to learn from, understand, and respond to their community's knowledge, concerns, and needs, if research and policy are to lead towards sustainability. Consequently, it is important that both an increase in knowledge and awareness is coupled with a multidimensional and transdisciplinary approach to address issues of global environmental change.

Global environmental change is a global issue and affects all scales, local, regional, national and global. Thus, efforts to maintain and enhance resilience and adaptation to the long-term effects of change need to be addressed by all levels of governance. In situations in which uncertainties and change are key features of the ecological systems and social organization, critical factors for sustainability are resilience, the capacity to cope and adapt, and the conservation of sources of innovation and renewal (Lebel/Anderies/Cambell/Folke/Hatfield-Dodds/Hughes/Wilson 2006). Interventions in socio-ecological systems with the aim of altering resilience, whether it is an ecosystem service or a community, immediately confront issues of governance. Who decides what should be made resilient to what? For whom is resilience to be managed, and for what purpose? How do certain attributes of governance function in society to enhance the capacity to manage resilience?

The increased unpredictability and scale of current environmental changes are becoming more difficult to deal with, and new adaptations are required. Adaptation to environmental change, including climate change, involves a diverse range of environmental services, which enable people to sustain their livelihoods, to diversify their production strategies, and to incorporate adaptive management schemes into their domestic infrastructures. Ecosystem managers, whether political, local or indigenous, can proactively alter the context in which ecosystems develop (Fischlin/Midgley/Price/Leemans/Gopal/Turley/Rounsevell/Dube/Tarazona/Velichko 2007), thus improving resilience. This involves not only anticipatory adaptation options and responses but also resilience which is largely involved in the process of adaptation. Societies need to strengthen their capability for responding and adjusting to disturbance and uncertainty, while keeping their livelihoods flexible and open to change. Enhancing resilience involves many elements including innovation, knowledge and learning, diversity, adequate human-environment interactions and the capacity of self-organization, all of which can be governed.

75.5 Science-Policy Interaction

To improve both the conduct of research and the selection and implementation of policies to address global environmental change and to bridge the gap between scientists and practitioners, IHDP has made extensive use of the scientific community built through its projects and networks to enable and encourage interaction between science and policy. An open dialogue between the scientific and policy communities is necessary not only for the development of well-guided policies but also for the formation of pertinent research agendas. By extending IHDP's original mandate to disseminate knowledge, science-policy interaction has become a new strategic pillar of the IHDP. The programme acts as a matchmaker and dialogue facilitator, organizing a number of capacity development, communication, and outreach activities. IHDP is a network of networks capable of building bridges among scientists in different disciplines, different issue areas, and different national and regional settings. Bringing members of the scientific and policy communities together, Science-Policy Dialogue Workshops have been held annually starting in 2006. A second series, e.g. the Bonn Dialogues on Global Environmental Change, was started in 2007. These activities exemplify IHDP's effort to mainstream science-policy with a dialogue process targeting the public.

75.6 Capacity Development

Capacity development forms an important part of IHDP's work to strengthen and broaden the network of global environmental change researchers. IHDP's capacity development activities provide an avenue for encouraging new researchers and incorporating their research into the network. Key mechanisms include the *International Human Dimensions Workshops* (IHDW) started in 1998 and the Open Meetings of the Human Dimensions of Global Environmental Change Research Community initiated in 1995 to promote interdisciplinary collaboration on a global basis.

In its second decade, IHDP has redefined its capacity development approach and expanded its efforts in three ways:

- The traditional concept of capacity building has been supplanted by capacity development, indicating that IHDP will not only build new capacity but also strengthen and further develop existing capacity;
- IHDP's capacity development strategy not only targets individuals from developing countries and countries in transition but also includes scientists from developed countries who contribute to IHDP's goals;
- Although IHDP's investments in capacity development mainly target individual researchers, institutions backing individual scientists will also benefit as enhanced international visibility and career development of single researchers will ultimately support their home institutions.

75.7 Conclusions

This chapter illustrates both the importance of human dimensions research when addressing global environmental change and how this focus of research has changed over the past decade, with the incorporation of and emphasis on socio-ecological systems. Human decisions and actions have become a decisive influence on terrestrial, marine, and atmospheric systems at a global scale. Based on this, human responses to current global environmental change define future social and environmental conditions. Human-environment interactions and the socio-ecological systems to which they give rise are complex, marked by changes that are often non-linear, sometimes abrupt, and quite frequently irreversible. It is because human dimensions science is central to addressing global change issues, and their many associated complexities, that it is thriving and increasingly in demand.

Despite these efforts and advances in knowledge, global environmental change continues at an unprecedented rate, causing loss in ecosystem health for instance and threatening human security. While it is clear that the problems we face are largely social rather than purely biophysical, there remain a number of challenges for the human dimensions community in the decade ahead. Human dimensions research needs to become more translatable and thoroughly integrated into policy and human dimensions perspectives, and approaches need to be more relevant and effective in fostering social transformations necessary to address change challenges. Greater attention must be paid to the relationships and interactions between and across disciplinary boundaries in order to understand complex coupled socio-ecological systems. This would enable recognition and integration of different types of knowledge, perspectives, and approaches to science that are crucial to human dimensions research, especially as we live in a world that is experiencing rapid changes that have far-reaching implications.

76 DIVERSITAS: Biodiversity Science Integrating Research and Policy for Human Well-Being

Bruno A. Walther, Anne Larigauderie and Michel Loreau

76.1 Introduction

Biodiversity, or the variety of life on earth, makes up and sustains all life processes of the biosphere. Therefore, biodiversity contributes utilitarian values, such as ecosystem goods and services, option values for future use, as well as cultural values, such as educational, intellectual and recreational opportunities, aesthetic and spiritual enjoyment, and a sense of identity, to human well-being.

Biodiversity is almost invariably impacted negatively by unsustainable human resource consumption. The main drivers of biodiversity change are direct overexploitation of natural resources as well as the more important indirect drivers of change such as habitat conversion and fragmentation caused by land use changes, pollution, and invasive species.[1] Consequently, current scientific evidence overwhelmingly demonstrates a continued decline in the status of biodiversity since humans became the dominant species on earth.[2] About 1.5–1.8 million species have been scientifically described, but the number of undescribed species is rather uncertain, with the currently accepted estimate being about 10–15 million species; however, estimates range as high as 50–100 million.[3] While the total global number of species will remain uncertain for the foreseeable future, we already know that extinction rates of known species now exceed normal rates by 100–1000 times due to human impacts on the biosphere (Lawton/May 1995; Regan/Lupia/Drinnan/Burgman 2001). Rates of global biodiversity change have reached a magnitude and speed that greatly surpass change due to natural processes except those of cataclysmic events such as meteor strikes. Therefore, many biodiversity scientists insist that we are already experiencing the beginning of a 'sixth extinction event' on the scale of other massive die-offs during the earth's history, such as the disappearance of dinosaurs at the end of the Cretaceous (Wilson 1988; Savage 1995; Myers 2003).

Moreover, even if many species are not yet extinct, their populations have severely declined, both in numbers and distributions. These population declines not only make these species more vulnerable to local and global extinction (Gilpin/Soulé 1986; Hanski 1999; Oborny/Meszena/Szabo 2005) but also reduce their genetic diversity and therefore their future potential to adapt to environmental changes[4], at exactly the time when environmental changes are accelerating dramatically due to human actions.[5] Changes in population have led to reduced and restructured habitats and to altered ecosystem functions, biogeochemical cycles and chemical composition of soils, water and

1 See: Sala/Chapin III/Armesto/Berlow/Bloomfield/Dirzo/Huber-Sanwald/Huenneke/Jackson/Kinzig/Leemans/Lodge/Mooney/Oesterheld/LeRoy Poff/Sykes/Walker/Walker/Wall (2000); Bennett/Milner-Gulland/Bakarr/Eves/Robinson/Wilkie (2002); Millennium Ecosystem Assessment (2005a); Millennium Ecosystem Assessment (2005b); Secretariat of the Convention on Biological Diversity (2006).

2 See: Vitousek/Mooney/Lubchenco/Melillo (1997); Baillie/Hilton-Taylor/Stuart (2004); Millennium Ecosystem Assessment (2005a); Balmford/Bennun/ten Brink/Cooper/Côté/Crane/Dobson/Dudley/Dutton/Green/Gregory/Harrison/Kennedy/Kremen/Leader-Williams/Lovejoy/Mace/May/Mayaux/Morling/Phillips/Redford/Ricketts/Rodríguez/Sanjayan/Schei/van Jaarsveld/Walther (2005); Loh/Green/Ricketts/Lamoreux/Jenkins/Kapos/Randers (2005); Pauly/Watson/Alder (2005).

3 See: May (1990); Heywood (1995); Baillie/Hilton-Taylor/Stuart (2004); Wilson (2004).

4 See: Brook/Tonkyn/Q'Grady/Frankham (2002); Frankham (2005); O'Grady/Brook/Reed/Ballou/Tonkyn/Frankham (2006); Honnay/Jacquemyn (2007).

5 See: Haberl/Erb/Krausmann/Gaube/Bondeau/Plutza/Gingrich/Lucht/Fischer-Kowalski (2007); Harte (2007); World Resources Institute (2007).

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atmosphere (Gitay/Suárez/Dokken/Watson 2002; Millennium Ecosystem Assessment 2005a).

Such massive declines and changes in species distributions invariably affect the functioning of ecosystems. For example, the widespread application of herbicides and insecticides has led to dramatic decreases in insect pollinators and their food plants, so that there is now a 'pollinator crisis' in some agricultural areas such that agricultural crops are no longer sufficiently pollinated.[6] More importantly, the widespread human transformation of once highly diverse natural ecosystems into relatively species-poor managed ecosystems (e.g., food monocultures) has led to irreversible biodiversity loss, with consequent loss of various ecosystem services (see 76.3.3 below). It is becoming increasingly clear that biodiversity of both pristine and well-managed ecosystems delivers important services such as the production of foods and other goods, the capacity to store carbon and recycle nitrogen, or the natural spaces for ecotourism to thrive in, to name just a few (Daily 1997; Farber/Costanza/Wilson 2002; Millennium Ecosystem Assessment 2005a). These examples demonstrate that ecosystem services directly affect human well-being, and biodiversity decline leads directly and indirectly to reduced benefits for people and increasingly limiting opportunities for development and livelihoods options in the short and long term, as well as increasing occurrences of sudden negative changes in the world's ecosystems and life processes (Millennium Ecosystem Assessment 2005a). Further understanding of the status, trends and functions of biodiversity is therefore critical if decision-makers at all scales, as well as the public, are to be informed about the global scale of biodiversity degradation, and the consequences of such degradation on ecosystem services and human well-being.

Based on this rising awareness of the importance of biodiversity to human well-being, society and governments are increasingly prepared to define and implement rules which allow for the long-term sustainable use of biodiversity. Therefore, the most pressing challenge is the need to establish the scientific foundations for the appropriate future social, political and economic actions aimed at maintaining an acceptable level of biological diversity and functional ecosystems on Earth. Towards this ultimate goal, biodiversity science will play a crucial role in understanding the Earth system and thus informing responsible and sustainable policy making. Faced with these challenges, the scientific community decided to organize itself in order to study these complex issues and provide science-based solutions using interdisciplinary and global research networks. This was the ultimate rationale for the establishment of the DIVERSITAS programme.

The DIVERSITAS Science Plan (2002) states that the overall goals of DIVERSITAS are to (1) promote an integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge, and (2) provide the scientific bases for the conservation and sustainable use of biodiversity. DIVERSITAS achieves these goals by implementing a portfolio of international scientific projects and networks which are detailed below. Each programme is built around a few central research challenges (or foci) which advance our scientific knowledge of biodiversity status, trends and functions. With its special focus on the science of the conservation and sustainable use of biodiversity, this increased knowledge in turn supports decision makers to make more rational policies regarding environmental threats, challenges, vulnerabilities and risks.

Below, we will specify the specific scientific contribution of each DIVERSITAS programme to help humankind to cope with global environmental change, disasters and security. Whenever possible, we use work contributed by scientists associated with the DIVERSITAS programme to support our arguments; therefore, citations are made selectively, reviewing the work of DIVERSITAS and not necessarily the entire biodiversity research and conservation community.

After a brief history of DIVERSITAS (76.2), we present the scientific agenda of DIVERSITAS (76.3), beginning with its overall mission and structure (76.3.1). The central message of this chapter is contained in the sections (76.3.2–76.3.4) in which we portray some of the main scientific achievements of DIVERSITAS which have relevance to the theme of this book, i.e. how biodiversity research can identify threats, challenges, and risks to human well-being and thus help humanity to better cope with global environmental change. We round this off with a brief description of the various DIVERSITAS Cross-cutting Networks (76.3.5), of the science policy bridge supported by DIVERSITAS (76.3.6), and our conclusions (76.4).

6 See: Buchmann/Nabhan (1996); Allen-Wardell/Bernhardt/Bitner/Burquez/Buchmann/Cane/Cox/Dalton/Feinsinger/Ingram/Inouye/Jones/Kennedy/Kevan/Kopowitz/Medellin/Medellin-Morales/Nabhan/Pavlik/Tepedino/Torchio/Walker (1998); Kremen/Williams/Thorp (2002).

76.2 DIVERSITAS History: Building Biodiversity Science

76.2.1 Phase I: 1991-1998

DIVERSITAS, in its current structure, was launched in 2002. However, its birth dates back to 1991. In the wake of the negotiations on the *Convention on Biological Diversity* (CBD), the *United Nations Educational, Scientific and Cultural Organisation* (UNESCO), the *Scientific Committee on Problems of the Environment* (SCOPE) and the *International Union for Biological Sciences* (IUBS) – later joined by the *International Council for Science* (ICSU) and the *International Union of Microbiological Societies* (IUMS) – established an international, non-governmental umbrella programme that would address the complex scientific questions posed by the loss of and change in global biodiversity, and provide scientific advice to the CBD. Two main axes were developed during this period:

The first axis consisted in contributing to the implementation of Articles 6–8 and 10 of the CBD, and particularly article 7a: "Identify components of biological diversity important for its conservation and sustainable use." A number of workshops were held and papers were published, e.g., to implement the *Global Taxonomy Initiative* (GTI) of the CBD (DIVERSITAS 1999). Furthermore, DIVERSITAS initiated the Species 2000 Programme which focused on a global linking of taxonomic databases.

The second axis was the development of a new field for biodiversity science looking at the links between biodiversity and ecosystem functioning. The books below, which were the results of a series of workshops organized under the auspices of SCOPE, established this new field and laid the groundwork for further experimental and theoretical research carried out under DIVERSITAS and the *International Geosphere-Biosphere Programme* (IGBP). These books also contributed to the *Global Biodiversity Assessment* (Heywood 1995), an initiative of the *World Resources Institute* (WRI).

- *Biodiversity and ecosystem function* (Schulze/Mooney 1994).
- *Mediterranean-type ecosystems: The function of biodiversity* (Davis/Richardson 1995).
- *Arctic and alpine biodiversity: Patterns, causes and ecosystem consequences* (Chapin/Körner 1995).
- *Islands: Biological diversity and ecosystem function* (Vitousek/Loope/Adsersen 1995).
- *Biodiversity and savannah ecosystem processes* (Solbrig/Medina/Silva 1996).
- *Functional roles of biodiversity: A global perspective* (Mooney/Cushman/Medina/Sala/Schulze 1996).

Toward the end of its first phase, DIVERSITAS also contributed to the establishment of the *Gobal Invasive Species Programme* (GISP) in 1997 to investigate how invasive species affect biodiversity. During this first phase, which ended in 1998, the DIVERSITAS Secretariat was hosted by UNESCO's *Man and the Biosphere* (MAB) Programme.

76.2.2 Phase II: Biodiversity Science Evolves

After a lapse of three years, the sponsors of DIVERSITAS decided in 2001 to launch a second phase. They opened a new Secretariat, hosted by ICSU in Paris, and called upon a task force of scientists to develop an international framework for biodiversity research. DIVERSITAS undertook a series of workshops and consultations engaging scientists around the world. The DIVERSITAS Scientific Committee met for the first time in April 2002, marking the beginning of the second phase of DIVERSITAS.

The DIVERSITAS Science Plan (2002) reflects the will to build a dynamic and integrative approach to biodiversity science which took account of the changing concept of biodiversity, which by this time was no longer just the 'property of biologists' but had become a concept at the heart of many human activities (Barbault/Cornet/Jouzel/Mégie/Sachs/Weber 2002). Scientists acknowledged that biodiversity changed as a result of its own evolutionary and ecological dynamics, but increasingly also as a result of deliberate human actions as well as their unintentional consequences. In turn, these changes affect the well-being of human societies.[7] To understand this reciprocal interaction of coupled ecological and human systems, a more integrative biodiversity science had to be developed. Therefore, DIVERSITAS recognized the need to continue efforts to integrate its community, which was still fragmented among types of ecosystems (terrestrial, freshwater, and marine), types of organisms and disciplines, especially biology and ecology on one side and the socio-economic sciences on the other (Dirzo/Loreau 2005).

7 See: Liu/Dietz/Carpenter/Folke/Alberti/Redman/Schneider/Ostrom/Pell/Lubchenco/Taylor/Ouyang/Deadman/Kratz/Provencher (2007).

Another important integrative step occurred when DIVERSITAS became a founding partner in 2002 of the *Earth System Science Partnership* (ESSP; chap xy by Leemans/Rice/Henderson-Sellers/Noone), recognizing the links between biodiversity and other areas of global concern, such as climate change and land use change. The ESSP includes three other partners which are: the *International Geosphere-Biosphere Programme* (IGBP; chap. xy 77 Noone/Nobre/Seitzinger), the *International Human Dimensions Programme on Global Environmental Change* (IHDP; chap. 75 by Falkenhayn/Rechkemmer/Young), and the *World Climate Research Programme* (WCRP; chap. 78 by Church/Asrar//Busalacchi/Arndt).

76.3 Scientific Agenda of DIVERSITAS

76.3.1 Overall Mission and Structure

After publication of its Science Plan (2002), DIVERSITAS implemented its mission through the initiation of four Core Projects and five Cross-cutting Networks (see DIVERSITAS website, Box 76.1). DIVERSITAS can be considered as a think tank for promoting cutting-edge, innovative and internationally relevant biodiversity research, and its main achievement is the establishment of several interlinked scientific communities, built around these Core Projects and Cross-cutting Networks. Over the years, various types of activities have been performed, which include:

- provide common international frameworks for collaborative research on biodiversity;
- build scientific networks across countries and disciplines;
- perform scientific syntheses;
- engage scientists in scientific workshops and conferences;
- promote standardized methods;
- guide and facilitate global databases;
- build an important link with policy makers.

Box 76.1: The DIVERSITAS programme and related initiatives. **Source**: Compiled by the authors.

DIVERSITAS <http://www.diversitas-international.org/> is one of the four international global environmental change research programmes, the others being the International *Geosphere-Biosphere Programme* (IGBP) <http://www.igbp.net/>, the *International Human Dimensions Programme on Global Environmental Change* (IHDP) <http://www.ihdp.unu.edu/>, and the *World Climate Research Programme* (WCRP) <http://wcrp.wmo.int/wcrp-index.html/>.

Together they founded the *Earth System Science Partnership* (ESSP) <http://www.essp.org/>) which is a partnership for the integrated study of the Earth System, the ways that it is changing, and the implications for global and regional sustainability. Other programmes and initiatives mentioned in this chapter are here listed alphabetically with complete names and websites given:

- *Assembling the Tree of Life project* (ATOL); <http://atol.sdsc.edu/>;
- *Barcode of Life Initiative (*BOLI); <http://www.dnabarcodes.org/>;
- *Consortium for the Barcode of Life* (CBOL); <http://www.barcoding.si.edu/>;
- *Convention on Biological Diversity* (CBD); <http://www.cbd.int/>;
- *Encyclopedia of Life* (EOL); <http://www.eol.org/>;
- *Global Invasive Species Programme* (GISP); <http://www.gisp.org/>;
- *Global Mountain Biodiversity Assessment* (GMBA); <http://gmba.unibas.ch/index/index.htm/>;
- *Global Taxonomy Initiative* (GTI); <http://www.cbd.int/gti/>;
- *Group on Earth Observations Biodiversity Observation Network* (GEO BON); <http://www.earthobservations.org/cop_bi_geobon.shtml/>;
- HERBIS project; <http://www.herbis.org/>;
- *Intergovernmental Panel on Climate Change* (IPCC); <http://www.ipcc.ch/>;
- *International Council for Science* (ICSU); <http://www.icsu.org/index.php/>;
- *International Mechanism of Scientific Expertise on Biodiversity* (IMoSEB); <http://www.imoseb.net/>;
- *International Union for Biological Sciences* (IUBS); <http://www.iubs.org/>;
- *International Union of Microbiological Societies* (IUMS); <http://www.iums.org/>;
- ISI Web of Knowledge; <http://apps.isiknowledge.com.gate1.inist.fr/>;
- *Man and the Biosphere* (MAB) Pro*gramme;* <http://www.unesco.org/mab/>;
- *Millennium Ecosystem Assessment* (MA); <http://www.millenniumassessment.org/en/index.aspx/>
- NatureUganda; <http://www.natureuganda.org/>;
- Ramsar Convention on Wetlands; <http://www.ramsar.org/>;
- *Scientific Committee on Problems of the Environment* (SCOPE); <http://www.icsu-scope.org/>;
- Species 2000 Programme; <http://www.sp2000.org/>;
- *Subsidiary Body for Technical and Technological Advice* (SBSTTA); <http://www.cbd.int/convention/sbstta.shtml/>;
- United Nations Educational, Scientific and Cultural Organisation (UNESCO); <http://portal.unesco.org/>;
- *United Nations Environment Programme* (UNEP); <http://www.unep.org/>;
- *United Nations Framework Convention on Climate Change* (UNFCCC); <http://unfccc.int/2860.php/>;
- *World Resources Institute* (WRI); <http://www.wri.org/>;
- 2010 Biodiversity Indicators Partnership (2010 BIP); <http://www.twentyten.net/>.

It is not the subject of this chapter, however, to summarize the many activities of these various projects, but to portray some of the main scientific achievements of DIVERSITAS which have relevance to the theme of this book, i.e. how biodiversity research can identify threats, challenges, and risks to human well-being and thus help humanity to better cope with global environmental change. Three main themes have crystallized over the years:

1. To improve our capacity to observe and model biodiversity change, which in turn improves our ability to identify challenges and threats much earlier (early warning function).
2. To develop a better understanding of how biodiversity change affects ecosystem functioning and services, and how ecosystem services link to human well-being.
3. To investigate the social, legal, economic and political motivators that have an impact on the drivers of biodiversity change to guide the sustainable use of biodiversity and its associated ecosystem services.

Below, we present the contribution of DIVERSITAS towards each theme.

76.3.2 Improving Capacity to Observe and Model Biodiversity Change

While it is widely accepted that we are in the midst of a biodiversity crisis, with both populations and species experiencing often dramatic losses, we still experience major gaps in our global observation of biodiversity status and trends. There are several reasons for this: (a) the myriad forms of biodiversity, from genes to populations, species and ecosystems, are often extremely localized in their distribution, relatively expensive to sample and tantalizingly difficult to identify, and thus do not render themselves easily to global observation, unlike, for example, atmospheric gases; (b) biodiversity observation needs to include not just composition, but also structural complexity, functional relationships and evolutionary dynamics, as these factors greatly determine the responses of biodiversity to environmental change; (c) while some biodiversity observation systems exist, there are still large geographical gaps (often in the most biodiversity-rich regions, e.g., tropical rainforests), taxonomic gaps (most monitoring is focused on vertebrates and higher plants), or methodological gaps (most monitoring is not long-term and inconsistent in space and time and between observers); and (d) biodiversity data is held by a very large number of heterogeneous data providers (e.g., government agencies, NGOs, scientists, lay people, etc.), and many of these data are then only used by the data collector but do not become globally available because the delivery pipeline is blocked, either because data sets are not made available or because they are not made interoperable for use through global search engines and internet providers (Scholes/Mace/Turner/Geller/Jürgens/Larigauderie/Muchoney/Walther/Mooney 2008).

DIVERSITAS addresses these challenges mainly through three initiatives, its two Core Projects called bioGENESIS and bioDISCOVERY and the newly formed network called *Group on Earth Observations Biodiversity Observation Network* (GEO BON).

One of the aims of bioGENESIS is to facilitate the development of new strategies and tools for discovering and documenting biodiversity (Donoghue/Yahara/Conti/Cracraft/Crandall/Faith/Häuser/Hendry/Joly/Kogure/Lohmann/Magallón/Moritz/Tillier/Zardoya/Prieur-Richard/Larigauderie/Walther 2009). For example, it would revolutionize our ability to document and monitor biodiversity to develop rapid-capture technologies for identifying known species and discovering new ones. Of special interest is the development of a cost-effective, hand-held, automated species-identifier. The idea is to analyse a tiny sample of an organism; quickly extract, amplify, and sequence a set of target DNA markers; and then compare these to known sequences to situate the unknown within the tree of life. In this context, a key bioGENESIS initiative is to coordinate workshops aimed specifically at connecting the current efforts to develop DNA barcoding as a global standard for species identification (represented by the *Barcode of Life Initiative* (BOLI) and the *Consortium for the Barcode of Life* (CBOL) and the 'Tree of Life' activities, represented by the *Assembling the Tree of Life* project (ATOL)). Furthermore, new technologies are being promoted, e.g., real-time analysis of field images, use of remote-controlled microscopes, development of image recognition identification tools and automated digital capture of museum specimens and associated information (for a good example, see the HERBIS project). Information gained through such methods then needs to be connected to knowledge bases used by decision-makers, including the emerging *Encyclopedia of Life* (EOL).

While bioGENESIS thus addresses challenges of identification, bioDISCOVERY aims to promote the science that will improve our ability to objectively assess, monitor and predict biodiversity status and

trends on a global scale. Such knowledge is essential given that biodiversity underpins all life processes on earth, and with it all the ecosystem services so vital to human well-being (76.3.3). Given the inherent complexity of biodiversity outlined above, bioDISCOVERY tackles this challenge from both a scientific as well as an institutional angle.

The scientific goals to address this challenge are outlined in the bioDISCOVERY Science Plan (Ash/Jürgens/Leadley/Alkemade/Araujo/Asner/Bachelet/Costello/Finlayson/Lavorel/Mace/Mooney/Parr/Scholes/Soberon/Turner/Prieur-Richard/Larigauderie/Walther 2009) whose aim is to develop a scientific framework to assess the current extent of biological diversity, to monitor its change, to understand the underlying processes responsible for those changes, and to predict future changes. Assessment of global biodiversity must be improved across spatial and temporal scales, at different levels of biological organization (i.e. genes, populations, species, functional groups and ecosystems), and in terms of the various attributes and functions of biodiversity. This will lead to advances in the spatial and temporal assessment of genetic, population, species and ecosystem biodiversity, and of the interactions between them. For example, almost nothing is known about the global status of genetic, microbial or marine biodiversity, while global data on land-cover change also remain elusive. In addition to encouraging the collection of more primary biodiversity data, existing but often dispersed and heterogeneous data need to be better linked through the use of global data clearinghouses.[8] Improved data availability would enable the inclusion of a wider range of taxa[9] as well as an assessment of their functions; e.g., assess functional groups which deliver essential ecosystem processes, such as nitrogen-fixing soil organisms (Barrios 2007) or which deliver disservices such as invasive species.[10] Broader, functional approaches to classification will thus provide a considerably improved foundation for assessment, particularly in light of increasing attention of decision-makers to ecosystem functioning and services (76.3.3).

While assessments evaluate the status of biodiversity, continuous monitoring is essential to establish time lines that can detect biodiversity change, e.g., the disappearance of global fish stocks.[11] Detecting trends must go hand-in-hand with the identification of the main drivers of biodiversity change, e.g., land degradation or harvesting levels, so that not only the species or ecosystems at greatest risk can be pinpointed (early warning function) but that also the underlying causes of declines can be determined (cause-effect relationship). This will give decision-makers much better scope to identify risks and avert disasters before they happen.[12]

To operationalize global biodiversity monitoring, bioDISCOVERY has played a key role in developing the scientific framework during the early planning stages for the GEO BON which is a global partnership to collect, manage, analyze and report on the status and trends of the world's biodiversity.[13] The network will provide a scientifically robust framework for global biodiversity monitoring and define a strategy to reach strategic network goals and objectives.[14]

However, monitoring systems cannot monitor everything. Because of the complex nature of ecosystems, any effective early warning system will have to

8 For example, GIS Internet Resources, at: <http://www.tec.army.mil/gis/>, GISWiki: free portal for Geoinformatics, at: <http://en.giswiki.net/wiki/Main_Page/>; Global Invasive Species Database, at: <http://www.issg.org/database/welcome/>; Global Resource Information Database - Sioux Falls, at: <http://www.na.unep.net/>; Websites for Digital GIS Data, at: <http://www-sul.stanford.edu/depts/gis/web.html/>.

9 A taxon (plural: taxa) is the term used for a taxonomic unit, with each taxon receiving a name which designates an organism or a group of organisms. In biological nomenclature according to Carl Linnaeus, a taxon is assigned a taxonomic rank and can be placed at a particular level in a systematic hierarchy reflecting phylogenetic relationships. Taxonomy is the science of classification, and taxonomies are composed of taxa arranged in a hierarchical structure which should, but not always do reflect phylogenetic relationships between the taxa.

10 See: Perrings/Williamson/Dalmazzone (2000); Graham/Newman/Jarnevich/Shory/Stohlgren (2007).

11 See: Pauly/Watson/Alder (2005); Worm/Barbier/Beaumont/Duffy/Folke/Halpern/Jackson/Lotze/Micheli/Palumbi/Sala/Selkoe/Stachowicz/Watson (2006); Lovett/Burns/Driscoll/Jenkins/Mitchell/Rustad/Shanley/Likens/Haeuber (2007).

12 See: Cortet/Gomot-De Vauflery/Poinsot-Balaguer/Gomot/Texier/Cluzeau (1999); Kshatriya/Cosner/van Jaarsveld (2001); Tegler/Sharp/Johnson 2001; Grenfell/Ellery/Preston-Whyte (2005); Thuiller/Richardson/Pysek/Midgley/Hughes/Rouget (2005); Duchev/Distl/Groeneveld (2006); Gotelli/Ellison (2006); Fleming/van der Merwe/McFerren (2007).

13 See: Ash/Jürgens/Larigauderie/Leadley/Mace/Mooney/Scholes/Walther/Lane/Muchoney/Geller/Turner (2007); Walther/Larigauderie/Ash/Geller/Jürgens/Lane (2007); Ash/Jürgens/Larigauderie/Leadley/Walther (2008).

14 See: Andrefouet/Costello/Ferrier/Geller/Höft/Jürgens/Lane/Larigauderie/Mace/Miazza/Muchoney/Parr/Pereira/Sayre/Scholes/Stiassny/Turner/Walther (2008).

include a fair amount of modelling (Anderson/Bugmann/Dearing/Gaillard 2006). Therefore, another scientific challenge is to fill monitoring gaps with ecological modelling which uses the inevitably limited data base to extrapolate biodiversity status and trends across space and time.[15] For example, one of the key weaknesses of remote sensing is its uncertain link to lower levels of biodiversity. While a West African forest may still be structurally intact to the eyes of a remote sensor, with an undisturbed canopy of healthy trees, hunting may have completely decimated the mammalian fauna.[16] Furthermore, forests with the most intense hunting pressures may often be in civil war zones, making on-the-ground monitoring a practical impossibility. Therefore, to get a true picture of biodiversity change in such intractable situations, we need ecological models that may use parameters such as human population, food consumption or gun availability as proxies to estimate biodiversity loss. Likewise, modelling may be needed to estimate biodiversity trends for mega-diverse taxa such as invertebrates, fungi and microbes, where monitoring simply cannot do the job.

It is of further strategic importance for biodiversity science to turn monitoring data, which by themselves are rather useless to data users such as conservation or government agencies, into products which relay critical information to data users. Some of the most important such products are biodiversity indicators.[17] It is widely acknowledged that current global indicators of biodiversity are insufficient to provide representative measures of biodiversity change – due to lack of data and methodological constraints. Building on ongoing initiatives such as the CBD (CBD 2003; Mace/Baillie 2007) and its associated *2010 Biodiversity Indicators Partnership* (2010 BIP), the review and refinement of existing[18] and the development of new, global biodiversity indicators is a high priority. For example, indicators need to be developed that monitor not just the conservation status of various taxa, but also relate to ecosystem functions and services such as carbon sequestration, water regulation (76.3.3) or to ecosystem productivity, stability and resilience *per se*, and can easily be incorporated into biodiversity models and scenarios. The aim is to develop indicators that are sufficiently robust, representative, and sensitive to monitor global biodiversity change, but also fulfil the requirement to communicate complex biodiversity data in an easily understandable manner to decision-makers and the public, e.g., by indicating when dangerous thresholds are being reached.[19]

The final goal of bioDISCOVERY is to enhance our understanding of biodiversity change in response to multiple natural and anthropogenic drivers based on integrated analyses of observations, experiments and models which will be used to develop improved, quantitative scenarios of future biodiversity change. Such computer-based model scenarios will have to integrate ecological concepts such as food webs, species interactions and community assemblage as well as conservation concepts such as meta-population theory, minimum viable population, area selection algorithms, fragmentation and connectivity, into a spatially explicit *Geographic Information System* (GIS) modelling framework that draws on data gathered from various monitoring approaches.[20] Furthermore, variables such as drivers of change and ecosystem services need to be linked into the modelling framework to finally create an operational biodiversity model that can render regional and global biodiversity scenarios given various socio-economic inputs, thus delivering a key tool for conservation managers and policy makers which will allow them to weigh the consequences of various policy options for biodiversity,

15 See: Thuiller/Lavorel/Araújo/Sykes/Prentice (2005); Anderson/Bugmann/Dearing/Gaillard (2006); Bugmann/Gurung/Ewert/Haeberli/Guisan/Fagre/Kaab (2007); Katzner/Milner-Gulland/Bragin (2007); Leyequien/Verrelst/Slot/Schaepman-Strub/Heitkonig/Skidmore (2007); Turner/Lambin/Reenberg (2007); Wessels/Prince/Malherbe/Small/Frost/VanZyl (2007).

16 See: Walsh/Abernethy/Bermejo/Beyersk/De Wachter/Akou/Huljbregis/Mambounga/Toham/Kilbourn/Lahm/Latour/Maisels/Mbina/Mihindou/Obiang/Effa/Starkey/Telfer/Thibault/Tutin/White/Wilkie (2003); Brugiere/Badjinca/Silva/Serra/Barry (2006).

17 See: Niemi/McDonald (2004); Müller/Lenz (2006); Levrel (2007); Mace/Baillie (2007); Smyth/Watzin/Manning (2007).

18 See: Butchart/Stattersfield/Bennun/Shutes/Akçakaya/Baillie/Stuart/Hilton-Taylor/Mace (2004); Loh/Green/Ricketts/Lamoreux/Jenkins/Kapos/Randers (2005); Global Footprint Network (2006).

19 See: Balmford/Bennun/ten Brink/Cooper/Côté/Crane/Dobson/Dudley/Dutton/Green/Gregory/Harrison/Kennedy/Kremen/Leader-Williams/Lovejoy/Mace/May/Mayaux/Morling/Phillips/Redford/Ricketts/Rodríguez/Sanjayan/Schei/van Jaarsveld/Walther (2005); Buckland/Magurran/Green/Fewster (2005); Green/Balmford/Crane/Mace/Reynolds/Turner (2005).

20 See: Bani/Massimino/Bottoni/Massa (2006); Peterson/Sanchez-Cordero/Martínez-Meyer/Navarro-Sigüenza (2006).

ecosystem services, and, ultimately, human well-being.[21] How ecosystem services and socio-economic drivers of change are related to biodiversity change is the subject of the next two themes.

76.3.3 Exploring the Links between Biodiversity Change, Ecosystem Functioning and Services, and Human Well-being

Given that the world is in the midst of a biodiversity crisis, what are actually the arguments for conserving biodiversity? Three main arguments on how biodiversity enhances human well-being have been advanced:

1. Biodiversity has an intrinsic value because it enriches life by providing educational, intellectual and recreational opportunities, aesthetic and spiritual enjoyment, and a sense of identity. While some argue that all such services can be enumerated in economic terms (e.g., earnings from ecotourism), others argue that they are essentially fundamental rights to a good life, equivalent to human rights and thus cannot be given a monetary value. Conservation and sustainable use of biodiversity thus become ethical issues of good moral conduct towards other life forms as well as towards fellow human beings and cultures.
2. Biodiversity has an economic value by providing ecosystem goods and services, which can be extracted goods (e.g., foods, fibres, medicines) or indirect services (e.g., pollination, carbon sequestration, nutrient cycling, pest control, ecotourism).
3. Biodiversity has an option value by providing future services, especially as a legacy to future generations and as an insurance against future challenges and risks, e.g., by storing genetic diversity which might be needed to design new foods or medicines or to adapt to rapid environmental change.

Because of a growing realization among biodiversity scientists that the second argument may have the strongest impact on current decision-makers, a conscious effort was made by DIVERSITAS to advance the science of ecosystem functioning and how it relates to biodiversity on the one side and ecosystem services on the other. DIVERSITAS addresses this challenge through its Core Project called ecoSERVICES which examines the impact of biodiversity changes on ecosystem functioning and services (Bulte/Hector/Larigauderie 2005). While the very concept of ecosystem services goes back to at least Plato (Daily 1997), the recent scientific interest in ecosystem services has been staggering. There has been an exponential increase in the number of publications on this topic over the last two decades (figure 76.1), perhaps only comparable to the explosion of interest in global climate change. DIVERSITAS has been at the forefront of this scientific endeavour with a series of workshops, publications and policy initiatives beginning in 1991.

Together with SCOPE and the *United Nations Environment Programme* (UNEP) which early on published global summaries on the subject (Heywood 1995; Mooney/Cushman/Medina/Sala/Schulze 1996), DIVERSITAS developed the field of ecosystem functioning and services through several landmark publications on the topic which were also the basis for some of the conclusions made in the *Millennium Ecosystem Assessment* (2005a).[22]

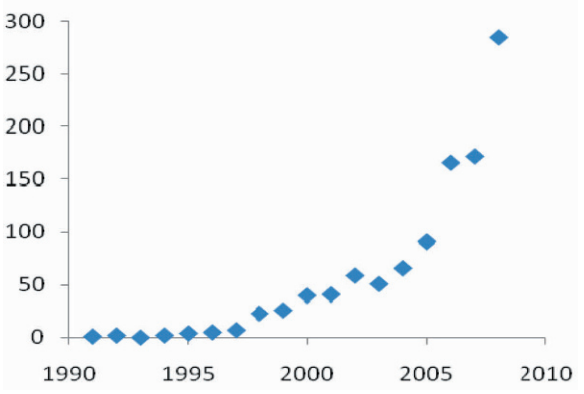
From all this research, several important conclusions for the relationship between biodiversity and ecosystem functioning were drawn:

1. The loss of genetic variability within a population of a species can reduce its flexibility to adjust to environmental change, e.g., climate change.
2. The loss of biodiversity within ecosystems generally reduces resource utilization, productivity and the capacity to resist changing environmental conditions and rebound from extreme conditions, while increasing spatial and temporal variation in ecosystem processes as well as susceptibility to invasion (however, several other factors, such as propagule pressure, disturbance regime, and

21 See: Parr/Sier/Battarbee/Mackay/Burgess (2003); Williams/Moore/Toham/Brooks/Strand/D'Amico/Wisz/Burgess/Balmford/Rahbek (2003); Santelmann/White/Freemark/Nassauer/Eilers/Vache/Danielson/Corry/Clark/Polasky/Cruse/Sifneos/Rustigian/Coiner/Wu/Debinski (2004); Carpenter/DeFries/Dietz/Mooney/Polasky/Reid/Scholes (2006); Naidoo/Ricketts (2006).

22 See: Chapin/Schulze/Mooney (1992); Schulze/Mooney (1994); Mooney/Lubchenco/Dirzo/Sala (1995); Mooney/Lubchenco/Dirzo/Sala (1995b); Emmerson/Solan/Emes/Paterson/Raffaelli (2001); Loreau/Naeem/Inchausti/Bengtsson/Grime/Hector/Hooper/Huston/Raffaelli/Schmid/Tilman/Wardle (2001); Kinzig/Pacala/Tilman (2002); Loreau/Naeem/Inchausti (2002); Statzner/Moss (2004); Hooper/Chapin/Ewel/Hector/Inchausti/Lavorel/Lawton/Lodge/Loreau/Naeem/Schmid/Setala/Symstad/Vandermeer/Wardlem (2005).

Figure 76.1: The number of publications per year enumerated by the scientific literature search engine ISI Web of Knowledge (see box 76.1) when the search word "ecosystem services" was used. The search was carried out on 16 December 2008.



resource availability also strongly influence invasion success).

3. The addition or deletion of dominant or keystone species (even if they are rare, such as top predators) can have profound effects on the capacity of an ecosystem to provide services. Keystone species are those with unique traits, e.g., for fixing nitrogen, capturing water, avoiding erosion, causing disturbance, and so forth; consequently, the effects of their removal or addition can be predicted *a priori*. Although the success of an invasive species in a new habitat is difficult to predict, its impact on ecosystem functioning upon establishment can be predicted based on whether the new species utilizes or produces a unique resource.
4. The simplification of ecosystems to produce greater yield of individual products (e.g., food monocultures) comes at the cost of the loss of ecosystem stability and ecosystem services, which then need to be subsidized by the use of often costly inputs, e.g., water, fertilizers and pesticides.
5. Certain ecosystems, e.g., those found in arid regions and on islands, appear particularly vulnerable to disturbance and hence alteration of their functioning. These sensitive systems all have low representation of key functional types (organisms that share a common role).
6. Anthropogenic alteration and fragmentation of ecosystems and landscapes reduces the overall amount of ecosystem services. Many of these ecosystem changes are difficult, expensive, or impossible to reverse or fix with technological solutions. Therefore, human societies will have to learn to maintain and increase the buffering capacity provided by biodiversity to ensure the long-term sustainable use of ecosystems.

While these conclusions hold in general, they can to some extent differ among different ecosystems, and should be treated with more caution for freshwater and marine ecosystems, as these have been severely understudied compared to terrestrial ecosystems.

These important conclusions on the link between biodiversity and ecosystem functioning and services then led to the next phase of scientific inquiry which is to link ecosystem services to human well-being, e.g., through quantification of economic benefits. Consequently, the scientific goals of the ecoSERVICES Science Plan (Bulte/Hector/Larigauderie 2005) are not only to further expand the research on the above conclusions by expanding the scale and complexity of future studies[23], but also to include economic and social researchers to investigate (1) how preferences for certain ecosystem services influence decision-making both at the individual and the societal level and (2) how to translate scientific knowledge about ecosystem services into economics to inform decision-makers about current versus future costs and benefits in comparable units of impact on human well-being.[24] Towards this goal, experimental and field studies need to be supplemented by the development of integrated ecological-economic models.[25] Such models

23 See: Loreau/Mouquet/Gonzalez (2003); Naeem/Wright (2003); Cardinale/Ives/Inchausti (2004); Gessner/Inchausti/Persson/Raffaelli/Giller (2004); Giller/Hillebrand/Berninger/Gessner/Hawkins/Inchausti/Inglis/Leslie/Malmqvist/Monaghan/Morin/O'Mullan (2004); Petchey/Downing/Mittelbach/Persson/Steiner/Warren/Woodward (2004); Raffaelli (2004); Vinebrooke/Cottingham/Norberg/Scheffer/Dodson/Maberly/Sommer (2004); Hooper/Chapin/Ewel/Hector/Inchausti/Lavorel/Lawton/Lodge/Loreau/Naeem/Schmid/Setala/Symstad/Vandermeer/Wardlem (2005); Balvanera/Pfisterer/Buchmann/He/Nakashizuka/Raffaell/Schmid (2006); Bulling/White/Raffaelli/Pierce (2006); Raffaelli (2006); Duffy/Cardinale/France/McIntyre/Thebault/Loreau (2007); Hector/Bagchi (2007).

24 See: Costanza/D'Arge/de Groot/Farber/Grasso/Hannon/Limburg/Naeem/O'Neil/Paruelo/Raskin/Sutton/van den Belt (1997); Daily/Söderqvist/Aniyar/Arrow/Dasgupta/Ehrlich/Folke/Jansson/Jansson/Kautsky/Lubchenco/Mäler/Simpson/Starrett/Tilman/Walker (2000); Balmford (2002); Farber/Costanza/Wilson (2002); Wätzold/Drechsler/Armstrong/Baumgartner/Grimm/Huth/Perrings/Possingham/Shogren/Skonhoft/Verboom-Vasiljev/Wissel (2006); Baumgärtner (2007); Tschirhart (2007).

will contribute towards a scientific basis for sustainable ecosystem-based management which is essential to achieve conclusion 6 (Tschirhart 2007); in other words, without reliable ecological-economic models, decision-makers and managers will find it difficult to choose policy and management options that maintain the buffering capacity of functional ecosystems and, at the same time, satisfy other societal needs, e.g. the provision of foods and fibres.

Yet quantifying the value of ecosystem services in specific localities and measuring their worth against that of competing land uses is no simple task. For example, a typical tradeoff is to quantify the economic benefits of a particular development project versus the benefits supplied by the ecosystem that would be destroyed. While in many cases the value of ecosystem services remains highly uncertain, the pace of destruction of natural ecosystems and the irreversibility of most such destruction warrants that we begin valuing ecosystem services, even if such an enterprise is fraught with difficulties. Just as societies have recognized fundamental human rights, it may be prudent to establish fundamental ecosystem protections even though uncertainty over economic values remains.

Two short examples shall illustrate that the research led by DIVERSITAS and many others on the value of ecosystem services is already making an impact on actual decision-making and global policy setting.

In the rush to produce sugar cane for biofuels, Uganda's President Yoweri Museveni wanted to give away a third of the 30,000 hectare Mabira Forest Reserve which is globally recognized as an *Important Bird Area* (IBA).[26] However, in October 2007, after months of intensive campaigning by several environmental organizations, the Uganda Ministry of Finance and Economic Planning announced that these plans had been dropped. What made this decision significant was that it was heavily influenced by a report published by *Nature-Uganda* which clearly showed that the economic value of the forest if conserved would surpass the anticipated economic value from future sugarcane harvests. The list of 'ecosystem services' (livelihoods, food, clean water, protection from soil erosion, ecotourism, etc.) provided by the reserve to over 120,000 adjacent community members was another important finding in the report which eventually won over the government.[27] This may very well be the first instance in which the explicit enumeration of ecosystem services changed a major policy decision within one of Africa's poorest nations.

Going from the local to the global scale, the German Federal Ministry for the Environment and the European Commission, with the support of several other partners, jointly presented an interim report of *The Economics of Ecosystems & Biodiversity* (TEEB) (European Communities 2008) during the Ninth Conference of the Parties to the *Convention on Biological Diversity* (CBD COP-9) in Bonn, Germany, in May 2008. The study evaluates the costs of the loss of biodiversity and the associated decline in ecosystem services worldwide, and compares them with the costs of effective conservation and sustainable use. It is intended to sharpen awareness of the value of biodiversity and ecosystem services and facilitate the development of cost-effective policy responses, notably by preparing a 'valuation toolkit'. Mimicking the Stern report on the economics of climate change (Stern 2006) and hoping for a similar impact on global awareness and policy-making, the TEEB will continue its investigation and present its final report at the Tenth Conference of the Parties to the *Convention on Biological Diversity* (CBD COP-10) in Nagoya, Japan, in 2010.

76.3.4 Investigating the Socio-economic Drivers of Biodiversity Change to Guide the Sustainable Use of Biodiversity

Given the realization of the irreplaceable value of ecosystem services (be it intrinsic, economic or optional value), there is an urgent need to investigate what motivates people and societies to keep using biodiversity in unsustainable ways, and how human behaviour may

25 See: Williams/Moore/Toham/Brooks/Strand/D'Amico/Wisz/Burgess/Balmford/Rahbek (2003); Moore/Balmford/Allnutt/Burgess (2004); Santelmann/White/Freemark/Nassauer/Eilers/Vache/Danielson/Corry/Clark/Polasky/Cruse/Sifneos/Rustigian/Coiner/Wu/Debinski (2004); Polasky/Nelson/Lonsdorf/Fackler/Starfield (2005); Bulling/White/Raffaelli/Pierce (2006); Naidoo/Balmford/Ferraro/Polasky/Ricketts/Rouget (2006); Naidoo/Ricketts (2006); Pitcher/Ainsworth (2008); and especially recent issues of the journal Ecological Economics.

26 An Important Bird Area (IBA) is a definition adopted by BirdLife International to recognize those terrestrial areas which are key sites for bird conservation, especially of threatened and endemic species; at: <http://www. birdlife.org/action/science/sites/index.html/>.

27 Anonymous, 2007: "BirdLife Partners applaud Uganda's decision to drop Mabira Forest give-away"; at: <http://www.birdlife.org/news/pr/2007/10/mabira.html/> (6 June 2008).

be changed to guide us towards the path of the sustainable use of biodiversity and its associated ecosystem services. DIVERSITAS addresses this challenge through its Core Project called bioSUSTAINABILITY which investigates the social, legal, economic and political motivators that have an impact on the drivers of biodiversity change to guide the sustainable use of biodiversity and its associated ecosystem services (DIVERSITAS 2004). Within these broader goals, a major focus of bioSUSTAINABILITY is to understand the reasons for the successes and failures of current conservation policies. Failures can often be attributed to one of the following factors:

1. policies do not recognize and effectively address the underlying motivations and incentives of individuals, organizations, and governments whose actions impact biodiversity,[28]
2. society often fails to appreciate the full value of the ecosystem services that biodiversity provides[29] (76.3.3 above) and/or
3. society at large has become dysfunctional to such a degree that conservation is not feasible.[30]

To measure success or failure, bioSUSTAINABILITY is developing indicators of the effectiveness of programmes and policies that impact on biodiversity, e.g., by identifying the positive or negative net effects on biodiversity of various social, political and economic drivers.[31] Understanding the effects of drivers of change is a prerequisite to develop successful conservation policies and to understand the mechanisms and conditions associated with various outcomes. Finally, bioSUSTAINABILITY investigates how to (1) incorporate this information into decision-making processes, (2) improve understanding of cause and effect mechanisms, and (3) develop adequate incentives to minimize impacts.[32]

What makes evaluating different policy options so difficult is that different groups within society often have diverse views about which outcomes are desirable and which trade-offs are acceptable. For example, one group may be interested in the value of the production of commodities, while another one may be more interested in conserving biodiversity (Deacon/Parker 2008). Reaching decisions which are acceptable to all stakeholders is a complex process. While top-down decisions may be easy to formulate, they usually ignore important stakeholder groups and are therefore likely to fail in the long term. Efforts to reach a consensus from the bottom-up, which require participatory processes and the involvement of all stakeholder groups, are more difficult, but their inclusive nature means that solutions are more likely to persist. Using case studies ranging from the local to the international scale, scientists involved in bioSUSTAINABILITY have examined the dynamics of multiple stakeholder groups, the criteria used to decide who participates and who makes decisions and best practice for building consensus, including cost-benefit analyses of conservation investments.[33]

Even with an improved understanding of these decision-making processes, much uncertainty remains because both ecological and socio-economic systems exhibit complex dynamic behaviours that interact in often unpredictable ways.[34] A challenge for long-term

28 See: Bohn/Deacon (1997); Mitchell/Keilbach (2001); Clark/Mitchell/Cash/Alcock (2002); Mitchell (2002); Mitchell (2003); Tarui/Polasky (2005); Clark/Mitchell/Cash (2006); Polasky (2006); Mitchell (2007); Deacon/Parker/Costello (2008); Tarui/Mason/Polasky/Ellis (2008).

29 See: Tilman/Polasky/Lehman (2005); Hassan/Ngwenya (2006); Matete/Hassan (2006); Dale/Polasky (2007).

30 See: Deacon (1994); Bohn/Deacon (1997); Dudley/Ginsberg/Plumptre/Hart/Campos (2002); Deacon/Mueller (2004); Bulte/Damania/Deacon (2005); Fjeldså/Alvarez/Lazcano/Leon (2005); Aldhous (2006).

31 See: Niemi/McDonald (2004); Pardal/Cardoso/Sousa/Marques/Raffaelli (2004); Müller/Lenz (2006); Dale/Polasky (2007); Smyth/Watzin/Manning (2007).

32 See: Deacon/Brookshire/Fisher/Kneese/Kolstad/Scrogin/Smith/Ward/Wilen (1998); Cash/Clark/Alcock/Dickson/Eckley/Guston/Jäger/Mitchell (2003); Colding/Folke/Elmqvist (2003); Tarui/Polasky (2005); Matete/Hassan (2006); Polasky (2006); Mehta/Haight/Homans/Polasky/Venette (2007); Deacon/Parker/Costello (2008); Deacon/Parker (2008); Tarui/Mason/Polasky/Ellis (2008).

33 See: Bohn/Deacon (1997); Mitchell/Keilbach (2001); Clark/Mitchell/Cash/Alcock (2002); Mitchell (2002); Mitchell (2003); Tarui/Polasky (2005); Clark/Mitchell/Cash (2006); Matete/Hassan (2006); Mitchell (2006); Mitchell (2007); Murdoch/Polasky/Wilson/Possingham/Kareiva/Shaw (2007); Nelson/Uwasua/Polasky (2007); Barbier/Koch/Silliman/Hacker/Wolanski/Primavera/Granek/Polasky/Aswani/Cramer/Stoms/Kennedy/Bael/Kappel/Perillo/Reed (2008); Costello/Polasky (2008); Tarui/Mason/Polasky/Ellis (2008).

34 See: Folke/Carpenter/Elmqvist/Gunderson/Holling/Walker (2002); Scheffer/Carpenter (2003); Folke/Carpenter/Walker/Scheffer/Elmqvist/Gunderson/Holling (2004); Carpenter/Brock (2006); Kinzig/Ryan/Etienne/Allison/Elmqvist/Walker (2006); Liu/Dietz/Carpenter/Folke/Alberti/Redman/Schneider/Ostrom/Pell/Lubchenco/Taylor/Ouyang/Deadman/Kratz/Provencher (2007).

biodiversity conservation and sustainability is to understand the dynamics of these coupled systems to predict how these dynamics might be affected by different social and economic decisions.[35] However, the very complexity of these systems means that it will be difficult to forecast the future. Surprises and uncertainty inherent in such dynamics make traditional approaches, which assume nearly complete information, of little use. Long-term sustainable management of biodiversity resources requires novel approaches (see e.g. GEO BON in 76.3.2 above).

Therefore, the analysis of the potential usefulness of a range of methodological approaches to assess the sustainability of coupled socio-ecological systems is a key goal of bioSUSTAINABILITY. In particular, bioSUSTAINABILITY intends to analyse the following promising methods: stochastic dynamic programming;[36] management of resilience;[37] multi-agent systems;[38] integrated environmental assessment modelling;[39] safe minimum standards (Berrens 2001; Drucker 2006); and the precautionary principle.[40] Such methods promise to deliver better early warning functions which will be able to detect when dangerous thresholds are reached at which system functions may change in dramatic and irreversible ways (e.g., collapse of fisheries, coral bleaching, landslides due to deforestation). Wherever possible, reversible damage needs to be redressed through implementation of restorative efforts and sustainable policies.[41] Such investigations are therefore invaluable as human societies attempt to cope with the challenges associated with global environmental change.

76.3.5 DIVERSITAS Cross-cutting Networks

The work of the four Core Projects of DIVERSITAS is mirrored and amended by the work of five Cross-cutting Networks which have gradually evolved and focused on specific themes or ecosystems, embracing issues also partially addressed in the Core Projects:

- *agroBIODIVERSITY* investigates relationships between biodiversity and agriculture (Jackson/Bawa/Pascual/Perrings 2005).
- *ecoHEALTH* explores relationships between biodiversity and health.
- *freshwaterBIODIVERSITY* researches issues related to freshwater biodiversity.[42]
- *Global Invasive Species Programme* (GISP) addresses issues related to invasive species (McNeely/Mooney/Neville/Schei/Waage 2001).
- *Global Mountain Biodiversity Assessment* (GMBA) focuses on mountain biodiversity issues (Spehn/Körner 2005; Spehn/Liberman/Körner 2006).

In the context of this chapter, it would go too far to detail their substantial contributions (for details, see DIVERSITAS website, box 76.1), but they all contribute to building global scientific capacity to focus on how to address biodiversity change and its implications on human societies.

76.3.6 Strengthening the Science Policy Bridge

To cope with *global environmental change* (GEC), an efficient flow of information is crucial. To bridge the

35 See: Janssen/Bodin/Anderies/Elmqvist/Ernstson/McAllister/Olsson/Ryan (2006); Moorcroft (2006); Tallis/ Kareiva (2006); Turner/Lambin/Reenberg (2007); Polasky (2008).

36 See: Costello/Polasky (2008); Hauser/Possingham (2008); Li/Huang/Nie/Nie (2008).

37 See: Folke/Carpenter/Elmqvist/Gunderson/Holling/Walker (2002); Folke/Carpenter/Walker/Scheffer/Elmqvist/Gunderson/Holling (2004); Janssen/Bodin/Anderies/Elmqvist/Ernstson/McAllister/Olsson/Ryan (2006); adaptive management (Daily 2000); Folke/Carpenter/Elmqvist/Gunderson/Holling/Walker (2002); Folke/Carpenter/Walker/Scheffer/Elmqvist/Gunderson/Holling (2004); Hauser/Possingham (2008).

38 See: Abielmona/Petriu/Groza (2007); Marcos/Flores/Ogbinar/Jose/Taborda (2007); Peyravi/Pashaci/Taghiyareh (2007).

39 See: Matete/Hassan (2006); Krol/Bronstert (2007); Lacitignola/Petrosillo/Cataldi/Zurlini (2007); Matthies/Giupponi/Ostendorf (2007); Smith/Fulton/Hobday/Smith/Shoulder (2007); Sutherst/Maywald/Bourne (2007); Weber (2007); Aranzabal/Schmitz/Aquilera/Pineda (2008); Buckley (2008); Ferreira/Hawkins/Monteiro/Moore/Service/Pascoe/Ramos/Sequeira (2008).

40 See: Gable (2003); Prato (2005); Aronson/Precht (2006); Failler/Pan (2007); Finnoff/Shogren/Leung/Lodge (2007); Morgan/Tsao/Guinotte (2007); Fenichel/Tsao/Jones/Hickling (2008); Hauser/Possingham (2008).

41 See: Young (2000); van Andel/Aronson (2003); Mitsch/Jørgensen (2004); Temperton/Hobbs/Nuttle/Halle (2004); Young/Petersen/Clary (2005); Falk/Palmer/Zedler (2006); Irwin/Ranganathan (2007); Mooney (2007); Schuster/Smits/Ullal (2008).

42 See: Dudgeon/Arthington/Gessner/Kawabata/Knowler/Lévêque/Naiman/Prieur-Richard/Soto/Stiassny/Sullivan (2006); Naiman/Prieur-Richard/Arthington/Dudgeon/Gessner/Kawabata/Knowler/O'Keeffe/Lévêque/Soto/Stiassny/Sullivan (2006).

gap between the monitoring, science and assessment communities dealing with biodiversity change, DIVERSITAS has made extensive use of the scientific community built through its Core Projects and Cross-cutting Networks to take the lead in the on-going consultations on a global monitoring network and a global assessment mechanism, namely the GEO BON (see 76.3.2 above) and the consultation on an *International Mechanism of Scientific Expertise on Biodiversity* (IMoSEB). IMoSEB was initiated by the French Government in January 2005 at a summit entitled "Biodiversity: Science and Governance"[43] and gained momentum in 2006 through a vibrant process involving hundreds of scientists, representatives of governments, international and non-governmental organizations, as well as UN agencies. The central focus of this consultation is the need for a new mechanism, called IMoSEB, which, like the *Intergovernmental Panel on Climate Change* (IPCC), would provide independent and regular scientific expertise on and assessment of biodiversity to the biodiversity-related conventions, such as the CBD, the *Ramsar Convention on Wetlands*, or the *United Nations Framework Convention on Climate Change* (UNFCCC).

During this consultation process, a broad consensus has been emerging on the fact that the current situation in terms of availability and use of scientific expertise for decision-making on biodiversity is not satisfactory. The *Subsidiary Body for Technical and Technological Advice* (SBSTTA) of the CBD is not fulfilling this role, and would benefit from such a mechanism. Issues that have been debated in the consultation include the governance of IMoSEB, the framework of IMoSEB (what should its relation with the CBD be?), the time frame (should IMoSEB produce regular assessments or fast expertise on emerging topics, or both?), and the geographical scale (could a global mechanism deliver relevant information at the local level?). A final meeting of the International Steering Committee, at the end of 2007, discussed all these major issues, and came up with final recommendations on the mandate and governance of IMoSEB.

IIn broad strokes, they recommend that IMoSEB should be:

- scientifically independent, credible and inclusive;
- policy-legitimate through inter-governmental and multi-stakeholder involvement;
- policy-relevant without being policy-descriptive;
- based on a robust and relevant conceptual framework;
- communicated in an appropriate form for consideration and possible action;
- supported by networking efforts of scientific and knowledge holders.

IMoSEB should address decision-makers from governments and other sectors of society at global, regional and national scales and promote dialogue between international agencies and decision-makers. IMoSEB would thus provide scientific support to multilateral environmental agreements, national governments and other decision-makers which are concerned with consequences of biodiversity change. The main activities of IMoSEB would include

- influencing the research agenda by highlighting scientific gaps,
- generating interdisciplinary knowledge through regular independent assessment,
- providing policy support by responding to requests for information on specific issues,
- identifying emerging issues and threats and
- building capacity at the regional and national level.

Since May 2008, IMoSEB and the follow-up process to the Millennium Ecosystem Assessment (2005a) have engaged in discussions and come to the agreement that a single mechanism for both initiatives would be more appropriate than two separate ones, given the high level of congruence between the two initiatives. All modalities of this new mechanism, referred to as the *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (IPBES, <http://ipbes.net/en/index.aspx/>) were considered by governments and other stakeholders at an "ad hoc intergovernmental and multi-stakeholder meeting on an intergovernmental science-policy platform on biodiversity and ecosystem services" held in Putrajaya, Malaysia, from 10–12 November 2008 under the auspices of the UNEP Executive Director. Delegates from 78 countries and 25 organizations discussed needs and modalities to strengthen the science-policy interface on biodiversity and ecosystem services. There was broad recognition of the need to improve the science-policy interface which should use existing relevant assessments and the best available multidisciplinary knowledge (i.e., natural, social and economic sciences, including traditional and indigenous knowledge). Many delegates agreed that the role

43 See: Loreau/Oteng-Yeboah/Arroyo/Babin/Barbault/Donoghue/Gadgil/Häuser/Heip/Larigauderie/Ma/Mace/Mooney/Perrings/Raven/Sarukhan/Schei/Scholes/Watson (2006).

of an independent science policy platform should be to compile, assess and synthesize existing scientific knowledge, thereby indentifying areas of science requiring further development, and to provide policy-relevant, evidence-based and peer-reviewed information to multiple stakeholders including multilateral environmental agreements without being policy-prescriptive. A second meeting, most likely to be held in 2009, will continue this process. DIVERSITAS will continue to ensure a strong representation of the biodiversity community in this process.

76.4 Conclusions

This chapter illustrates how biodiversity science has changed over this past decade, moving from a purely 'naturalist' view of the world excluding humans to a vision that takes into account human activities and their interaction with earth system processes. Consequently, the scientific community has changed the way it works and built numerous bridges across disciplines. Biodiversity scientists have learned to interact with politicians and other decision-makers, and have increasingly been called upon to shape policies to protect biodiversity at the national and international level. Strong concepts have emerged, such as the consequences of biodiversity change and loss for ecosystem functioning and services and human well-being, thanks to DIVERSITAS and the *Millennium Ecosystem Assessment* (2005a).

Yet, in spite of all these efforts, losses of populations and species and destruction of ecosystems continue unabated. A strong case still needs to be made for biodiversity. Public opinion does not feel threatened by the loss of biodiversity, as is the case for climate change. Biodiversity losses remain seen by most as the disappearance of a charismatic species far away from home, a sad event, but not of a threatening nature to daily life. Therefore, the biodiversity crisis, even more than the climate change crisis, will require a multi-disciplinary approach both on the science side as well as on the policy, education and management side, combining and integrating different approaches, subjects and disciplines. The main challenge for the biodiversity community in the few years ahead is to make a strong enough case for biodiversity, to influence public opinion, and to make an impact on political agendas. Humankind does not have much time to avert the further irreversible loss of biodiversity in all its multifaceted splendour.

77 The International Geosphere-Biosphere Programme's (IGBP) Scientific Research Agenda for Coping with Global Environmental Change

Kevin J. Noone, Carlos Nobre and Sybil Seitzinger

77.1 Introduction[1]

The UN *Millennium Development Goals* (MDGs) are simultaneously an inspiring and formidable challenge for society: within the next few years we must aim to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat deadly diseases; ensure environmental sustainability; and construct a global partnership for development. At the same time, society is faced with other challenges such as global climate change, air pollution, decreases in global biodiversity, food and water resources, and how all of these issues tie into global security. Humankind does not have the luxury of solving these problems one at a time; they need to be resolved together. Solving these problems requires knowledge of how the coupled human-environmental Earth system works that is sufficiently broad and deep to allow us to accurately assess the causes of past and current changes and predict future ones.

In this regard, the need for process-level understanding of how the human-environmental system works has not diminished, but in fact underpins our ability to achieve sustainable development. The science community still must concentrate on understanding the interactions and feedbacks between biological, chemical and physical processes and human systems. However, scientists, resource managers, private enterprise and policy makers require a common understanding in order for their interactions to be mutually beneficial, and for us to be able to imagine, assess and implement solutions for the MDGs and address other issues of global environmental change.

The global environmental changes brought on by human activities have already and will continue to have significant, planetary-scale consequences. Rockström, Steffen, Noone, Persson, Chapin III and coauthors (2009a, 2009b) have recently identified nine "planetary boundaries" which if exceeded would increase the risk of the Earth System moving into a state less suited for the needs of our current society. They provide specific estimates for seven of the nine boundaries, and show that humanity has already exceeded three. This recent analysis itself builds upon work from a number of roots, among them the concept of limits to growth (Meadows/Meadows/Randers/Behrens III 1972; Turner 2008), studies of the coupled human-environmental system (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schnellnhuber/Turner/Wasson 2004; Schellnhuber/Crutzen/ Clark/Claussen/Held 2004; Liu/Dietz/Carpenter/Folke/Alberti et al. 2007) and resilience (Folke 2006; Walker/Barrett/Polasky/Galaz/Folke et al. 2009). A common characteristic of all of this work is the necessity of an interdisciplinary approach to framing and carrying out research in these areas. Attainment of global sustainability in a fundamentally interconnected world is only possible through coordinated, collective and cooperative efforts by all peoples. The scientific community has a special and significant role to play in this effort.

The goals of this chapter are to discuss the challenges of pursuing research in the area of *global environmental change* (GEC), give examples of the kinds of questions that require an international, interdisciplinary research approach, and outline how the *International Geosphere-Biosphere Programme* (IGBP) contributes to this effort.

1 The authors are grateful to three anonymous reviewers for helpful comments and to Hans Günter Brauch for his patience during the process of completing this chapter.

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Figure 77.1: The 'big picture' puzzle. The left pane shows the unassembled puzzle, in which focused, disciplinary research serves to draw out detail in each of the puzzle pieces. The right pane shows the assembled puzzle, in which scientific effort has been expended to assemble the pieces together in order to view the big picture. A limitation of this depiction is the fact that the picture is changing all of the time, and is not static as shown here.

77.2 The Research Challenge of Global Environmental Change

Three hundred years ago, in the time of Sir Isaac Newton, science was called natural philosophy. In the centuries since, we have divided science up into a multitude of focused disciplines. In any University catalogue one finds departments of chemistry, physics, economics, meteorology, law, and many more. Agencies that fund scientific research are structured in similar ways. With this structure, we have sliced the 'big picture' up into a large number of smaller, more manageable pieces. There are some good reasons for taking this focused, reductionist approach. It is a necessary step in developing an understanding of the processes that determine how complex systems behave. If we view the complex earth system as a large puzzle, the reductionist approach helps us to bring out the details of each one of the pieces of the puzzle. However, regardless of how much detail we achieve for each of the individual pieces, seeing the 'big picture' is not possible unless all the puzzle bits are assembled. A major research challenge of GEC is developing the science of (and the institutional support structure for) putting together the big picture (figure 77.1).

In its two decades of existence, IGBP has attempted to develop and provide the structure within which international, multidisciplinary science can be organized and applied to both doing the fundamental, process-oriented research needed to bring out the detail in each of the puzzle pieces in the Earth System – as well as how the details are changing, but also (and perhaps more importantly) to put a structure in place that enables the puzzle to be put together. Even though IGBP has a very broad scientific base (se section 77.3.2 below), the challenges of doing research on global environmental change require an even more comprehensive base.

77.2.1 Investigating the Coupled Human-Environmental Earth System

The kinds of questions now being asked of the research community have changed over the last decades, and reflect the increasing appreciation of the interconnectedness of the earth system. In the past, many scientific questions of societal importance could be successfully addressed by concentrating on either individual or a small number of the components of the earth system, even though answering the questions still required international, interdisciplinary collaboration. For example, finding out what caused the development of the Antarctic ozone hole required international collaboration among atmospheric chemists and meteorologists. Understanding the causes and conse-

quences of acid rain required collaboration between atmospheric scientists and terrestrial ecologists. In contrast, the kinds of questions now being asked of the scientific community increasingly show the need for a more holistic approach; one that couples natural and social sciences methodologies and expertise from the outset. For example (chap. 74 on the ESSP):

- Can agricultural practices and water management policies on regional and local scales be adapted to changes in precipitation patterns caused by global warming?
- What are the trade-offs between food and biofuels production and what will be the consequences of large-scale land use and ecosystem changes caused by these activities?
- What are the impacts of the predicted climate changes on food production and human security?
- What new forms of governance and management systems do we need in order to implement equitable responses to the challenges of global environmental change?
- What role does urbanization play in the health effects of air pollution? Do megacities play a role in affecting the energy balance of the planet and in the hydrological cycle?

In addition, the GEC research community is challenged to present research results in more accessible and informative ways to stakeholders – particularly those concerned with adaptation and sustainable development. IGBP is frequently expected to answer questions on the effects of GEC on regional – and even local scales: stakeholders seek local strategies to adapt to future environmental change. Here in a nutshell we have some of the greatest challenges of doing research on GEC issues: a) mobilizing, coordinating and enabling researchers from around the globe and from a multitude of disciplines across the natural and social science spectrum to pursue collaborative research; b) develop the ability to pursue research that is relevant for scales going from local to global; c) involving end users in the design, production and use of the results of this research.

IGBP is one component in a larger effort aimed at pursuing GEC research – the *Earth System Science Partnership* (ESSP). Our own strategy is described in the following sections. However, it should be kept in mind that IGBP's current and future activities are intended to contribute to helping achieve the goals of ESSP as well as our own (chap. 74). Descriptions of some of the other partners and projects in ESSP can be found in chap 75 (on the International Human Dimensions Programme on Global Environmental Change), chap. 76 (on DIVERSITAS) and in chap. 79 (on the World Climate Research Programme).

77.3 IGBP's Scientific Strategy

IGBP's scientific strategy is aimed at achieving its overall vision: "to provide scientific knowledge to improve the sustainability of the living Earth". IGBP's scientific strategy has evolved since the start of the Programme in 1987. IGBP was created at a time when little understanding existed of how the Earth worked as a system, how the parts were connected, or even about the importance of the various component parts of the Earth system. Feedback mechanisms were not always clearly understood, nor were the dynamics controlling the Earth system as a whole. Herbert Friedman, in the introduction to the report *Toward an International Geosphere-Biosphere Program: A Study of Global Change* (NRC 1986) called for a "bold, 'holistic' venture in organized research – the study of whole systems of interdisciplinary science in an effort to understand global changes in the terrestrial environment and its living systems". IGBP's scientific implementation began in earnest in the early 1990's with the launch of five projects.[2] Five additional projects began over the course of the 1990's,[3] culminating in a transition between IGBP's first and second phases. Originally, the first of the IGBP core projects were essentially independent of each other, and were aimed at progressing fundamental understanding of the governing processes in each of their respective domains. They did so quite successfully, but as time went on the scientific community in IGBP realized that a much greater level of connectedness across the various domains was necessary in order to address system-level questions about the nature and function of the Earth system. A synthesis of key findings from IGBP's first phase (IGBP-I) was conducted during 2000–2003, and laid the groundwork for the

2 *Biospheric Aspects of the Hydrologic Cycle* (BAHC), *Global Change and Terrestrial Ecosystems* (GCTE), *International Global Atmospheric Chemistry* (IGAC), *Joint Global Ocean Flux Study* (JGOFS), and *Past Global Changes* (PAGES).

3 *Land-Ocean Interactions in the Coastal Zone* (LOICZ), *Land-Use and Land-Cover Change* (LUCC), *Global Analysis, Integration, and Modelling* (GAIM), and *Data and Information Service (DIS), Global Change System for Analysis, Research, and Training* (START).

transition into our second phase (IGPB-II: 2004–2013).

In this second phase, IGBP's mandate is "to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth System, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions" (Brasseur/Steffen/Noone 2005). The initial strategy for the second phase is described in detail in IGBP's science plan and implementation strategy (IGBP 2006).

As IGBP continues to evolve, the scientists involved in the network are realizing that in addition to the process-level discovery science that IGBP has facilitated, there is an increasing need to develop a kind of *applied* Earth system science – science that takes fundamental understanding about how the Earth system functions, and applies this knowledge to support decisions about issues of societal relevance. Engaging stakeholders is a necessary component of this new enterprise for IGBP. These issues were highlighted in an international review of IGBP (ICSU-IGFA 2009) that will guide IGBP's development in the coming years.

77.3.1 Linking Process Understanding with Decision Support

Human adaptation to a changing environment can take many forms, and can have both positive and negative environmental impacts. Small-scale measures could include increased use of air conditioning as temperature increases, architectural changes for more efficient heating and cooling, better forecasting and warning systems for extreme events, and increased water usage. Larger-scale issues could vary from switching to renewable energy sources to attempts at 'geo-engineering'. The large-scale movement of people away from areas adversely affected by climate change and by other environmental and socioeconomic stresses is also a form of adaptation. Each of these options, and the decisions behind them, has environmental consequences that must be carefully evaluated before they are implemented. The greater the consequences of a decision or an adaptation scheme, the greater care needs to be taken in considering its application. Another fundamental issue about adaptation schemes is whether they will contribute to an increase or decrease in equity across the globe. The predictions recently released by the IPCC Working Group 2 show that in many cases the areas facing the largest changes in climate are not only located in countries that have contributed the least to the atmospheric build-up of greenhouse gases, but also those that have the least ability to adapt to them (IPCC 2007). Clearly, the basic science research needed to support decisions about adaptation needs a tightly coupled natural-social science support structure. The need to understand how individual aspects of and processes in the natural and social worlds work has not diminished, but in fact underpins the answers to questions of sustainable development and adaptation (figure 77.2).

At the base of the pyramid are all of the myriad investigations into the nature of the individual processes that govern Earth system behaviour. This process-level research was mentioned earlier with the analogy of achieving a high level of detail in each of the puzzle pieces of the Earth system. The next level higher is one in which system-level integration can be pursued. This corresponds to the previous analogy of putting together the 'big picture' puzzle. The apex of the pyramid represents activities that aim to convert this system-level understanding into information relevant for decision support for global environmental change issues. This pyramid analogy highlights a few important points regarding discovery research and decision support:

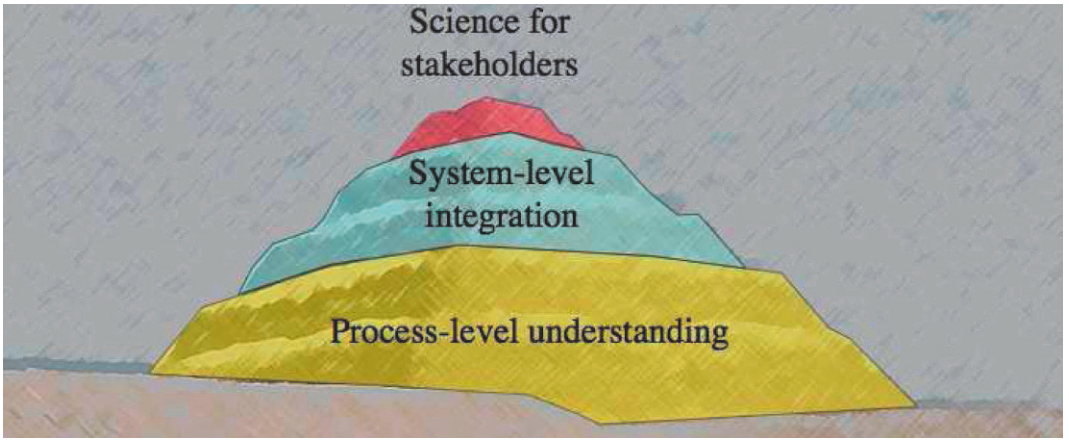
1. Robust decision support *requires* having a foundation of basic process-level research. Without this support, the risk of making incorrect (and ill-informed) decisions is much greater;
2. System-level integration and analysis is necessary for decision support, since the Earth system behaves as a tightly coupled human-environmental system;
3. The volumes of each of the layers are roughly proportional to the number of people and the amount of resources that need to be expended in each of the different endeavours.

We still must concentrate on first class science involving the interactions and feedbacks between biological, chemical and physical processes and human systems. However, scientists, resource managers and policy makers require a common understanding in order for their interactions to be mutually beneficial.

77.3.2 The IGBP Structure

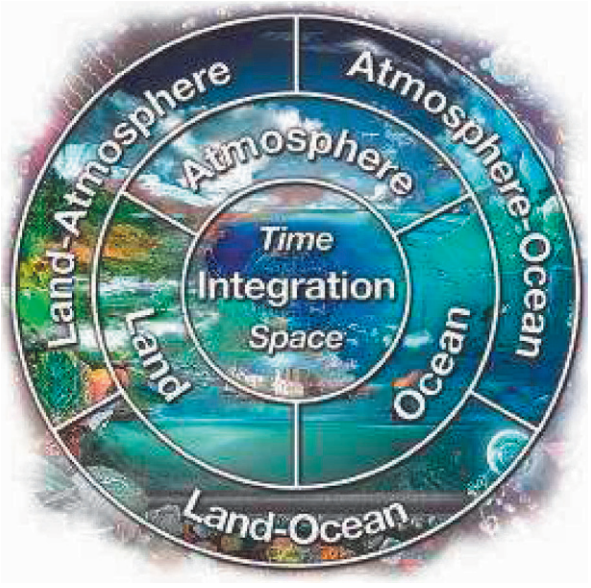
Given the need for investigating interactions and feedbacks between biological, chemical and physical processes and human systems, what sort of support struc-

Figure 77.2: Linking process understanding with decision support.



ture is needed? The support and organizational structure to fill these needs should facilitate international, multidisciplinary research. It should engender and enable connections between domain-oriented research efforts. It should combine observational and modelling approaches. IGBP has attempted to respond to these needs by taking on a structure depicted in figure 77.3.

Figure 77.3: The current structure of IGBP. The projects of IGBP focus on the main reservoirs (atmosphere, land, ocean), the interfaces between the reservoirs, and projects that integrate across time, space, and domain.



IGBP is organized around nine projects. Three look at processes affecting the main physical and biogeochemical reservoirs in the earth system: the *International Global Atmospheric Chemistry* (IGAC) project concentrates on the atmosphere; the *Global Land Project* (GLP) at terrestrial systems; and the *Global Ocean Ecosystem Dynamics* (GLOBEC) and *Integrated Marine Biogeochemistry and Ecosystem Research* (IMBER) projects look at the marine domain (the GLOBEC project formally ended in 2009). Three projects examine the interfaces between these reservoirs: the *Integrated Land Ecosystem-Atmosphere Processes Study* (iLEAPS) looks at the land-atmosphere interface; the *Land-Ocean Interactions in the Coastal Zone* (LOICZ) project examines the land-ocean interface; and the *Surface Ocean Lower Atmosphere Study* (SOLAS) project concentrates on the atmosphere-ocean interface. The two remaining projects are even more broadly integrative in nature. The *Past Global Changes* (PAGES) project tries to understand the Earth's environment in the past in order to enable predictions into the future, and the *Analysis, Integration and Modelling of the Earth System* (AIMES) project looks at the processes driving global biogeochemical cycling (including human activities) at many scales, both in the past and into the future.

This suite of tightly coupled projects mirrors the tightly coupled earth system. The coupling allows for a good deal of cross-fertilization between areas, and enables a holistic approach to understanding how the earth system works. In addition to the projects, IGBP sponsors *fast track initiatives* – activities intended to cross over several of the project subject areas and to allow us to identify and analyze horizon issues in earth system science. These initiatives are aimed at producing timely synthesis articles for leading journals; e.g., (Diaz/Lavorel/Bello/Quétier/Grigulis et al. 2007; Duce/LaRoche/Altieri/Arrigo/Baker et al. 2008).

Table 77.1: IGBP projects, web sites and co-sponsor organizations. **Source:** Compiled by the authors.

Project	Co-sponsors	Website
IGAC	*International Commission on Atmospheric Chemistry and Global Pollution* (ICACGP)	<http://www.igac.noaa.gov/>
GLP	*International Human Dimensions Programme on Global Environmental Change* (IHDP)	<http://www.globallandproject.org/>
IMBER	*Scientific Committee on Oceanic Research* (SCOR)	<http://www.imber.info/>
GLOBEC	*International Oceanographic Commission* (IOC), SCOR	<http://www.globec.org/>
iLEAPS		<http://www.ileaps.org/>
SOLAS	*World Climate Research Programme* (WCRP),SCOR, ICACGP	<http://www.uea.ac.uk/env/solas/>
LOICZ	IHDP	<http://www.loicz.org/>
PAGES		<http://www.pages.unibe.ch/>
AIMES		<http://www.aimes.ucar.edu/>

In many cases, IGBP projects and activities are co-sponsored and supported by partner organizations. These partnerships are both necessary and extremely valuable in terms of being able to approach complex issues relating the coupled human-environment system (table 77.1). Each project has developed a science plan and implementation strategy describing the projects goals and approaches.

While the list of acronyms may appear daunting, it does illustrate a few salient points:

- A wide range of both natural and social science disciplines and collaborations are necessary in order to build a holistic, 'big picture' view;
- No single organization is able to effectively support and sponsor this wide range of activities;
- The scientific community has become ever more connected in its attempts to learn about and predict the behaviour of the coupled human-environment system.

Form should follow function; the organizational structure should facilitate and not obstruct integrative, international, multidisciplinary research. The following section shows examples of this kind of science, and of how it is facilitated.

77.3.3 IGBP Products

In addition to the many scientific papers published as a result of centrally-coordinated activities or the work of scientists involved in IGBP projects, IGBP produces a suite of products aimed at different target audiences: the scientific community, the education sector, managers and funders, and the media. These are available via the 'Resource Room' at the IGBP website. One example of products aimed at the scientific community is the IGBP synthesis book series. A major synthesis activity was carried out at the end of the first phase of IGBP that led to a series of books published by Springer (table 77.2).

Presentation material about GEC issues (and about IGBP's approach) is available for the education community from the IGBP website, as are reports and popular science articles. Press releases are developed for the media, and are available for download.

IGBP has recently developed a 'climate change index' that brings together the key parameters from the atmosphere, ocean and cryosphere: atmospheric carbon dioxide levels – the main driver of change – global surface temperature, sea-level rise and summer arctic sea-ice extent. In doing so the index provides a compelling snapshot of which direction the Earth system is heading, and how fast.[4] Finally, IGBP produces annual reports about its yearly activities for managers and funders. These reports include science highlights, activity reports, and a budget summary.

77.3.4 Applied Earth System Science

In the pyramid metaphor, *applied* earth system science would be the apex. It would be the framework with which increases in our knowledge are converted of how the earth system works into information that can be of practical benefit to humankind. Actors in the policy, private, regulatory and other sectors are increasingly in need of assessments of the risks and op-

4 IGBP will publish the index annually and promote it to policymakers, government departments, the public, the media, and other organizations. It will be available on the IGBP website and as a PowerPoint slide, with easy access to the underlying data.

Table 77.2: IGBP synthesis series books. **Source:** Compiled by the authors.

Book Title	Reference
Paleoclimate, Global Change and the Future	Alverson, Bradley and Pedersen (2003)
Atmospheric Chemistry in a Changing World	Brasseur, Prinn and Pszenny (2003)
Ocean Biogeochemistry	Fasham (2003)
Vegetation, Water, Humans and the Climate	Kabat, Claussen, Dirmeyer, Gash, de Guenni et al. (2004)
Global Change and the Earth System	Steffen, Sanderson, Tyson, Jäger, Matson, Moore III, Oldfield, Richardson, Schnellnhuber, Turner, Wasson (2004)
Coastal Fluxes in the Anthropocene	Crossland, Kremer, Linde-boom, Marshall Crossland and Le Tissier (2005)
Land-Use and Land-Cover Change	Lambin and Geist (2006)
Terrestrial Ecosystems in a Changing World	Canadell, Pataki and Pitelka (2007)
Carbon and Nutrient Fluxes in Continental Margins	Liu, Atkinson, Quiñones and Talaue-McManus (2010)

portunities presented by GEC. They need information in digestible form in order to be able to evaluate and manage risks, compare options, and evaluate the potential consequences of decisions. This kind of information requires the involvement of these sectors, and necessarily needs to involve the natural and social sciences throughout the process of knowledge generation. Within IGBP, the AIMES project is leading the development of a programme-wide effort to develop applications of earth system science. As a comprehensive set of examples of applied earth system science is beyond the scope of this chapter, two examples are presented as illustrations of the concept.

77.3.4.1 Marine Ecosystem Dynamics and Fisheries Management

Roughly 1 billion people worldwide are dependent on fish as their primary source of protein, yet about 75 per cent of global fisheries are over-fished or at their biological limit. Clearly, a sustainable global fishing industry requires understanding the end-to-end processes controlling the entire marine food chain (the entire chain from nutrient inputs to top predators), as well as how different management approaches influence the marine environment – ranging widely from e.g., regulations on agricultural fertilizer use, land use regulation in semi-arid regions and desertification, all the way to regulations on the catches of specific marine species. The combination of work carried out in the IGBP marine projects is a good illustration of attempts to achieve this truly end-to-end research. Work within the GLOBEC project has shown that changes in Arctic climate have contributed to shifts in the abundance and seasonality of many species of organisms in the northwest Atlantic Ocean (Greene/Pershing 2007). Further work has used a coupled physical, biophysical and ecosystem model to predict past and future cod production in the North Atlantic (Svendsen/Skogen/Budgell/Huse/Stiansen/Adlandsvik/Vikebø/Asplin/Sundby 2007), predicting increased cod recruitment for this region in 2007–2008. This kind of understanding and predictive tools will be of great use for understanding and assessing how climate change and human activities will impact marine ecosystems and food production.

77.3.4.2 Nitrogen and Sustainability

Humans have had a huge impact on the amount of nitrogen flowing through the earth system. In the century between 1890 and 1990, the total amount of reactive nitrogen created by human activities increased nine fold (Galloway/Cowling 2002)). However, the production of reactive nitrogen is far from uniform. In many developing countries, a persistent lack of nitrogen fertilizer has exacerbated food insecurity and continuing land degradation, while many developed countries have been challenged with pollution due to excessive nitrogen, including aquatic euthrophication and the loss of terrestrial biodiversity.

A major global management issue is how to optimize the use of nitrogen to promote human well-being, and at the same time minimize the negative impacts of nitrogen on the environment. The *International Nitrogen Initiative* (INI) was established in 2003 (<http://initrogen.org>) to address these challenges, and was helped on its way through an IGBP fast track initiative. The INI focuses on a) the production and assessment of basic knowledge on the production and distribution of reactive nitrogen, b) developing management solutions for regions with an un-

Box 77.1: Excerpts from the Cape Town Declaration. **Source**: <http://www.igbp.net/page.php?pid=415>. .

Attainment of global sustainability in an interconnected world is only possible through coordinated, collective and cooperative efforts by all peoples. The path to sustainability will be different for different parts of the earth, as a result of their history and environmental circumstances. The developing world has the opportunity to attain wellbeing of individual citizens without compromising the integrity of their natural environments. Likewise others, such as the developed world, must find effective ways to contribute to global sustainability. Science has a fundamental role in helping to realize these opportunities. ...

The participants of this Congress commit to work together to pursue science that will aid us in achieving sustainable development of our common, global resources. We commit

- To build upon the successes we have had of constructing a scientific infrastructure that brings together scientists from many nations, disciplines and backgrounds, from across the natural and social sciences;
- That we use this human and intellectual capital to build the next level of scientific infrastructure that is necessary to understand and predict the behavior of coupled human-environmental systems;
- That the framework for this scientific infrastructure be built around the ideas of sustainability and ethical global stewardship of the Earth System;
- That we challenge ourselves with using the understanding that we develop about these coupled systems as the scientific basis for assessments and communication of the options risks, vulnerabilities and possibilities for future sustainable development of our planet.

der- or over-abundance of nitrogen and c) developing engineering and policy tools to implement such solutions. For example, Galloway and Cowling (2008) suggest four interventions that could lead to a reduction in about 28 per cent of the amount of reactive nitrogen created in 2005. These include 1) controlling NO_x emissions from fossil fuel combustion; 2) increasing the nitrogen uptake efficiency of crops; 3) improving animal management strategies; and 4) building and improving urban sewage treatment facilities.

Besides direct anthropogenic production of reactive nitrogen, other human activities have had significant influence on the global nitrogen cycle. Duce, LaRoche, Altieri, Arrigo, Baker and co-authors (2008) showed that anthropogenically-produced atmospheric nitrogen could account for around one third of the ocean's external (non-recycled) nitrogen supply and up to three per cent of the annual new marine biological production. An important consequence of this anthropogenic fertilization of the oceans is the conclusion that from 1860 to the present, this deposition has led to a ten-fold increase in *nitrous oxide* (N_2O) emissions from the oceans. While anthropogenically-stimulated biological production in the oceans temporarily reduces atmospheric CO_2 concentrations, the emission of N_2O partially offsets the cooling due to reduced CO_2. Knowing the nature and magnitude of these competing effects will allow better judgments to be made regarding the efficacy and utility of biological carbon sequestration in the oceans.

77.4 Future Directions

These two examples illustrate how IGBP is moving from facilitating basic research into the functioning of the earth system into framing this new discovery research in ways that will be of more direct use to stakeholder communities. These efforts are entirely consistent with two of the recommendations of a recent international review of IGBP: a) developing priorities for the IGBP that are question- and problem-based; and b) maximize the scientific, policy and practice impacts of IGBP research. IGBP's future development will also be influenced by the 'visioning' process currently underway in our parent organization, the *International Council for Science* (ICSU).

In this regard, the strategic development of IGBP will include:

- Continuing the basic, international, multidisciplinary discovery research into the processes driving earth system dynamics;
- Organizing and conducting this research with increasing attention given to the end uses and end users of this new knowledge – building an *applied* earth system science;

These characteristics were nicely expressed in the 'Cape Town Declaration' (box 77.1), developed at the Fourth IGBP Congress on "Sustainable Livelihoods in a Changing System" in Cape Town, South Africa in May 2008. Achieving the commitments of the Cape Town Declaration is the centre piece of IGBP's plans for the future.

78 Climate Information for Coping with Environmental Change: Contributions of the World Climate Research Programme

John A. Church, Ghassem R. Asrar, Antonio J. Busalacchi and Carolin E. Arndt

78.1 Introduction[1]

Every day climate variability and change shapes the world, including the natural environment and its biodiversity on which society depends for water, food and other ecosystem services. Since the evolution of *homo sapiens* about 200,000 years ago, it is only in the last 10,000 years that we have moved from a hunter-gatherer existence to our modern society with its critical dependence on agriculture and exploitation of natural resources at an ever increasing rate. The relatively stable climate during the Holocene was an important component in making this transition possible (Burroughs 2005).

To provide the scientific basis for the provision of climate information that society has become increasingly dependent on, the *World Meteorological Organisation* (WMO), the *International Council for Science* (ICSU) and the *Intergovernmental Oceanographic Commission* (IOC) agreed to sponsor the *World Climate Research Programme* (WCRP). Since its inception, the two major objectives of the WCRP have been to determine a) the predictability of climate, and b) the effect of human activities on climate.

WCRP completes research projects designed to improve our knowledge of the climate system. It also develops observational programmes and models for knowing how climate has and is changing and how it is likely to change in the future. This information forms an essential scientific basis for the Intergovernmental Panel on Climate Change assessments (IPCC, 2007) which in turn help society respond to the threats and challenges and overcome the vulnerability and risks associated with global climate and environmental change.

This chapter outlines the links between climate and society (78.2), requirement for useful climate information (78.3) and establishment of the WCRP (78.4). Then progress in addressing these issues over recent decades is reviewed (78.5) and challenges and opportunities for the future (78.6) and the strategy for the next decade (78.7) are discussed, drawing on the *World Climate Research Programme Strategic Framework 2005–2015* (2005) and the *WCRP Accomplishment Report 2007–2008* (at: <http://wcrp.wmo.in>). Part 78.8 draws some general conclusions and highlights the policy relevance of the WCRP's achievements.

78.2 Climate and Society

Today, climate not only impacts on food and water supplies but it also has major impacts on human health, business, the economy and our society (figure 78.1). While our increasing mastery of technology and exploitation of energy reserves has given us some limited ability to adapt to climate variations and the associated environmental change, the burgeoning population of the world, increasing urbanization and the increasing demand we are making on our environment means that we are also becoming increasingly vulnerable to changes in climate, particularly as felt through extreme events such as floods, droughts, and other climate phenomena. These impacts are felt by the poorest of the poor struggling against drought or floods to the most well off in rich western nations devastated by the impact of events such as temperature extremes, hurricanes and storm surges. Failure to

1 This chapter is a contribution to the CSIRO Climate Change Research Programme and Wealth from Oceans Flagship and was supported by the Australian Government's Cooperative Research Centres Programme through the Antarctic Climate and Ecosystems Cooperative Research Centre. JAC was partly funded by the Australian Climate Change Science Programme. The authors are grateful for the sustained support and sponsorship of WCRP for the past 30 years by the WMO, ICSU and UNESCO/IOC, and for the long-standing voluntary efforts of the scientific community.

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Figure 78.1: Human well-being and local economies are severely affected by droughts and floods. Tropical storms and in particular, the torrential rains and high wind speeds associated with them, cause damage to lives and properties in the order of tens of billions US$ worldwide. **Sources:** Photos clockwise from top left: J. Isaac: <FAO/13702/J.Isaac>; NASA: <www.travelblog.org/Rich>; SanSan Samuel: <www.freedigitalphotos.net/>, J. Barker Free Digital Photo; Texas Forest Service by Jan Amen.

adequately plan for and respond to these climatic changes leaves society vulnerable to the impacts of disasters and conflict, and the associated security risks.

Examples of the sectors critically impacted by climate include:

- *Agriculture* is vital in all parts of the globe and in many developing nations' accounts for over 50 per cent of GDP (World Bank 2008). In 2007, the number of undernourished people was approaching 1 billion. Large changes in productivity occur in response to interannual climate variations. Famine is all too often the result of the deadly combination of drought and war. Exploiting the good years and preparing for the bad years are both important.
- *Potable water* is a critical resource and today about one in six people worldwide, that is 0.9 billion people, lack access to clean water (UNICEF/WHO 2008). Water is also an important as an energy source, the extremes of which in the form of drought and floods also impact on agricultural productivity and the natural environment.
- *Health risk* from vector borne disease such as diarrhoe and malaria from which about 2 million peo-

ple died in 2008 (WHO 2008) is directly related to climate variations and indirectly to climate through availability of food and water. Human health is also impacted by extreme temperatures such as heat waves and cold snaps.

- *Temperature variations* affect the demand for energy for heating and cooling and also affect the efficiency of power plants. Renewable energy from hydro, wind and solar power are all sensitive to climate variations and change.
- *Tourism*, an important industry for developed and developing nations, will only flourish with good weather and climate conditions (UNWTO 2008).
- *The marine environment*, as a major source of protein, a haven for tourists and its role in transport is also directly impacted by climate variability and change (see for example http://www.millenniumassessment.org/en/index.aspx).
- *Civil infrastructure*, in the form of dams, roads, bridges and ports, built to last several decades, is vulnerable to changes in climate on these same time scales.
- *Banking and reinsurance* are impacted by damage from severe weather/climate events such as prolonged droughts or severe floods, temperature extremes and through economic conditions related to climate.
- *The natural environment* is under many sources of stress, with climate variability and change adding significantly to these, leading to desertification and rapid losses in biodiversity (see for example http://www.millenniumassessment.org/en/index.aspx).

Climate phenomena are many and varied. Hundreds of millions of people are affected by the monsoons of South and East Asia, Africa and the Americas. Sudden and severe onset of the monsoon can bring devastating floods and major loss of life. Failure of the monsoons bring drought and famine to millions. El Niño events and the associated droughts and floods affect nations surrounding the Pacific Ocean and more distant parts of the globe.

Perhaps the most important issue of our times is climate change resulting from the burning of fossil fuels. It will have far reaching and long lasting impacts on the natural environment and virtually every aspect of our existence on the Earth. Some aspects of climate change are clear – rising temperatures, changing rainfall patterns and rising sea level. But at what stage should climate change be considered 'dangerous'; for example will we cross a threshold leading to a disintegration of the Greenland and West Antarctic Ice Sheets and a sea-level rise of metres making many people stateless. These impacts are potentially severe, affecting the whole globe, the lives of many millions and even the viability of some nations. Clearly these changes will directly affect human welfare, peace and security, as recognized by the award of the 2007 Nobel Peace Prize to the *Intergovernmental Panel on Climate Change* (IPCC) and Mr Al Gore.

It is becoming increasingly clear that many of these climate variations are felt most acutely through extreme weather events such as heat waves, cold snaps, sustained drought, hurricanes and typhoons. The frequency and intensity of these events are directly related to interannual and decadal variations in climate as well as longer-term changes in climate. Perhaps the clearest example is the intense hurricane activity in the Caribbean region and the southern United States of America in recent years. To understand what is happening to climate and why, and to effectively predict future conditions and their impact, we have to recognize the connection across the time scales from extreme events through seasonal and decadal climate variations to centennial climate change. Similarly, we have to consider the range of space scales; all impacts of climate are local but they occur in a global climate system, with individual events sometimes related to conditions on the far side of the world; climate is a global issue with regional and local consequences.

Today, knowledge of how weather varies and predictions of tomorrow's weather are important to our everyday life and a wide range of businesses. Accurate predictions are critical to avoiding disasters that can occur in response to extreme events. Similarly, knowledge of seasonal to interannual variations in climate, including improved predictions in many regions and sectors, are proving increasingly valuable for agriculture, fisheries, water supply management and in some regions for minimizing the impacts of diseases such as epidemic malaria.[2] Projections of climate change have already had and are continuing to have a huge impact on society. Agreeing to appropriate mitigation and adaptation strategies in response to human induced climate change is a huge challenge for society. Robust climate science is required to respond to this challenge. However, there remains uncertainty in both the

2 See: Palmer/Alessandri/Andersen/Canteloube/Davey/Délécluse/Dequé/Diez/Doblas-Reyes/Fedder-sen/Graham/Gualdi/Guérémy/Hagedorn/Hoshen/Keenlyside/Latif/Lazar/Maisonnave/Marletto/Morse/Orfila/Rogel/Terres/Thomson (2004).

short-term predictions of seasonal climate variations and the long-term projections of climate change, particularly at the regional and local scale where decisions about adaptation are made. Much of our current planning is for developments and infrastructure for the next few decades. On these time scales, both the signal of natural variability of climate and the change of climate in response to changes in greenhouse gas concentrations are important. Demonstrated skill in predicting the natural decadal variability in climate is urgently needed.

If the challenges facing society are to be adequately confronted and overcome, sustainable development is to be accomplished and the United Nation's *Millennium Development Goals* (MDGs) achieved, society urgently needs robust climate science. This requires understanding of what is happening now to our climate, and what will happen over coming seasons, years and decades to centuries. Such information is critical to underpinning peace and security in the world.

There are three major challenges in the climate arena:

- *Improving our prediction of short term climate variability*. This includes improved observations and understanding of climate variability, extending the geographical range and the lead time of useful predictions. Specific issues to address include for example the timing and onset of monsoons, break periods in the monsoons, the next season's and year's rainfall and temperatures.
- *Reducing the uncertainty of projections of climate change, particularly at the regional and local scale*. Society needs robust prediction of how and why present climate is evolving, how phenomena such as the monsoons and *El Niño/Southern Oscillation* (ENSO) will change, how quickly sea level will rise, what long-term changes we are committing future generations to, what climate variations might be termed 'dangerous' and thus what are the appropriate long-term greenhouse gas stabilization levels.
- *Developing the capability to make decadal predictions of climate variations*. On decadal time scales, both natural climate variability and anthropogenic climate change are important. This is a new and developing area.[3]

All of these three challenges are closely related and felt most acutely through extreme events. It is essential to take a holistic view of the climate system if societies' demand for sound climate information is to be satisfied.

An additional and equally important challenge is building two-way communication between the climate science community and the many and varied stakeholders. This communication is required to ensure that progress in the science is exploited for the benefit of society and the environment and to ensure the development of sound international and national climate policy. This policy and societal relevance also provides a greater focus for climate science itself.

78.3 Requirements for Useful Monitoring and Prediction of the Climate System

Climate varies on all time scales, from seasons to years, decades, and a century and longer. Adequately understanding and predicting it requires consideration of the sun, the atmosphere (including its chemical state and both the troposphere and the stratosphere), the hydrosphere, the oceans, the terrestrial regions, the cryosphere, the biosphere and the interactions between all of these spheres and with society.

Monitoring climate and thus knowing how the current state differs from previous climate condition, and why it differs, is in itself valuable for decision making by society. Beyond the time-scale of weather forecasts, the ability to predict climate depends on the behaviour of the parts of the climate system with a longer 'memory' of past conditions (including the oceans, the biosphere, and the cryosphere) and variation in the 'forcing' of climate by both natural and human-induced factors. These 'forcings' include variations in the radiation received from the sun, changes in aerosols in the stratosphere as a result of violent volcanic eruptions, changes in the properties of the land surface as a result of natural variations (for example changes in snow cover) and also human activities (for example deforestation). Perhaps most importantly in recent decades and for the coming century are increases in the concentration of greenhouse gases in the atmosphere that trap some of the outgoing long-wave radiation and thus heat the earth.

Significant advances have been made in quantitative predictions of the climate system over coming

3 Meehl/Goddard/Murphy/Stouffer/Boer/Danabasoglu/Dixon/Giorgetta/Greene/Hawkins/Hegerl/Karoly/Keenlyside/Kimoto/Kirtman/Navarra/Pulwarty/Smith/Stammer/Stockdale (2009).

seasons. These predictions are dependent on the current state of the climate system and thus it is critical to have comprehensive observations if we are to accurately predict climate. Projections of climate on time scales of decades to centuries and longer are less dependent on the initial state of the climate system but they are critically dependent on the evolution of all components of the climate system, including those slowly evolving components. Observations and the understanding of the climate system are critical to the development and testing of models needed to accurately simulate climate on all time scales.

To be valuable, climate predictions need to include uncertainty estimates that can be obtained by performing an ensemble of predictions with slightly different estimates of the climate system at the start of the prediction and/or slightly different model parameters, and by rigorous comparisons with observations. The quantities predicted include the means, trends and statistical characteristics of a large number of quantities that may be of practical use, such as surface temperature, wind, precipitation, atmospheric chemical state, ocean state, soil moisture, snow cover, sea ice, and the state of the El Niño-Southern Oscillation and other climate phenomena. The time-scales for the predictions range from weeks to decades and to the projections of climate change over decades to centuries.

78.4 Recognizing the Need – Establishment of the World Climate Research Programme

The first World Climate Conference in 1979 focussed on the relationship between climate and humankind.[4] The Conference recognized the importance of climate variability, the impact of extreme events and the potential for climate change to impact on all aspects of society. As a result, the Conference called for the establishment of the *World Climate Research Programme* (WCRP) as a principal component of the *World Climate Programme* (WCP). The WCRP was initially (since 1980) sponsored jointly by the *World Meteorological Organization* and the *International Council for Science*. The *Intergovernmental Oceanographic Commission* of UNESCO also established a climate programme in the 1980's. In 1993, these two activities were merged with WCRP, now jointly sponsored by WMO, ICSU and IOC.

A WMO/ICSU/IOC *Joint Scientific Committee* (JSC) is responsible for formulating the overall scientific concepts and goals of the WCRP and for organizing the required international co-ordination of research efforts. The activities of WCRP are organized through a series of projects and working groups and increasingly through integration across the full spectrum of WCRP activities. WCRP is supported by its Joint Planning Staff and the individual projects are supported by International Project Offices.

Since its inception, the two major objectives of the WCRP have been to determine a) the predictability of climate, and b) the effect of human activities on climate. To achieve these objectives, the WCRP promotes and coordinates essential research into understanding the behaviour of the various components of the climate system and their interactions, and their relations to the broader Earth system and the needs of society. Particular foci of WCRP include:

- improving the knowledge and understanding of global and regional climate variability and change, and of the mechanisms responsible;
- assessing the evidence of significant trends in global and regional climates;
- developing and improving numerical models capable of simulating and assessing the predictability of the climate system over a wide range of space and time scales and suitable for operational predictions;
- investigating the sensitivity of the climate system to natural and human-induced change.

These objectives were reaffirmed at the *Conference on the WCRP: Achievements, Benefits and Challenges* in Geneva in August 1997 (WMO 1998), with the immediate research priorities:

- to assess the nature and predictability of seasonal to interdecadal variations of the climate system at global and regional scales, in order to provide the scientific basis for operational predictions of these variations for use in climate services in support of sustainable development;
- to detect climate change and attribute causes, and project the magnitude and rate of human-induced climate change, its regional variations and related sea-level rise, as needed for input to the WMO/UNEP *Intergovernmental Panel on Climate*

4 This conference was organized by the *World Meteorological Organization* (WMO), the *United Nations Educational, Scientific and Cultural Organisation* (UNESCO), the *Food and Agriculture Organisation* (FAO), the *International Council for Science* (ICSU) and the *World Health Organisation* (WHO).

Change (IPCC), the *United Nations Framework Convention on Climate Change* (UNFCCC), and other such Conventions.

WCRP now includes comprehensive investigations of all elements of the physical climate system (atmosphere, hydrosphere, oceans and cryosphere) and in partnership with the *International Geosphere-Biosphere Programme* (IGBP; chap. 77 Noone/ Nobre/ Seitzinger) and other international programmes chemical and biological components of the earth's climate system. WCRP's focus also includes the development of appropriate models for understanding the climate system, the rigorous testing of these models and their experimental use for prediction and projection on longer time scales of the climate system.

A critically important partnership is with the *Global Climate Observing System* (GCOS) and the *Global Earth Observations System of Systems* (GEOSS), to ensure the collection of sustained observations necessary for monitoring climate variability and change, understanding trends, and initializing models for the prediction of climate.

78.5 Addressing the Challenge: Achievements of the World Climate Research Programme

This section offers a brief overview of the achievements of WCRP since its formation.

78.5.1 Seasonal Climate Predictions

A number of centres around the world now produce regular predictions of climate conditions for the coming few seasons as a result of progress by the *WCRP Tropical Ocean-Global Atmosphere* (TOGA) Project (1985-1994) in understanding of tropical Pacific climate anomalies associated with the *El Niño-Southern Oscillation Phenomenon* (ENSO). This was a major breakthrough in climate forecasting and the TOGA project is widely recognized as being the first major success of the WCRP. The two most critical elements of the legacy of TOGA (Anderson/Sarachik/Webster 1998) are:

- An enhanced in situ and satellite observing system in the Pacific Ocean to monitor the evolution of El Niño events and to initialize models, and
- Coupled models capable of assimilating the observed data and providing useful predictions of conditions for the next few seasons in a number of regions of the world.

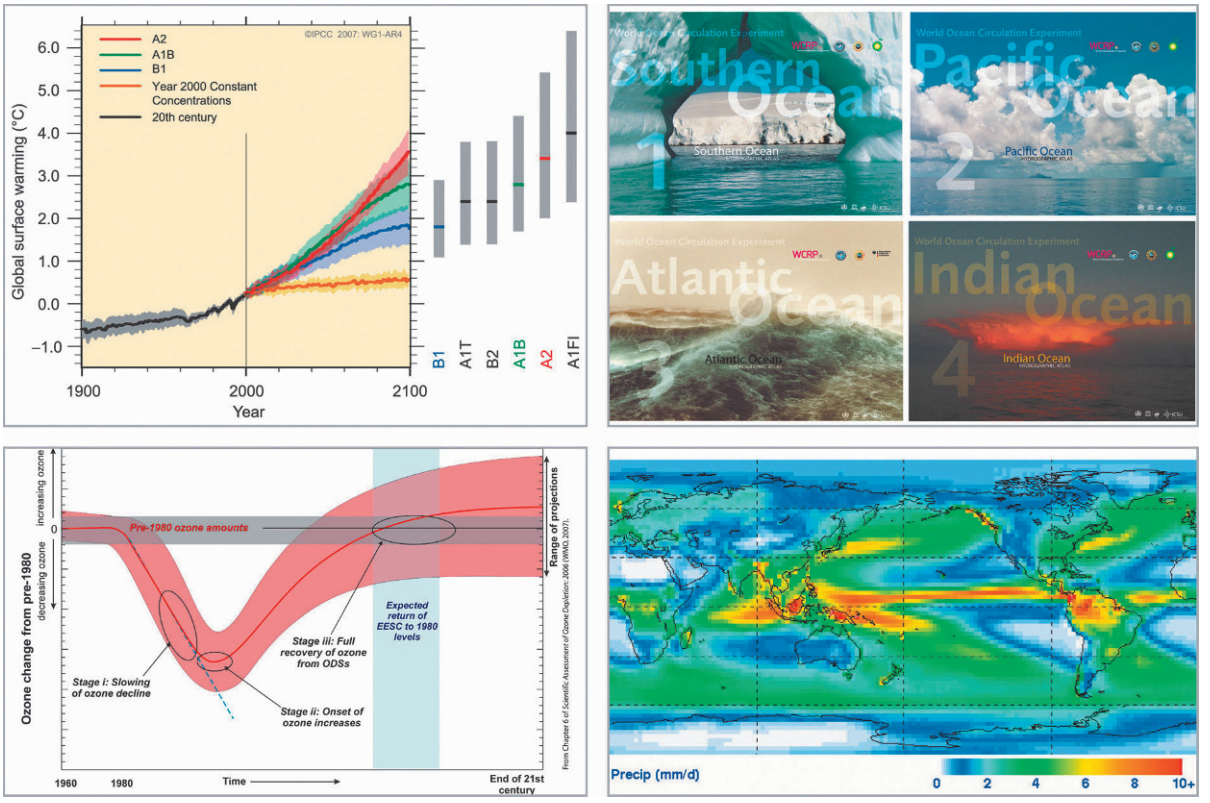
Through ongoing and increasingly integrated efforts of WCRP projects (CLIVAR, GEWEX, ACSYS/CliC, and SPARC), the skill of these models is increasing as the in situ observing systems are extended to other regions, improved satellite observing systems are implemented, greater understanding of associated processes such as the monsoons is achieved and the models are improved. The capability developed by the WCRP and now operational in a number of centres around the world are finding increasing application in a wide range of phenomena (for example minimizing the impact of epidemic malaria[5], and a greater appreciation of their potential is recognized (WCRP 2008d).

78.5.2 Understanding, Observations and Models of the Ocean and Climate

The *World Ocean Circulation Experiment* (WOCE 1990–2002) completed the first set of global observations of the ocean (as documented in a four-volume WOCE Hydrographic Atlas, top right panel of figure 78.2) and thus the first quantitative assessment of the ocean circulation's role in climate. WOCE also developed ocean observing systems (both *in situ* and satellite-borne) and led to improved ocean models that are now proving critical to improved projection of climate variability and change. The WOCE survey established a baseline to assess changes in time and to evaluate anthropogenic effects on the global ocean circulation. In partnership with the *Joint Global Ocean Flux Study* (JGOFS), a CO_2 and tracer chemistry survey was completed allowing robust documentation of the oceanic uptake of CO_2. Developments in float technology during WOCE led to the Argo programme; the global deployment of an array of profiling floats to measure temperature and salinity profiles in the upper 2 km of the ocean. Experimental devices such as gliders have the potential for performing repeat sections in historically difficult to observe regions of the ocean, such as western boundary currents. These developments (particularly Argo) are now central observational components that underpin the development of climate prediction on decadal time scales and

5 See: Palmer/Alessandri/Andersen/Canteloube/Davey/Délécluse/Dequé/Diez/Doblas-Reyes/Fedder-sen/Graham/Gualdi/Guérémy/Hagedorn/Hoshen/Keenlyside/Latif/Lazar/Maisonnave/Marletto/Mor-se/Orfila/Rogel/Terres/Thomson (2004).

Figure 78.2: Illustrative examples of WCRP accomplishments. Clockwise from top left: Projection of global averaged temperature for the 21st century as prepared for the IPCC AR4 using the WCRP *Coupled Model Intercomparison Project* results (IPCC 2007); The four ocean atlases produced by the WCRP *World Ocean Circulation Experiment*; Average global precipitation for 1979-2005 in mm per day (figure prepared by the WCRP-GEWEX Global Precipitation Climatology Project); Schematic observed and predicted evolution of global ozone (UNEP/WMO Scientific Assessment of Ozone Depletion: WMO 2006).



are critical in reducing uncertainties in the projection of climate change. The results are documented in almost 1800 refereed publications and summarized in Siedler, Church and Gould (2001). Much remains to be done in the exploitation of WOCE observations and in the further development of schemes to assimilate data into ocean models. These aspects of ocean research and model development are now being incorporated, as planned, into the WCRP *Climate Variability and Predictability* (CLIVAR) project, a successor to the TOGA and WOCE projects.

78.5.3 Snow, Ice, Frozen Ground and Climate

As demonstrated by the dramatic reduction in sea ice over the past few years, the Arctic region is both important for its role in climate and as a sensitive indicator of the impacts of climate change – how delicately balanced is the Arctic climate system? What is its role in global climate change? The achievements of the WCRP *Arctic Climate System Study* (ACSYS) Project provided: a basis for improved numerical simulations and reanalysis studies of the complex system involving polar atmosphere, oceans, sea-ice, and land; active development of an Arctic observing system, declassification of submarine sea-ice observations, generation of new satellite products, and collection and upgrading of circumpolar data sets; intercomparison projects which have led to advances in modelling of the polar environment and created a better basis for projections of amplified impact of the climate change in the polar region (an important aspect of the IPCC assessments). These studies have now been extended world wide to include considerations of all aspects of the cryosphere (ice, snow, frozen land) through the ongoing WCRP *Climate and Cryosphere* (CliC) Project. An important example of which is the need for improved understanding of ice-sheet dynamics and the stability of the Greenland and Antarctic ice sheets in order to understand better the potential for extreme sea-level rise.

78.5.4 The Global Water Cycle

Water is a critical resource globally, especially in certain regions. Its representation in models is critical to reliable predictions of fresh water quantity, quality and distribution. Understanding its movement and recycling around the globe is a central focus of the ongoing WCRP *Global Energy and Water Cycle Experiment* (GEWEX) project. Accomplishments of GEWEX include global datasets of clouds, precipitation (bottom right panel of figure 78.2), water vapour, surface radiation, and aerosols which have provided new insights about seasonal, interannual and regional variability of fresh water. These data sets have underpinned implementation of improved representation of the land-surface and clouds in climate models and improved prediction of precipitation in many regional and global weather forecasting and climate models. On a regional scale, GEWEX scientists are making significant progress towards the full understanding of the regional water and energy budgets and are helping determine the importance of these processes for regional predictions of climate, thus enabling the comprehensive modelling and evaluation of the components of the water/energy cycle over large river basins.

78.5.5 The Stratosphere and Climate and Ozone

Trends in stratospheric temperature, vertical distribution of ozone, and upper tropospheric and stratospheric water vapour and their representation in models are an important focus of the ongoing WCRP *Stratospheric Processes and their Role in Climate* (SPARC) project and an important element of climate change.[6] WCRP SPARC has made major contributions to the WMO/UNEP assessments of ozone depletion and IPCC climate assessments (lower left panel of figure 78.2), and is now working with the *International Geosphere-Biosphere Programme* (IGBP; chap 77 by Noone/Nobre/Seitzinger) to significantly improve our knowledge of the representation of atmospheric chemistry and aerosols in the models that will be used for weather forecasting and climate prediction. These efforts thus continue to support the Ozone and IPCC Climate Change Assessments.

6 See: Ramaswamy/Chanin/Angell/Barnett/Gaffen/Gelman/Keckhut/Koshelkov/Labitzke/Lin/O'Neill/Nash/Randel/Rood/Shine/Shiotani/Swinbank (2001).

78.5.6 Climate Change Detection, Attribution and Projection

The vast majority of the results assessed by the IPCC Working Group I in its successive reports are based on observations, research and model projections organized and coordinated by the WCRP and the vast majority of authors are closely associated with WCRP. Indeed without the model simulations coordinated by the WCRP there would be no climate change projections (top left panel of figure 78.2). Such WCRP coordinated results are the basis of key conclusions of successive IPCC scientific assessments such as the 4th Assessment Report (AR4) conclusions in 2007: "Warming of the climate system is unequivocal" and "Most of the observed increase in global average temperatures since the mid-20th century is *very* likely due to the observed increase in anthropogenic greenhouse gas concentrations."

Improved understanding of key climate processes by WCRP has led to significantly improved climate and operational weather and ocean forecasting models. WCRP's working groups have co-ordinated data analyses and climate model simulations that are the basis for our understanding of natural climate variability. In particular, improved modelling of the coupled physical climate system through systematic model diagnoses and intercomparisons has provided increasingly accurate simulations and predictions of natural climate variations, reducing uncertainty in their projections of human-induced climate change. In turn, the IPCC assessments provide the most authoritative, up-to-date scientific advice needed to inform the *United Nations Framework Convention on Climate Change* (UNFCCC). In this way, WCRP has helped provide the direct policy-neutral scientific underpinning of the political process. WCRP will continue to play an important role in helping to provide increasingly reliable climate change scenarios and making them (and their likely consequences) immediately available to decision makers, the media and the general public. These are critical contributions to deliberations on sustainable development, formulating mitigation and adaptation strategies, and managing the risks associated with climate variability and change on all sectors of the global environment and economy.

78.5.7 Global Climate Data Sets

Comprehensive climate observations are essential to climate prediction. Knowing how climate is changing underpins many societal needs. Provision of essential

global and regional climate observations are major components of all WCRP projects. Some of these have evolved into new operational climate observations and data-collection systems. In particular: the buoy array in the tropical Pacific is crucial for monitoring and for initializing model predictions of ENSO events; systematic observations of the ocean's three-dimensional structure, combined with satellite altimetry have provided the basis for establishing key elements of a *Global Ocean Observing System* (GOOS) and, in turn, also the *Global Climate Observing System* (GCOS). Indeed, the worldwide network of operational ocean profiling floats (The Argo Project) is a direct outgrowth from the global array of subsurface floats that was established in WOCE. The TOGA and WOCE projects established a solid foundation for the operational oceanography of today, and tomorrow.

78.5.8 Historical Atmospheric and Oceanic Conditions

Modern atmospheric and oceanic models can be used to assemble comprehensive estimates of past conditions from the relatively sparse historical data sets. These estimates (called *reanalyses*) are important in understanding climate variations and change. WCRP has provided strong support for the initiation and execution of atmospheric reanalysis projects and such activities are now well established. Oceanic reanalyses have started in the last decade as a result of the WOCE and CLIVAR projects and will become increasingly important. These activities are a major outgrowth of the Third WCRP-sponsored *International Conference on Reanalysis* held in Tokyo, Japan, in January 2008 (WCRP 2008c).

78.5.9 Capacity Building

WCRP has enabled scientists from countries with less developed scientific programmes to contribute to the global programme and to build up their research capability. The global change *System for Analysis, Research and Training* (START) has been established by the *International Geosphere-Biosphere Programme* (IGBP), the *International Human Dimensions Programme on Global Environmental Change* (IHDP, chap. 75 by von Falkenhayn/Rechkemmer/Young), and WCRP, to foster capacity building activities in developing countries, and thereby help them to become partners in international global change research. WCRP also benefits greatly from its partnership with regional networks such as the *Asia-Pacific Network* (APN) and the *Inter-American Research Institute* (IAI) to strengthen further its capacity building activities.

78.6 Challenges and Opportunities

The progress that WCRP has made in understanding the earth's climate system during the past 30 years and technological developments (in observations, computers and information systems, and telecommunication delivery mechanisms such as the internet) are enhancing our capability to serve increasingly greater segments of world society. This, coupled with the ever-increasing demand for reliable climate predictions and related products and services to establish policies to safeguard life and property and to better manage climate-sensitive natural resources and human developed systems and sectors, provides exciting new challenges and opportunities for WCRP. The challenges include:

- *Moving from daily/weekly weather forecasts to monthly, seasonal and longer-time climate prediction.* There is now a blurring of the distinction between shorter-term predictions and longer-term climate change projections and an increasing interest in demand for climate predictions for the next decade. These predictions will require knowledge of the current observed state of the climate system, particularly of the oceans, cryosphere, and land surface (including soil moisture, vegetation, etc.). Centennial climate projections also depend on scenarios for anthropogenic influence on the climate system and other factors, such as changes in the sun and volcanic eruptions which are not predictable but can be immediately taken into account as observed. The shorter time-scales and weather are important in influencing the longer-time-scale behaviour and the regional impacts of longer-term changes will be felt by society most acutely through changes in the shorter time-scale variability, including extreme events. As a result, and to obtain the information necessary for adaptation at the regional and local scale, climate models are being run with the highest possible spatial resolutions, resolutions that were employed in the best weather forecast models only a few years ago.
- *Environmental prediction and services.* The detailed physical prediction models of the coupled atmosphere, ocean and land system developed and used within WCRP are increasingly being extended to include atmospheric chemistry, the car-

bon cycle including evolving vegetation, and interactive marine ecosystems. It can be expected that full coupling with additional components of the Earth system will sometimes lead to quite different behaviour, as has been found for coupled ocean-atmosphere models.

- *Predictability of the climate/Earth system.* An important underpinning of the progress in weather forecasting has been the development of chaos theory and the notions of predictability. An essential aspect of the move to making predictions of the broader climate/Earth system is to further develop these ideas to provide a firm foundation, giving ideas on what predictions to attempt and what techniques to use. The possibility that the increasing breadth of models may lead to compounding the uncertainties in them, and therefore increasing the uncertainty in model predictions, provides a challenge that will require new theoretical and observational approaches.
- *Analysis of climate system behaviour.* There is a continuing and urgent need to analyse the behaviour of the climate system, assess what has occurred, define anomalies and trends in the climate system, and determine the extent to which these can be attributed to human activity or to natural variation.
- *Application of WCRP science to socio-economic problems and demonstration of the usefulness of WCRP-enabled analysis and predictions.* There is increasing use of weather and climate information and prediction services and products on the time-scale of weeks to seasons, but much more work is needed to improve these products. For longer time-scales, the IPCC requires the best possible climate science and climate projections to provide the scientific basis for its periodic assessments and hence its advice to the Parties to the UNFCCC. Most impacts of climate change depend on its regional manifestation and there is great political and social demand for more confidence in assessments and predictions at regional and local scales.

The following developments mean that there is now a real opportunity to meet the above challenges and deliver vastly improved products to the wide range of stake-holders.

- *New and increasing data streams*. Enormous quantities of data are available from the environmental satellites (upper left panel of figure 78.3) already launched or planned. Also, the Argo system of ocean profiling floats (lower left panel of figure 78.3), developed under WCRP projects is becoming an increasingly important source of oceanographic data and an integral part of a developing ocean observing system for climate. These and other *in situ* data are being integrated under the framework of the *Global Earth Observation System of Systems* (GEOSS), in order to optimize information products and services. They must be turned into quality-controlled climate data sets, requiring continuing pressure for observational data of climate quality and the continuous knowledge of data calibrations. Adhering to uniform international standards must be maintained as the observing system evolves.
- *The growth and availability of computing power.* The computing power becoming available (lower right panel of figure 78.3) means that in the future there will be an ability to run global models with resolution of a few kilometres (as required for many practical applications), very large model ensembles to assess uncertainty, simulations of paleoclimates with fully coupled global climate models, and, increasingly, highly-resolved regional models in response to the demand to develop adaptation policies and measures at the regional level.
- *An increase in the number of groups using global models*. As a result of greater and heightened attention to climate issues, there are now more groups capable of running climate models thus allowing the use of multi-model ensembles to overcome systematic deficiencies in single-model ensembles. This also increases the necessity to document the variety of model performance and understand the reasons for it.
- *The increasing complexity and realism of climate models.* High-resolution models including detailed physical parametrizations, cloud-resolving capabilities, and other detailed representations of relevant climate processes are being developed.
- *Modern data assimilation techniques applied to the Earth system models*. Numerical weather prediction has shown that maximum value can be obtained from the various streams of data by analysing them together in prediction models that are sufficiently accurate. This framework allows optimal state assessment based on past as well as present data. In the process, valuable information on model deficiencies can be obtained. Such data assimilation will increasingly be possible for the components of the coupled climate system and for the wider Earth system.

Figure 78.3: Satellite observations and in situ measurements taken in the ocean, the atmosphere and on land provide the basis for weather forecasts and climate predictions. The vast amount of observations collected on a daily basis is processed and then assimilated into models using the new generation of powerful computers. Training seminars in different parts of the world make sure that the users and decision makers properly understand and interpret the climate information products, and that the scientists receive feedback on the usefulness of their products and the users' needs. Images (top left to bottom right). **Sources:** ESA; Argo; www.ISRIC.org/V. van EngelenSOTER; JAMSTEC Earth Simulator Center.

78.7 Delivering on the Promise: The Future Strategy of the World Climate Research Programme

The WCRP has recognized the need to refocus its activities towards its original two aims and respond to the increasing demands of policy-makers and society for accurate and reliable climate predictions. As a result, WCRP developed its *Strategic Framework 2005–2015, Coordinated Observation and Prediction of the Earth System*. The aim of this WCRP Strategic Framework is: "To facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society" (at: <http://wcrp.wmo.in>).

This aim builds on the two overall objectives of WCRP that have guided its scientific activities for the past 30 years to deliver the best available state of knowledge on climate variability and change to decisions makers, in a manner consistent with the challenges/opportunities associated with the prediction of weather and climate across all time and space scales.

To meet this objective and to fulfil the existing and emerging societal needs for the best available knowledge of climate variability and change WCRP must focus its activities and partnership on five critical elements: 1) enhance understanding of the earth's climate system including the complex interactions among the major components (i.e. atmosphere, oceans, continents including the polar regions), and human activities, across the full spectrum of space and time scales; 2) support the continuity and innovation in observing systems to capture, document and analyse the state of the climate system; 3) exploit the resulting observations/information in conjunction

with climate models to predict and project earth's future climate; 4) enable the development of a climate information system to serve both the providers and users of observations and information in a timely and effective manner; and 5) establish a global network of experts (upper right panel of figure 78.3) to take full advantage of these capabilities to develop the best knowledge of the climate system for use by global, regional and local decision makers.

The focus is on developing mitigation and adaptation policies, strategies and solutions for managing the risks and opportunities associated with climate variability and change on major economic sectors (e.g. agriculture and food, water resources, energy and transportation, health and leisure, etc.). Some of these elements and/or their major components may exist today, but equally important is their integration and management as a continuum of activities to ensure efficient and timely delivery of the intended climate services to society in an effective and efficient manner. Such an approach will help shorten significantly the transition time from research and development to operations and services, thus meeting the emerging societal needs more efficiently. In short, developing a set of governance and operational principles is as important as the scientific and technical challenges associated with building and operating the climate information system.

The WCRP Strategic Framework facilitates addressing of these five elements by:

- integrating across the breadth of WCRP's projects and their activities;
- addressing the new challenges;
- regularly reviewing and assessing progress towards achieving the WCRP aims;
- identifying the emerging scientific objectives/priorities and addressing them in a timely manner;
- guiding existing and stimulating new scientific activities within WCRP; and
- increasing recognition and visibility for the scientific and societal relevance and importance of WCRP results and their impact.

Partnerships are essential to the successful development and implementation of the climate information system. The broadening of WCRP interest in climate/Earth system studies is necessary for climate prediction and projection and implies the need for continued and strengthened collaboration with the *International Geosphere-Biosphere Programme* (IGBP), The *International Human Dimensions Programme* (IHDP), *DIVSERSITAS* (a biodiversity programme) and with the *Earth System Science Partnership* (ESSP) as a whole. The seamless nature of the prediction problem and of many of its applications implies that close collaboration and coordination are also needed with the WMO *World Weather Research Programme* and its projects such as THORPEX. Ensuring that WCRP-developed scientific knowledge is used in an appropriate and timely fashion for an increasing number of practical applications also requires close collaboration with the other principal components of the WMO World Climate and Water Programmes, and their network of providers and users of climate information, e.g *Regional Climate Outlook Forum* (RCOFs) and *Regional Climate Centres* (RCCs).

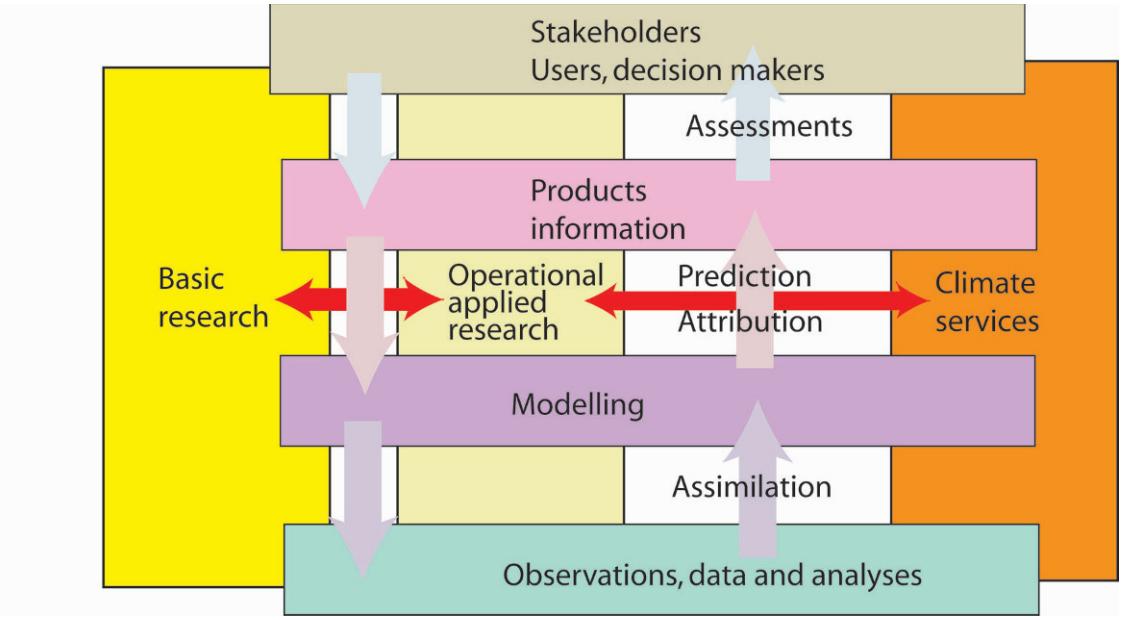
WCRP has taken a number of steps towards building the climate information system and network of experts with the aim to provide the best knowledge and information on climate variability and change to existing and emerging users of such information for decision making. These include:

- Before the *Fourth Assessment Report* (IPCC AR4) was completed, the WCRP in conjunction with IGBP had begun design of the set of model simulations that will underpin the climate change projections of the next IPCC report (Hibbard/ Meehl/ Cox/Friedlingstein 2007).
- Initiated a new field of climate science to provide the first ever coordinated set of decadal climate predictions.[7]
- With the *Global Climate Observing System* (GCOS) and the *International Geosphere-Biosphere Programme* (IGBP), the WCRP identified the key areas of scientific uncertainties in the AR4 (IPCC 2007) that need to be addressed by the climate observation and research communities during preparations for the Fifth IPCC Assessment Report.[8]
- With the *World Weather Research Programme* (WWRP) and the IGBP, the WCRP convened the *World Modelling Summit for Climate Prediction*. This summit made a clear statement calling for a revolution in climate prediction, requiring vastly

7 Meehl/Goddard/Murphy/Stouffer/Boer/Danabasoglu/Dixon/Giorgetta/Greene/Hawkins/Hegerl/Karoly/Keenlyside/Kimoto/Kirtman/Navarra/Pulwarty/Smith/Stammer/Stockdale (2009)

8 See: WCRP (2008a); Doherty/Bojinski/Henderson-Sellers/Noone/Goodrich/Bindoff/Church/Hibbard/Karl/Kajfez-Bogataj/Lynch/Parker/Prentice/Ramaswamy/Saunders/Simmons/Stafford/Smith/Stef-fen/Stocker/Thorne/Trenberth/Verstraete/Zwiers (2009).

Figure 78.4: A schematic of the flow of the climate information system, as basic research feeds into, and responds to the needs of, applied and operational research and the development of climate services. The system is built on the climate observing system that includes the analysis and assimilation of data using models to produce analyses and fields for initializing models; the use of models for attribution and prediction, and with all the information assessed and assembled into products and information that is disseminated to users. The users in turn provide feedback on their needs and how to improve information. **Source:** This figure was developed by K. Trenberth (2008: 18) and slightly modified by G. Asrar.



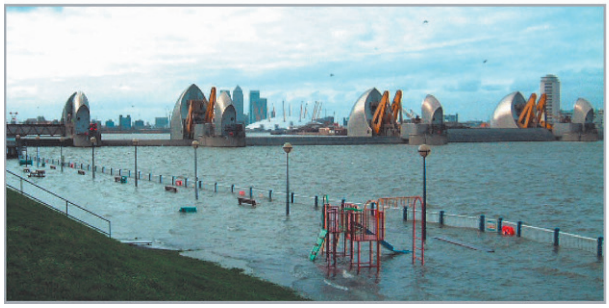
increased computing resources and appropriate personnel to develop further climate system models and verify their accuracy and adequacy, (Shukla/Hagedorn/Hoskins/Kinter/Marotzke/Miller/Palmer/Slingo 2009; Heffernan 2008). The resources required for such a Climate Prediction Project are small compared with the very large sums that will be required to develop solutions based on adapting to and mitigating the impacts of climate variability and change on aspects of our daily life, globally.

- Developed a series of cross cutting initiatives within WCRP to address critical and complex issues with tremendous societal impacts, including improved seasonal predictions (WCRP 2008b), the initiation of decadal predictions as referred to above, narrowing uncertainty regarding sea-level rise[9]; greater coordination of monsoon research activities in Asia, America, Africa and elsewhere; consideration of how to more effectively address the frequency and intensity of extreme events.
- Provided scientific expertise to, and coordinated research projects of the *International Polar Year*, leading to the agreement to establish a *Global Cryospheric Watch*.
- Established (for the first time and based on the need identified by the UNFCC, IPCC and WCRP constituencies) a *Regional Climate Modelling and Downscaling Task Group* to help with identifying scientific and technical foci for WCRP activities during the next decades.
- With the *International Geosphere-Biosphere Programme* undertaking a joint activity to significantly improve the representation of atmospheric chemistry and aerosols and cycling of carbon in the climate system models that will be used in future IPCC assessments.

The *Third World Climate Conference* (WCC-3) occurred in September 2009, 30 years after the first one. It is now the right time to propose and promote establishing a *Global Climate Information System* (figure 78.4). Such a system undoubtedly depends on the major components of observing systems that have been developed through international coordination and cooperation (e.g. *Global Climate Observing System*, etc.) and those under development. It must also

9 See WCRP (2006); Church/White/Aarup/Wilson/Woodworth/Domingues/Hunter/Lambeck (2008); Church/Woodworth/Aarup/Wilson (2009).

Figure 78.5: Climate adaptation solutions (clockwise from top left): A water reservoir in Africa; flood bunker in Bangladesh for protection during storm surges; water management and irrigation in China; flood prevention at the Thames barrier. **Sources:** <Treehuggerwww. PlayPumps.org>; International Federation of Red Cross and Red Crescent Societies (IFRC); UK Environment Agency; <www.WIKIMEDIA.org by J. Gao>.



take full advantage of the information management systems developed during the past 20 years, and the network of national and international global change research programmes, such as WCRP. However, to meet the challenges and opportunities identified earlier, operation and governance associated with this system must consider all components of the information system to be of equal importance and manage the two-way flow of information and decisions as a continuum. This implies that a weak link in this continuum will impact on the effectiveness of the system as a whole in capturing the required observations upstream and the timely delivery of required information to decision makers downstream. Another critical component of the system is an effective two-way communication between the climate science community and the rapidly growing user community and other stakeholders who are dependent on climate information. A number of examples of such operational Climate Information Systems are now being considered and implemented in several nations.

One very good example for the use of this system is the existing *UN Framework Convention on Climate Change* (UNFCCC) that has been in place for more than 20 years and is attempting to enable nations from around the world to develop environmental policies based on the best available scientific assessments. While there are many options for adaptation to the impacts of climate variability and change (figure 78.5), if these options are to be effective they all need to be supported by sound climate information (understanding, monitoring and robust predictions) and effective communication of that information to users and stakeholders.

78.8 Conclusions and the Science Policy Interface

WCRP has played a key role in encouraging and coordinating the very best of climate science that society needs to meet the challenges of *global environmental change* (GEC) and bringing this information to the attention of policy-makers and the public.

It was the international community of physical climate scientists that alerted the world to the reality of global warming, the prospect of anthropogenic climate change and its consequences. It is this same community that has determined the most likely causes of the recent global climate change and which has the capability to provide increasingly reliable climate change scenarios, which are crucial for many aspects related to planning for sustainable development.

Through the IPCC Assessments, WCRP has helped bring such climate-related issues to centre-stage by carrying out policy-relevant science and raising the level of scientific, governmental and public appreciation of the importance of climate issues, through fostering much greater cooperation between hitherto distinct scientific disciplines in understanding the whole climate system. As reviewed above, the vast majority of the results assessed by the IPCC Working Group I in its successive reports are based on research and model projections organized and coordinated by the WCRP and the vast majority of authors are closely associated with WCRP. Indeed without the model simulations coordinated by the WCRP there would be no climate change projections. Such WCRP coordinated results are the basis of key conclusions of successive IPCC scientific assessments such as the *4th Assessment Report* (AR4) conclusions (IPCC 2007). In turn, the IPCC assessments provide the most authoritative, up-to-date scientific advice needed to inform the UNFCCC. In this way, the WCRP has helped provide the direct policy-neutral scientific underpinning of the political process. In recent years, the WCRP, together with the *Earth System Science Partnership* (ESSP; chap. 74 by Leemans/Rice/Henderson-Sellers/Noone), has developed a dialogue directly with the Parties to the *United Nations Framework Convention on Climate Change* (UNFCCC). Similarly the work of the WCRP is directly relevant to the WMO/UNEP Ozone assessments, the UN *Convention on Biological Diversity* (CBD), the *Millennium Ecosystem Assessment* (MA), and the *UN Convention to Combat Desertification* (UNCCD) and of course directly underpins the achievement of a number of the UN's Millennium Development Goals (MDGs).

The WCRP will continue to play an important role in helping to provide increasingly reliable climate information and making them (and their likely consequences) available to decision-makers, the media and the general public. These are critical contributions to deliberations on sustainable development, formulating mitigation and adaptation strategies, and managing the risks associated with climate variability and change on all sectors of the global economy.

A critical further step is the development of a global climate information system that can capture the best available observations, climate system projections, and the expertise of the best minds from around the world to translate the available knowledge into a form and format that is useful to decision-makers. Providing easy and timely access to such information is the best gift that we can offer our generation, our children and those who will follow them. Such a system would be significant contribution to achieving the UN's *Millenium Development Goals* (MDGs) and responding to the threats, challenges, vulnerabilities and risks of global environmental change. This is indeed what the world expects from WCRP and its scientists and partners.

79 Key IPCC Conclusions on Climate Change Impacts and Adaptations

Martin Parry, Osvaldo Canziani, Jean Palutikof and Clair Hanson

79.1 Introduction

The IPCC Fourth Assessment on *Climate Change 2007: Impacts, Adaptation and Vulnerability* (IPCC 2007A) addressed three main issues: a) impacts of climate change which are observable now; b) future effects of climate change on different sectors and regions; and c) responses to such effects. The assessment included 12 key messages, which are summarized here.

79.1.1 Impacts of Climate Change are Occurring Now

A new development in the *IPCC's Fourth Assessment* (AR4) was the introduction of a chapter dedicated to observed and measurable impacts. The author team of this chapter examined more than 29,000 environmental data series and found that 89 per cent of these exhibited trends are consistent with warming. Most of the available data are terrestrial, rather than oceanic, and are concentrated in Europe and North America, leading to difficulties in drawing a global picture. Nevertheless, the conclusion is that natural systems around the world are being affected by regional climate changes, particularly temperature increases, and that these temperature increases are very likely to be the result of anthropogenic emissions *of greenhouse gases* (GHG).[1]

Most evident are reductions in snow, ice and frozen ground, which, in turn, are leading to enlargement and increased numbers of glacial lakes, and increased ground instability in permafrost and mountain regions. Although the greatest reduction in ice extent has occurred in the Arctic, some of the most obvious has been in tropical mountain environments, such as on Mt. Kilimanjaro, Kenya (figure 79.1).[2]

There is extensive evidence that recent warming is strongly affecting terrestrial biological systems, including such changes as earlier timing of spring events (e.g., leaf unfolding, bird migration and egg laying; and shifts in ranges of plant and animal species). In the oceans, and mainly at high latitudes, we can currently observe shifts in ranges and abundance of algae, plankton and fish.[3]

Probably the most important effect of GHG emissions is in the oceans, which have become increasingly acidic as *carbon dioxide* (CO_2) is absorbed by water to become carbonic acid. So far, we have recorded an average pH reduction of 0.1. Increasing acidity is expected to have major effects on shell-forming organisms, but research on this is in its infancy.[4]

Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic trends such as land-use change. These include earlier spring planting of crops, increase in forest fires in northern high latitudes and warmer and drier conditions in the Sahel, leading to a reduced length of growing season.[5]

1 See Rosenzweig/Casassa/Karoly/Imeson/Liu/Menzel/Rawlins/Root/Seguin/Tryjanowski (2007), section 1.4

2 See Cullen/Mölg/Kaser/Hussein/Steffen/Hardy (2006) and Rosenzweig/Casassa/Karoly/Imeson/Liu/ Menzel/Rawlins/Root/Seguin/Tryjanowski (2007), section 1.3.

3 See for example Sparks/Menzel (2002); Walther/Post/Convey/Menzel/Parmesan/Beebee/Fromentin/ Hoegh-Guldberg/Bairlein (2002); Menzel (2003); Parmesan/Yohe (2003); Root/Price/Hall/Schneider/Rosenzweig/Pounds (2003); Lehikoinen/Sparks/Zalakevicius (2004); Walther (2004); Rosenzweig/Casassa/Karoly/Imeson/Liu/Menzel/Rawlins/Root/Seguin/Tryjanowski (2007).

4 See Bindoff/Willebrand/Artale/Cazenave/Gregory/Gulev/Hanawa/Le Quere/Levitus/Nojiri/Shum/Talley/Unnikrishnan (2007) and Trenberth/Jones/Ambenje/Bojariu/Easterling/Klein Tank/Parker/Renwick/Rahimzadeh/Rusticucci/Soden/Zhai (2007).

5 See Ben Mohamed/Duivenbooden/Abdoussallam (2002); Hafner (2003); Benoit/Torre (2004); Chmielewski/Muller/Bruns (2004); Sauphanor/Bolvin (2004); Hilden/Lethtonen/Barlund/Hakala/Kaukoranta/Tattari (2005).

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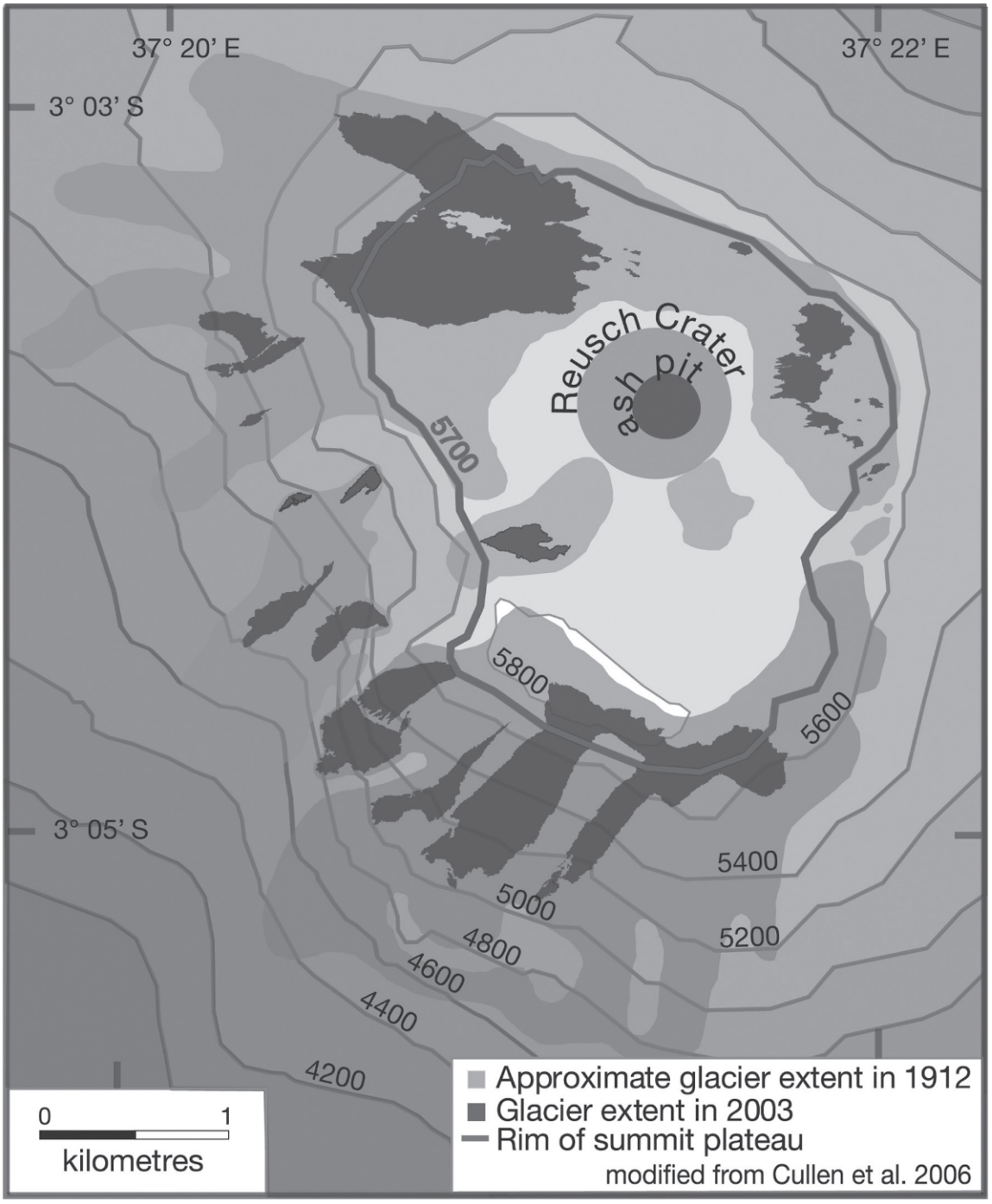
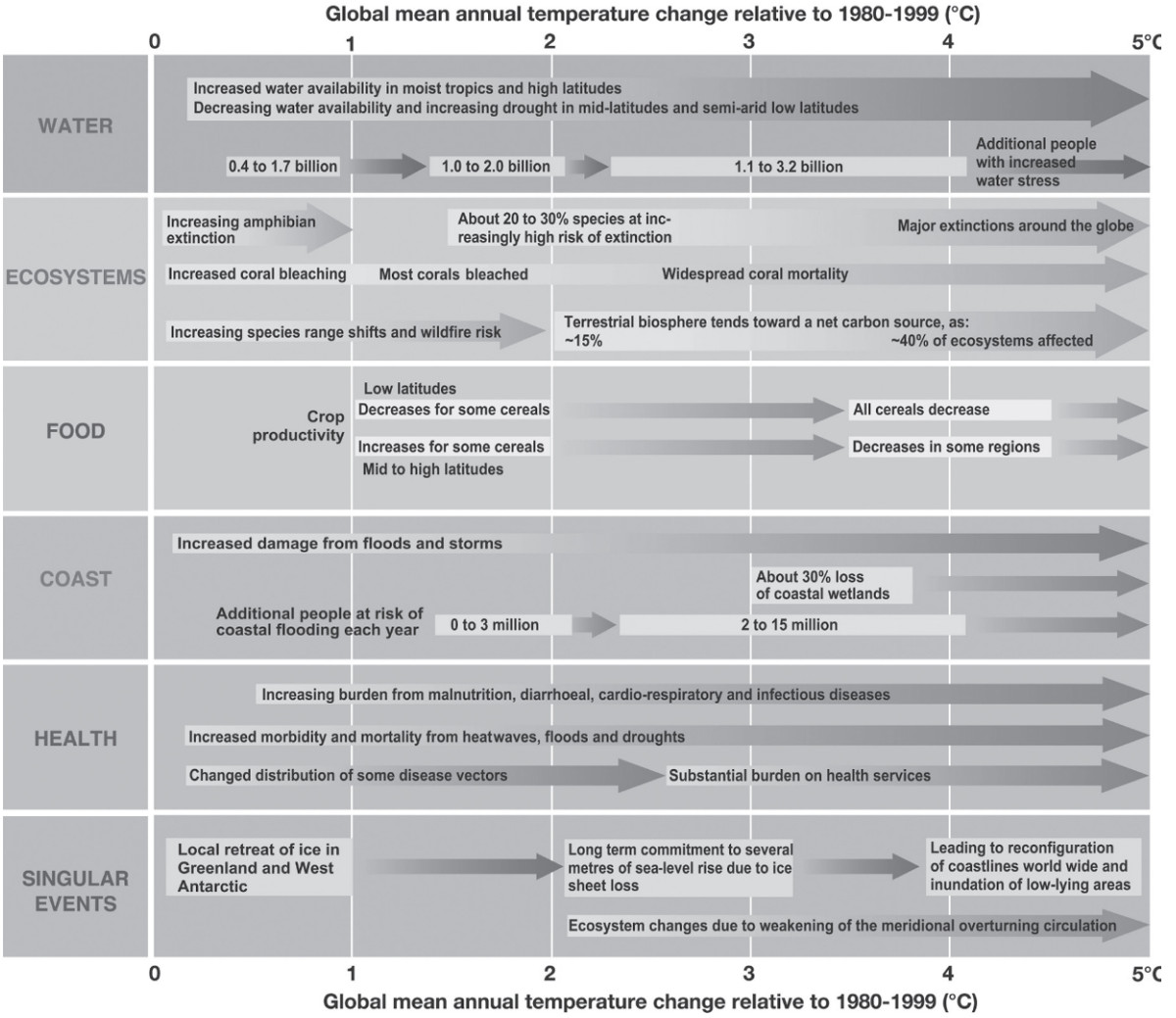
Figure 79.1: Change in glacier extent on Mt. Kilimanjaro (1912-2003). **Source:** IPCC (2007a: 440; modified from Cullen/Mölg/Kaser/Hussein/Steffen/Hardy 2006).



79.2 Key Impacts on the Most Vulnerable Places

Since the IPCC's Third Assessment (2001), many additional studies, particularly in regions that previously had been little researched, have enabled a more systematic understanding of how the timing and magnitude of impacts are likely to be affected by changes in climate and sea level associated with differing amounts and rates of change in global average tem-

Figure 79.2: Global impacts projected for changes in climate (and sea level and atmospheric carbon dioxide where relevant) associated with different amounts of global average surface temperature change in the 21st century. **Source:** IPCC (2007a: 66, Technical Summary).



perature.[6] The main conclusions regarding these impacts are summarized in figures 79.2 and 79.3.

From this assessment, the IPCC author team identified those systems (freshwater resources, management; ecosystems, properties, goods, services; food, fibre, forest products), sectors (industry, settlement, society; human health) and regions (Africa, Asia, Australia, Europe, Latin America, North America, Polar Regions, Small Islands) most likely to be especially affected by climate change.

The most vulnerable systems and sectors are:

- Some ecosystems, especially tundra, boreal forest, mountain, Mediterranean-type ecosystems, mangroves and salt marshes, coral reefs and sea ice biomes;
- Low-lying coasts, due to the threat of sea-level rise;
- Water resources in low-latitude regions, due to decreases in rainfall and higher rates of evapotranspiration;
- Agriculture in low-latitude regions, due to reduced water availability; and
- Human health, especially in areas with low adaptive capacity.

79.2.1 Case Study on Europe

Taking the European region as an example, to illustrate the points above, Europe's natural systems and biodiversity will be substantially affected by climate change. Sea-level rise is likely to cause inland migration of beaches and loss of up to 20 per cent of

coastal wetlands, reducing habitat availability for species that forage or breed in these areas (Nicholls 2004). Many ephemeral aquatic ecosystems in the Mediterranean are expected to disappear, and permanent ones become ephemeral (Alvarez Cobelas/Catalán/García de Jalón 2005). The northward expansion of forests is projected to reduce current tundra areas under some scenarios (White/Cannel/Friend 2000) and mountain communities face up to a 60 per cent loss of species under the SRES A1 scenario by 2080 (Thuiller/Lavorel/Araújo/Sykes/Prentice 2005). A large percentage of the European flora is likely to become vulnerable, endangered or committed to extinction by the end of the century (Thuiller/Lavorel/Araújo/Sykes/Prentice 2005). By the 2020's, increases are likely in winter floods in maritime regions and flash floods throughout Europe (Alcamo/Flörke/Märker 2007). Coastal flooding related to increased storminess and sea-level rise is likely to threaten an additional 1.6 million people annually by the 2080's (Nicholls 2004). Warmer, drier conditions will lead to more frequent and prolonged droughts as well as a longer fire season and increased fire risk, particularly in the Mediterranean region.[7] Water stress is likely to increase over central and southern Europe (river flow is expected to decrease by up to 50 per cent and 80 per cent, respectively in some rivers) (Santos/Forbes/Moita 2002; Alcamo/Flörke/Märker 2007). This has subsequent negative effects for the hydropower potential of Europe which is expected to decline on average by 6 per cent (around 20–50 per cent for the Mediterranean region by the 2070's) (Alcamo/Moreno/Nováky/Bindi/Corobov/Devoy/Giannakopoulos/Martin/Olesen/Shvidenko 2007). Crop pro-ductivity is likely to change with increases in the north and decreases in the Mediterranean region due to changes in temperature and precipitation (Alcamo Moreno/Nováky/Bindi/Corobov/Devoy/Giannakopoulos/Martin/Olesen/Shvidenko 2007). For human health, although there may be some health benefits from climate change for the European region, such as reduced cold-related mortality due to increased winter temperatures, on balance the overall impact will be negative (Alcamo/Moreno/Nováky/Bindi/Corobov/Devoy/Giannakopoulos/Martin/Olesen/Shvidenko 2007).

The most vulnerable regions are:

- The Arctic, because of high rates of projected warming on sensitive natural systems;
- Africa, especially the sub-Saharan region, because of low adaptive capacity and projected changes in rainfall;
- Small islands, due to high exposure of population and infrastructure to risk of sea-level rise and increased storm surge; and
- Asian megadeltas, such as the Ganges-Brahmaputra and the Zhujiang, due to large populations and high exposure to sea-level rise, storm surge and river flooding.

Within other areas, even those with high incomes, some people can be particularly at risk (such as the poor, young children and the elderly) and also some areas and some activities (for a summary see Wilbanks/Romero Lankao/Bao/Berkhout/Cairncross/Ceron/Kapshe/Muir-Wood/Zapata-Marti 2007, sections 1, 2 and 4).

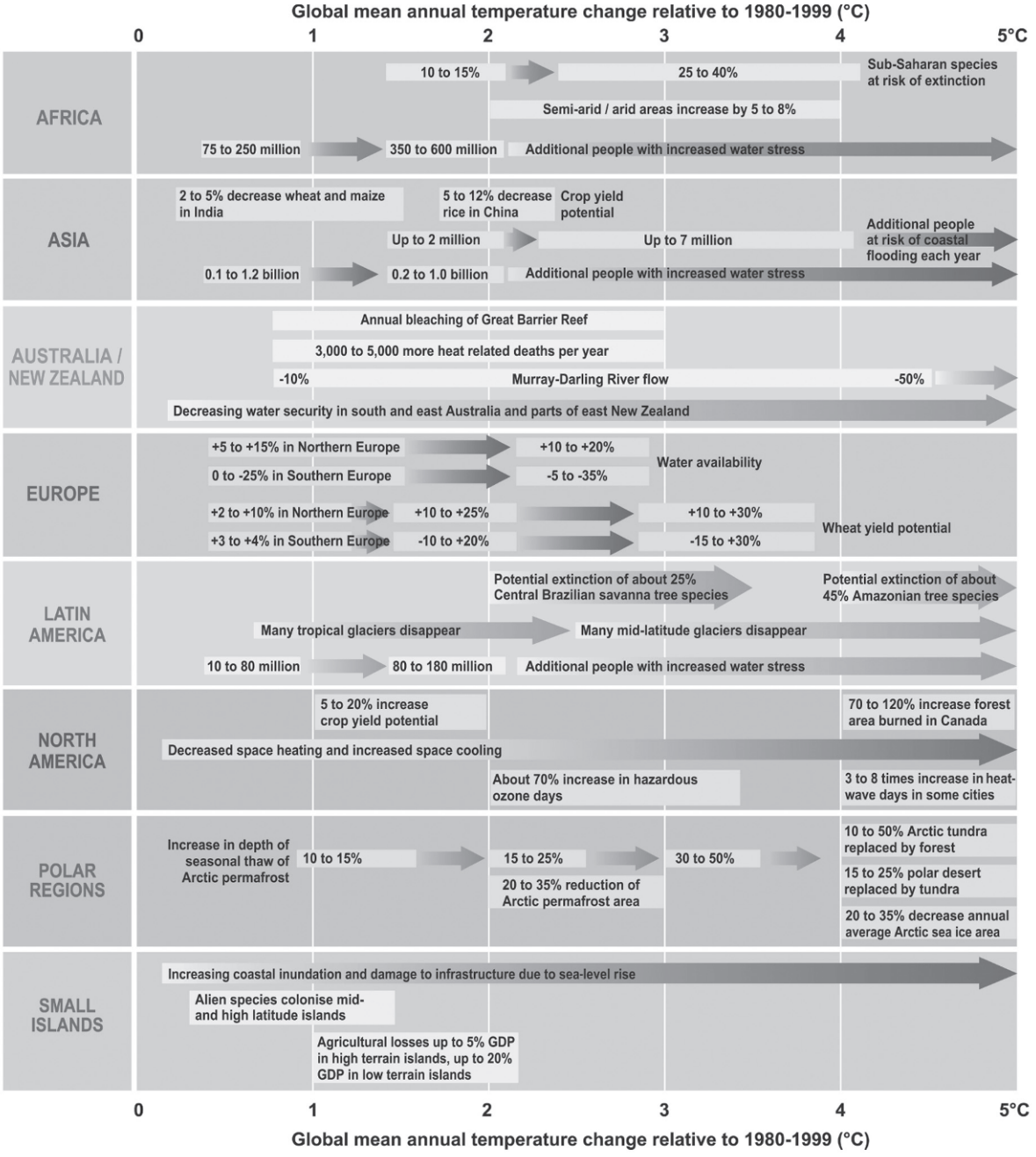
79.2.2 Case Study: Africa

Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of multiple stresses occurring at various levels, and low adaptive capacity. Africa's major economic sectors are vulnerable to current climate sensitivity, with huge economic impacts, and this vulnerability is exacerbated by existing developmental challenges such as endemic poverty, complex governance and institutional dimensions; limited access to capital, including markets, infrastructure and technology; ecosystem degradation; and complex disasters and conflicts. These in turn have contributed to Af-

6 Alcamo/Moreno/Nováky/Bindi/Corobov/Devoy/Giannakopoulos/Martin/Olesen/Shvidenko (2007); Anisimov/Vaughan/Callaghan/Furgal/Marchant/Prowse/Vilhjálmsson/Walsh (2007); Boko/Niang/Nyong/Vogel/Githeko/Medany/Osman-Elasha/Tabo/Yanda (2007); Confalonieri/Menne/Akhtar/Ebi/Hauengue/Kovats/Revich/Woodward (2007); Cruz/Harasawa/Lal/Wu/Anokhin/Punsalmaa/Honda/Jafari/Li/Huu Ninh (2007); Easterling/Aggarwal/Batima/Brander/Erda/Howden/Kirilenko/Morton/Soussana/Schmidhuber/Tubiello (2007); Field/Mortsch/Brklacich/Forbes/Kovacs/Patz/Running/Scott (2007); Fischlin/Midgley/Price/Leemans/Gopal/Turley/Rounsevell/Dube/Tarazona/Velichko (2007); Hennessey/Fitzharris/Bates/Harvey/Howden/Hughes/Salinger/Warrick (2007); Kundzewicz/Mata/Arnell/Döll/Kabat/Jiménez/Miller/Oki/Sen/Shiklomanov (2007); Magrin/Gay García/Cruz Choque/Giménez/Moreno/Nagy/Nobre/Villamizar (2007); Mimura/Nurse/McLean/Agard/Briguglio/Lefale/Payet/Sem (2007); Nicholls/Wong/Burkett/Codignotto/Hay/McLean/Ragoonaden/Woodroffe (2007).

7 See Polemio/Casarano (2004); Nunes/ Vasconcelos/Pereira/Dasgupta/Alldredge (2005); Salvador/ Lloret/Pons/Piñol (2005); Good/Barring/Giannakopoulos/Holt/Palutikof (2006).

Figure 79.3: Regional impacts projected for changes in climate (and sea level and atmospheric carbon dioxide where relevant) associated with different amounts of global average surface temperature change in the 21st century. **Source:** IPCC (2007a: 67, Technical Summary).



rica's weak adaptive capacity, increasing the continent's vulnerability to projected climate change (Boko/Niang/Nyong/Vogel/Githeko/Medany/Osman-Elasha/Tabo/Yanda 2007).

79.2.3 Case Study: Asian Megadeltas

The IPCC Fourth Assessment reported that the eleven megadeltas contained within a 10,000 km^2 area of Asia's coastal zone support a population of millions (Nicholls 1995; Woodroffe/Nicholls/Saito/Chen/Goodbred 2006). The Zhujiang, Changjiang

and Huanghe deltas are also ecomonically important accounting for a substantial proportion of China's GDP (Niou 2002; She 2004). Ecologically, the Asian mega deltas are critical diverse ecosystems of unique assemblages of plants and animals located in different climatic regions (IUCN 2003b; ACIA 2005; Macintosh 2005; Sanlaville/Prieur 2005). The Asian megadeltas are vulnerable to climate change and sea-level rise which could increase the frequency and level of inundation of megadeltas through storm surge and flooding from river drainage putting communities, biodiversity and infrastructure at risk of damage. This impact would be most pronounced in the seven megacities located in the deltas, particularly where natural ground subsidence is enhanced by human activities, such as in Bangkok in the Chao Phraya delta, Shanghai in the Changjiang delta, Tianjin in the old Huanghe delta (Nguyen/Ta/Tateishib 2000; Li/Fan/Deng/Korotaev 2004; Jiang 2005; Li/Zang/Saito/Xu/Wang/Matsumato/Zh 2005; Woodroffe/Nicholls/Saito/Chen/Goodbred 2006).

Many of the regional differences in impact will stem from changes in water availability (which is essential for human health and food production). Over the past five years, we have developed a clearer picture of how water availability may change regionally, with indications of important decreases in southern Europe and in northern and southern Africa (as described above). If these projected changes should occur, then impacts in these regions could be severe.

79.3 Likely Impacts due to Altered Frequencies and Intensities of Extreme Weather, Climate and Sea-level Events

The IPCC's *Fourth Assessment Report* (AR4) concluded, with increased confidence over the *Third Assessment* (TAR), that some weather events, such as heat waves, storms and droughts, which can have large impacts, are likely to become more frequent and widespread in the future and, in some cases, more intense. In general, the related impacts are expected to be broadly negative, including reduced water availability, damage to crops and increased potential for diseases, especially those transmitted by insect vectors. For example, it is a conclusion of the Fourth Assessment that intense tropical cyclone activity is likely to increase through the 21st century. Thus, it is reasonable to expect events such as Hurricane Katrina, which hit New Orleans in August 2005 and caused an estimated 4,000 fatalities, to occur more often in the future.

79.4 Large-scale Climate Events with Potential to Cause Very Large Impacts after the 21st Century

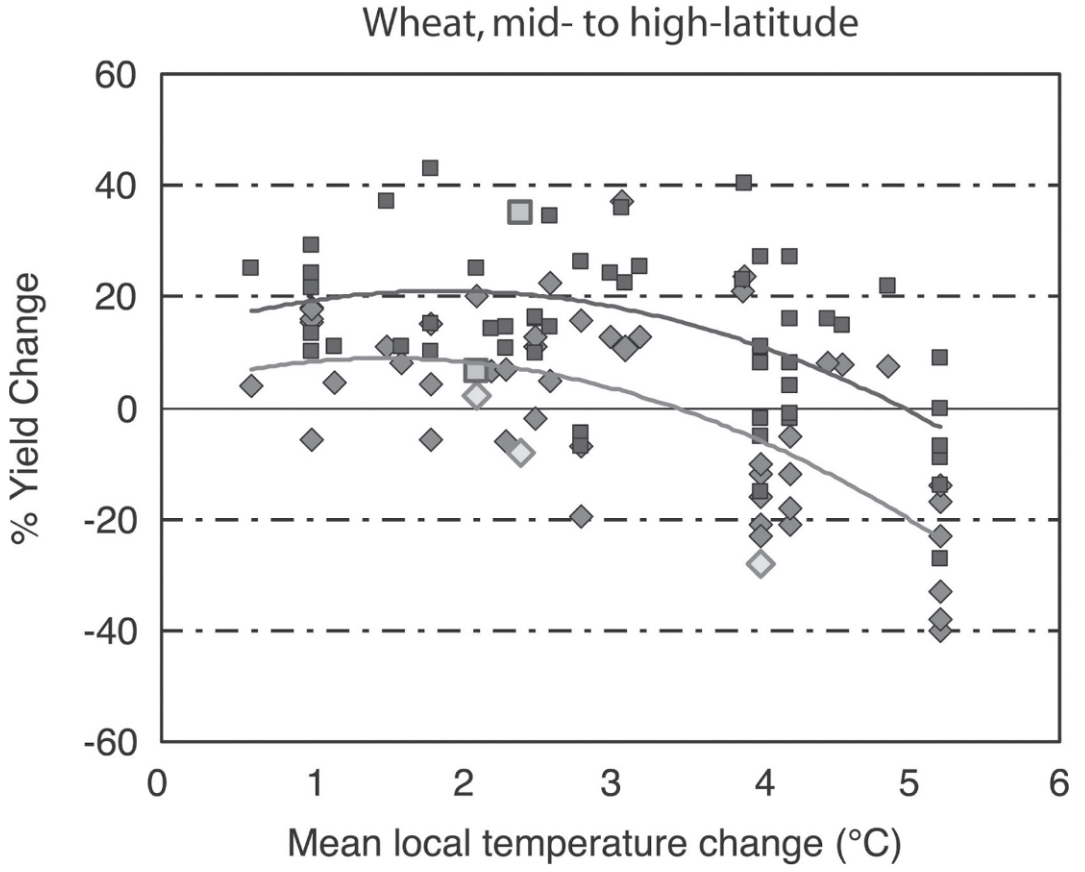
The IPCC Working Group I Fourth Assessment Report concluded that complete melting of the Greenland ice sheet, associated with a 1.9 °C to 4.6 °C global average temperature increase relative to pre-industrial levels, could lead to sea-level rises, over millennia, of 7 m. For the West Antarctic ice sheet, complete melting would contribute 5 m to sea-level rise. If this occurred, there would be widespread inundation of low-lying areas. Working Group II concluded that an abrupt change in the Meridional Overturning Circulation in the North Atlantic (i.e., weakening of the Gulf Stream), which could lead to cooling in northwestern Europe would be very unlikely to occur during this century.

79.5 Overall Negative Effect of Climate Change

The IPCC's *Fourth Assessment Report* (AR4) states that the impacts of future climate change will be mixed across regions, but negative overall. Some low-latitude and polar regions will experience net costs, even for small increases in temperature up to 2 °C or 3 °C before negative effects become more general. An example of this is possible increases in wheat yield for a temperature increase of 1 °C–3 °C at middle and high-latitudes but decreases in yield above 3 °C (figure 79.4).

These regions are the current 'breadbaskets' of the world, so the effects here would be keenly felt on food prices elsewhere; and, since agricultural production is a major part of global production, this explains why there is a wide band of uncertainty about the aggregate effects of climate change (with global losses between 1 and 5 per cent of *gross domestic product* (GDP) expected for a 4 °C warming – a conclusion which reinforces that of the IPCC's TAR (2001a). It is virtually certain, however, that such aggregate estimates of costs mask significant differences in impacts across sectors, regions, countries and populations. In some locations and among some groups of people with high exposure, high sensitivity and/or low adap-

Figure 79.4: Sensitivity of wheat yield in mid- to high latitudes. Responses indicate cases without adaptation (light grey dots) and with adaptation (dark grey dots). The studies analysed here include a range of precipitation changes and CO_2 concentrations (from IPCC 2007a: 286)



tive capacity, net costs will be significantly larger than the global aggregate.

79.6 Necessary Adaptation to Address Impacts from Warming From Past GHG Emissions

Working Group I (IPCC 2007d: 13) concluded that, even if emissions were stabilized now, global temperatures would increase on average by a further 0.6 °C by 2100. Furthermore, some current targets to reduce emissions assume a global average temperature increase of about 1.5 °C above present (i.e., 2 °C above pre-industrial temperatures). A significant amount of potential impact will therefore need to be adapted to, regardless of how effective are our efforts at mitigation.

79.7 Limited Current Adaptation and Needed Action to Reduce Vulnerability to Climate Change

There is growing evidence of human ability to adapt to observed and anticipated climate change. For example, climate change has been included in the design of infrastructure projects such as coastal defences in the Maldives (MOHA 2001; Mimura/Nurse/McLean/Agard/Briguglio/Lefale/Payet/Sem 2007) and the Netherlands.[8] Other examples include prevention of glacial lake outburst flooding in Nepal (Adger/Agrawala/Mirza/Conde/O'Brien/Pulhin/Pulwarty/Smit/Takahashi 2007), policies of water management in Australia[9], and government responses to heat waves in some European countries.[10]

8 See Government of the Netherlands (1997, 2005); Adger/Agrawala/Mirza/Conde/O'Brien/Pulhin/Pulwarty/Smit/Takahashi (2007).

Much more adaptation is needed, however. The array of potential adaptive responses available is very large, ranging from purely technological (e.g., sea defences), through behavioural (e.g., altered food and recreational choices), to managerial (e.g., altered farm practices) and to policy (e.g., planning regulations). We do not know, however, how effective various options are at fully reducing risks, nor their cost. This is especially true for larger amounts of warming over the long term and the IPCC authors concluded that adaptive capacity cannot be expected to cope with large amounts of long-term warming (IPCC 2007a: Section TS.5). This is why (as argued below) the combination of mitigation and adaptation will be essential.

79.8 Increased Vulnerability to Climate Change due to Other Stresses

Non-climate stresses can increase vulnerability[11] to climate change by reducing resilience and can also reduce adaptive capacity because of resource deployment to competing needs. For example, lower-than-normal receipts of rainfall in the Sahel have contributed to the reductions in the area of Lake Chad over the past 30 years. Equally important, however, may have been increased human abstraction of water from the rivers and streams that feed the lake. It is probably the combination of climate change and other trends that explain the lake's shrinkage.

79.9 Future Vulnerability Depending on Climate Change and on Development Pathways

Projected impacts of climate change can vary greatly due to the choice of future economic and social development pathway. New research on potential impacts allows for differences in regional population, income and technological development can be a strong determinant of vulnerability to climate change (Mimura 2001; Nicholls 2004, 2006).

To illustrate, figure 79.5 shows estimates of the global number of people at risk of flooding under different assumptions of socio-economic development (Nicholls 2004; Nicholls/Wong/Burkett/Codignotto/Hay/McLean/Ragoonaden/Woodroffe 2007). This indicates that the projected number of people affected is considerably greater under the A2-type scenario of development (a future world characterized by low per capita income and large population growth) than under other futures such as A1 (a high income/high population world); B1 (sustainable development/global governance); and B2 (sustainable development/local governance). Thus, difference in impact between these future conditions is largely explained, not by climate change, but by differences in vulnerability due to wealth and technology. This is important because it suggests that the choice of the development pathway can be a key to reducing impacts from climate change (e.g., Brooks/Adger/Kelly 2005; Haddad 2005; Jung/Srinivasan/Tamura/Sudo/Watanabe/Shimada/Kimura 2005; Tompkins/Adger 2005; Shaw 2006; Yohe/Lasco/Ahmad/Arnell/Cohen/Hope/Janetos/Perez 2007).

79.10 Sustainable Development and Climate Change Linkages

Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience.[12] At present, however, few plans for promoting sustainability have explicitly included either adapting to climate change impacts or promoting adaptive capacity (Hamlet 2003; Payne/Wood/

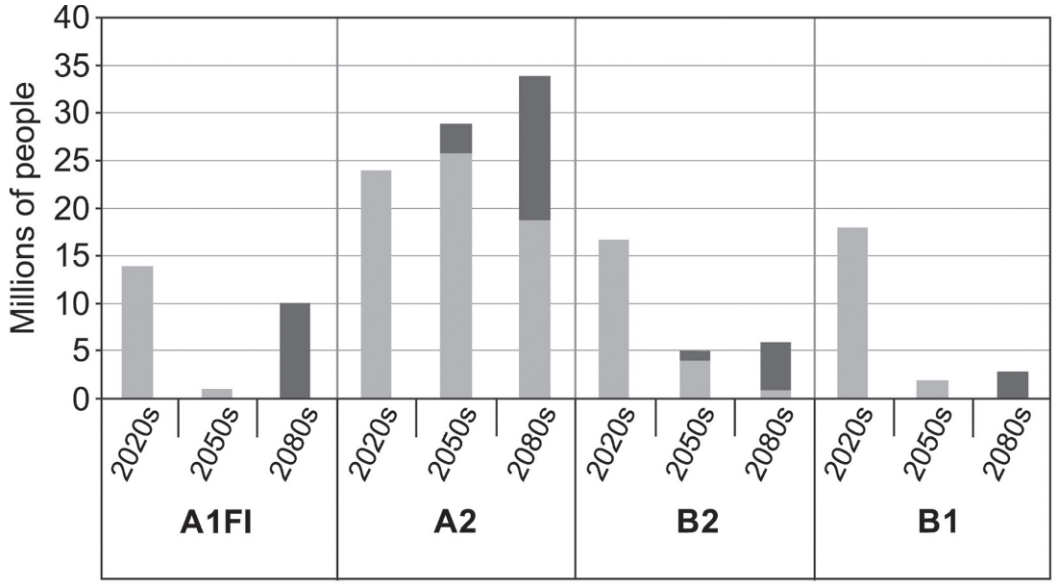
9 See Beare/Heaney (2002); Allen Consulting Group (2005); Hennessey/Fitzharris/Bates/Harvey/Howden/Hughes/Salinger/Warrick (2007).

10 See Garssen/Harmsen/de Beer 2005; Nogueira/Falcão/ Contreiras/Paixão/Brandão/Batista (2005); Pirard/Vandentorren/Pascal/Laaidi/Le Tertre/Cassadou/Ledrans (2005); Alcamo/Moreno/Nováky/Bindi/Corobov/Devoy/Giannakopoulos/Martin/Olesen/Shvidenko (2007).

11 Vulnerability, as used in the WGII Assessment is defined as: the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

12 See Kates (2000); Brooks/Adger/Kelly (2005); Haddad (2005); Jung/Srinivasan/Tamura/Sudo/Wa-tanabe/Shimada/Kimura (2005); Tompkins/Adger, (2005); Belliveau/ Smit/Bradshaw (2006); Ford/ Smit/Wandel (2006); Shaw (2006); Yohe/Lasco/Ahmad/Arnell/Cohen/Hope/Janetos/Perez (2007).

Figure 79.5: Estimated millions of people per annum at risk globally from coastal flooding. Light grey bars: numbers at risk without sea-level rise; dark grey bars: numbers at risk with sea-level rise. **Source**: IPCC (2007a: 75; Technical Summary).



Hamlet/Palmer/Lettenmaier 2004). On the other hand, it is very likely that climate change can slow the pace of progress towards sustainable development (e.g., impede achievement of Millennium Development Goals), either directly through increased exposure to adverse impacts or indirectly through erosion of the capacity to adapt (Arrow/Dasgupta/Goulder/Daily/Ehrlich/Heal/Levin/Maler/Schneider/Starrett/Walker 2004; MA 2005; Yohe/Lasco/Ahmad/Arnell/Cohen/Hope/Janetos/Perez 2007).

79.11 Avoided, Reduced or Delayed Climate Change Impacts due to Mitigation

A small number of impact assessments have now been completed for scenarios in which future greenhouse gases are stabilized. Although these studies do not take full account of uncertainties in projected climate under stabilization, they nevertheless provide indications of damage avoided or vulnerabilities and risks reduced for different amounts of emissions reduction (see for example Yohe/Malone/Brenkert/Schlesinger/Meij/Xing/Lee 2006).

79.12 Conclusion: Mix of Adaptation and Mitigation Measures to Cope with Climate Change Impacts

Even the most stringent mitigation efforts cannot avoid some impacts of climate change over the next few decades. Indeed, we are beginning to see these impacts now (Rosenzweig/Casassa/Karoly/Imeson/Liu/Menzel/Rawlins/Root/Seguin/Tryjanowski 2007). This makes adaptation essential, particularly in addressing near-term impacts. However, unmitigated climate change would, in the long term, be likely to exceed our capacity to adapt.

It is essential, then, to develop a portfolio or mix of strategies that includes mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research (on climate science, impacts, adaptation and mitigation). But analysis of the benefits of various mixes of strategy is severely restricted at present by lack of information on potential costs of impacts, by lack of comparable information on the damage that could be avoided by adaptation and, especially, by lack of understanding of how these impacts will vary under different socio-economic development pathways (Klein/Eriksen/Nass/Hammill/Tanner/Robledo/O'Brien 2007). It is important that these gaps in our knowledge are filled quickly.

80 Options for Mitigating Climate Change Results of Working Group III of the Fourth Assessment Report of the IPCC

Peter Bosch and Bert Metz

80.1 Introduction

In 2007 the United Nations Intergovernmental Panel on Climate Change (IPCC) completed its *fourth assessment report* (AR4). This report consists of three separate volumes on climate science, vulnerability to climate change and adaptation (chap. 79 by Parry/Canziani/Palutikof/Hanson) and mitigation of climate change, respectively. The IPCC reports are thorough and comprehensive assessments of published literature, put together by multidisciplinary teams of the best experts from around the world. These reports are subject to extensive review by independent experts and governments. The Summary for Policymakers of the reports is approved by the member countries of the IPCC.

This chapter focuses on the outcomes of the third volume, which is the product of working group III of the IPCC. This working group has evaluated the available literature to come up with an overview of all possible measures to reduce the worldwide emission of greenhouse gases, and an estimate of the global reduction potential and the costs involved. The chapter also includes references to a few major publications that appeared after the AR4 was completed, but it does not refer back to individual publications that have been assessed in the AR4.

The IPCC findings have already been very influential in shaping the international climate negotiations; especially during the *Conference of the Parties* (COP) of the *United Nations Framework Convention on Climate Change* (UNFCCC) in Bali in December 2007 that laid out the roadmap for the discussions on a new international climate agreement as a follow-up to the Kyoto protocol (chap. 83 by Egenhofer/Behrens/Georgiev).

In short, the conclusions of the AR4 on mitigation claim that it is possible to reduce *greenhouse gas* (GHG) emissions to levels that prevent dangerous warming of the atmosphere at reasonable costs. The economic potential for the mitigation of GHG emissions over the coming decades is enough to offset the projected growth of global emissions or to reduce emissions below current level. Beyond 2030 there are further opportunities for deep reductions of emissions, required for minimizing the risks of climate change. The economic impacts of such a low risk strategy would not amount to more than 3 per cent lower global GDP by 2030 than without controlling GHG emissions, or, in other words, a reduction of the yearly growth of world income by less than 0.12 per cent points. The measures to reduce GHG emissions will, however, not be taken without strong government policy action.

This chapter explores the required reductions of greenhouse gas emissions to prevent dangerous climate change impacts, taking a risk-based approach. It discusses the risks of climate change as a function of a change in climate, particularly mean global temperature increase (80.2); deals with the relation between GHG concentrations in the atmosphere and global temperature and the implications for reduction of GHG emissions (80.3); addresses the main question whether the technology is available to reduce greenhouse gas emissions to the desired levels of protection and provides a concise overview of options and costs involved (80.4). Further, it discusses policy action required to realize the emission reduction potentials (80.5), and in the conclusions it refers to questions for further research (80.6).

80.2 Coping with Climate Change

Continued GHG emissions at or above the current rates will cause further global warming and consequent changes in the global climate system that will be larger than those observed in the 20th century. For the next two decades most scenarios agree on a warming of 0.2 °C per decade. After this period the

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temperature projections depend on the emission scenario, that is, the assumptions with regard to population growth, economic growth and the choice of energy carriers. Best estimate temperature changes in 2090–2099 relative to the 1980–1999 period for the scenarios included in the IPCC Special Report on Emission Scenarios range from 1.8 to 4.0°C (with a likely range from 1.1 to 6.4°C; IPCC 2007: 747ff.).[1]

Associated changes in the climate are an increase in the frequency of hot extremes, heat waves and heavy precipitation, an increase in tropical cyclone intensity, a pole ward shift of extra-tropical storm tracks with consequent changes in wind, precipitation and temperature patterns, an increase in precipitation in high latitudes and a decrease in most subtropical land regions. It will lead to a decrease in sea ice extent (in some scenarios even a complete disappearance of Arctic sea ice in summer) and a decrease of the snow and permafrost areas.

Especially affected by climate change will be:

- The Arctic, because of the impacts of high rates of projected warming;
- Africa, because of low adaptive capacity and impacts on water resources;
- Small islands, due to the threat of sea level rise and extreme weather events;
- Mega deltas in Asia and Africa, with large populations exposed to sea level rise and river flooding (IPCC 2007a: 11–18).

Coping with climate change entails two types of action that are both needed:

1. *adaptation* to the impacts of changes in climate that are unavoidable as a result of large-scale GHG emissions since the industrial revolution, and
2. *mitigation* of climate change through reducing GHG emissions and maximizing carbon sinks (forests), so that additional climate change above the unavoidable is minimized.

Neither adaptation nor mitigation alone can avoid all climate change impacts, but together they can significantly reduce the risks of climate change and "prevent dangerous anthropogenic interference with the climate system" (the ultimate objective of the universally agreed UNFCCC).

Adaptation will be necessary in the short term to deal with the impacts that have been observed already and are expected for the near future (IPCC 2007a; chap. 79 by Parry/Canziani/Palutikof/Hanson). However, adaptation alone is not expected to cope with all projected effects of climate change, as in the long term unmitigated climate change would likely exceed the capacity of natural, managed and human systems to adapt. In other words, there are serious limits to adaptation, which we unfortunately do not yet understand well.

Mitigation of climate change, or reduction of GHG emissions and retaining or strengthening reservoirs of carbon in vegetation, is necessary to minimize the further build-up of the concentrations of GHG in the atmosphere that drive climate change. Given the very long lifetimes of GHGs in the atmosphere (25 per cent of *carbon dioxide* (CO_2) emitted today will still be in the atmosphere 5,000 years from now), emissions have to be reduced to almost zero in order to stabilize concentrations in the atmosphere. Because of slowness of the climate system, the effects of mitigation can only de detected after many years. After GHG concentrations in the atmosphere have stabilized, the rate at which the global average temperature increases is expected to slow down within a few decades.

80.3 The Mitigation Challenge

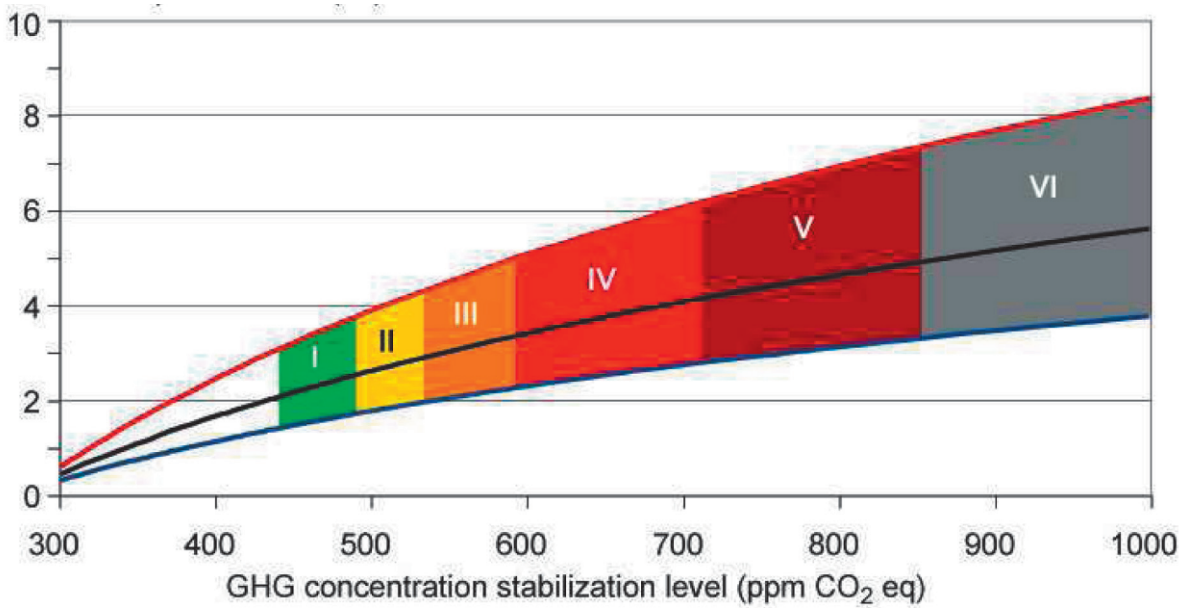
The challenge for the world is to stop the growth in GHG emissions and achieve an absolute reduction of emissions within the coming decades. In the past 30 years (between 1970 and 2004) global GHG emissions have increased by 70 per cent.[2] CO_2 emissions, the largest constituent, have even increased by about 80 per cent (data from Edgar database: Olivier/Van Aardenne/Dentener/Pagliari/Ganzeveld/Peters 2005; Olivier/Pulles/van Aardenne 2006).

Depending on the scenario assumed for future population growth, growth of GDP, choice of energy sources and land-use, GHG emissions in the coming thirty years will rise with another 25 to 90 per cent if no additional policies would be implemented. These numbers are based on the IPCC's *Special Report on Emission Scenarios* (SRES), which describes a collection of baseline scenarios without additional mitiga-

1 See Nakicenovic/Alcamo/Davis/de Vries/Fenham,/Gaffin/Gregory/Grübler/Jung/Kram/La Rovere/Michaelis/Mori/Morita/Pepper/Pitcher/Price/Riahi/Reohrl/Rogner/Sankovski/Schlesinger/Shukla/Smith/Swart/van Rooijen/Victor/Zhou (2000).

2 The six GHG emissions covered by the UNFCCC are: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, weighted by their *global warming potential* (GWP).

Figure 80.1: Stabilization scenario categories and their relationship to equilibrium global mean temperature change above pre-industrial temperatures in °C. **Source:** IPCC (2007b: 228).



Note: The central line uses the 'best estimate' climate sensitivity of 3°C (black line in middle of shaded area), the red line at the top of the shaded area is the upper bound of the likely range of climate sensitivity of 4.5°C, the blue line at the bottom of the shaded area represents the lower bound of the likely range of climate sensitivity of 2°C. Coloured shading shows the concentration bands for GHG stabilization in the atmosphere corresponding to the stabilization scenario categories I to VI as indicated in table 80.1. The data are drawn from IPCC (2007, chap. 10.8). The best estimate of climate sensitivity (3 °C) is higher than in the previous IPCC report (2.5°C), meaning that allowable concentration levels for the same temperature increase are now lower than indicated earlier.

tion measures (Nakicenovic 2000; IPCC 2007b: 31). In these scenarios, fossil fuels are projected to maintain their dominant position in the global energy mix to 2030 and beyond. Hence CO_2 emissions from energy use are projected to grow by 40 to 110 per cent between 2000 and 2030.

The precise size of the challenge of reducing GHG emissions depends on the impacts of climate change that societies are willing to accept, in light of the costs of taking mitigation measures. Since there is a direct link between climate change impacts and global mean temperatures, it is a matter of deciding at which temperature level climate should be stabilized. From there the allowable GHG concentration level can be derived. Figure 80.1 depicts the relationship between global mean equilibrium temperature and the GHG concentration in the atmosphere. The corresponding figure 80.2 shows for the same bands of temperatures/concentrations, the emission profiles as generated by a multitude of models simulating a stabilization of GHG concentrations in the atmosphere. Here, the coloured bands represent the spread over model outcomes. The lower the desired level of equilibrium GHG concentrations in the atmosphere:

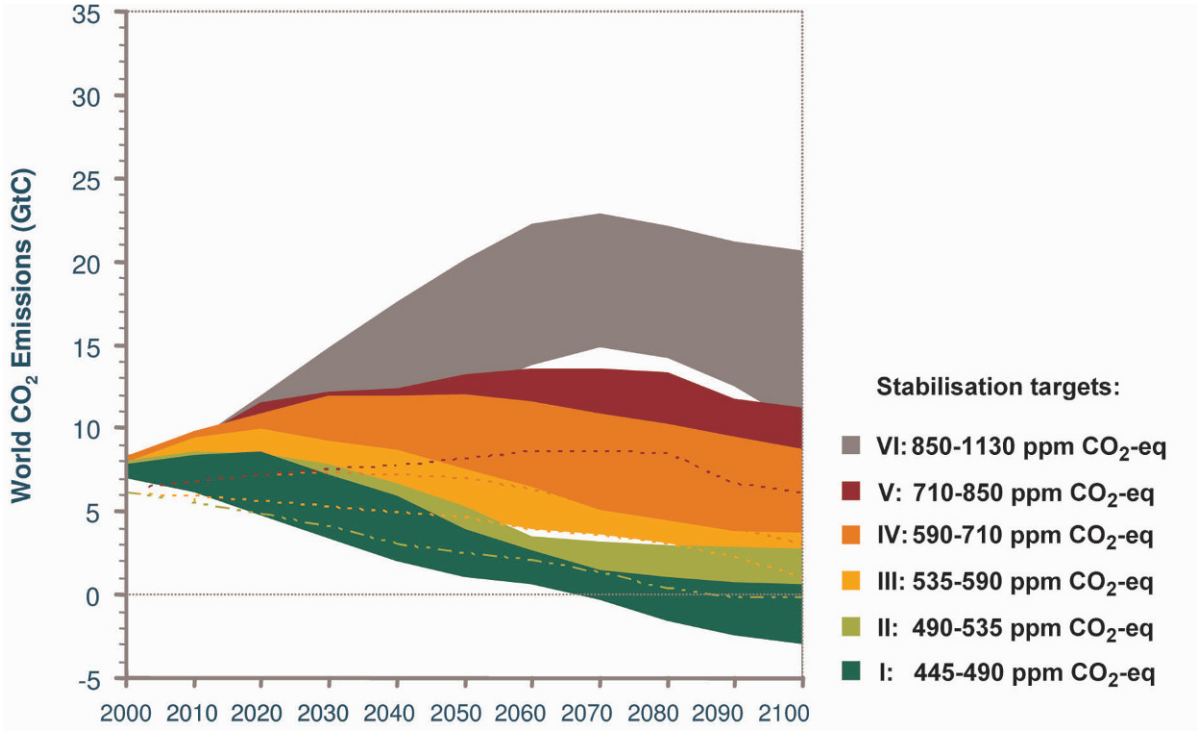
- the more emissions will have to be reduced at a given point in time; the political jargon for emission reductions linked with the lower concentration levels is 'deep cuts'.
- the earlier emissions have to peak; that means the moment global emissions start decline in absolute terms.

Table 80.1 summarizes the required emissions levels for different groups of stabilization concentrations and the associated equilibrium global mean temperature increase, using the 'best estimate' of climate sensitivity[3] (whereby the likely range of uncertainty is depicted in figure 80.1).

Especially for the lowest stabilization categories the time for implementing GHG emission reduction

3 Climate sensitivity is a measure of the climate system response to sustained radiative forcing. It is defined as the global average surface warming following a doubling of CO_2 concentrations.

Figure 80.2: Emission pathways of mitigation scenarios for alternative categories of stabilization levels (category I to VI defined in table 80.1). **Source:** IPCC (2007b: 199).



measures is very short. As shown in table 80.1 global GHG emissions will have to peak before 2015 in order to keep global temperature increase to 2.0–2.4 °C above the pre-industrial situation. This means that mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve any of the lower stabilization levels.

Of course it can be debated what is the appropriate level of stabilization of GHG concentrations to strive for. This is a normative decision that cannot be made on scientific grounds alone. Science can, however, inform these decisions. In a risk management framework that means scientific information about the risks belonging to certain stabilization levels (and the temperatures and precipitation belonging to them) should be considered together with information about the costs and policy efforts needed to reach these stabilization levels. And then there are two fundamentally different ways to use that information: (1) determine the acceptable risk level and then realize that level at the lowest possible costs (least cost risk management approach), or (2) compare the cost of no action (climate change damages) with the costs of achieving stabilization and go no further than what the damage costs are (cost-benefit approach). The latter approach is fraught with problems, because it requires monetization of a wide range of climate change damages (economic losses, health effects, ecosystem disappearance and many other). Nevertheless it is an approach widely used by economists. The AR4, assessing the literature that shows a wide range of estimates for climate change damages, could only conclude that costs of damages and costs of aggressive mitigation action are of the same order of magnitude. The Stern report that was published almost at the same time, taking into account the risk of catastrophic climate change events, the irreversible nature of some of the effects and a much longer time horizon, concluded that the damage costs far outweigh the costs of aggressive mitigation action (Stern 2006).

80.4 Potential for Mitigating Climate Change and Its Costs

A politically interesting part of mitigation analysis is the question of the potentials and costs of reaching climate policy targets. The distribution of potentials and costs across economic sectors and regions of the world shapes the negotiations on a future international climate agreement and the instruments to be used, such as the *Clean Development Mechanism*

Table 80.1: Characteristics of stabilization scenarios published after 2000. **Source:** IPCC (2007b: 198).

Category	Radiative Forcing (W/m^2)	CO_2 Concentration (ppm)	CO_2-eq Concentration (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using 'best estimate' climate sensitivity (°C)	Peaking year for CO_2 emissions (year)	Change in global CO_2 emissions in 2050 (per cent of 2000 emissions) (per cent)	No. of assessed scenarios
I	2.5 – 3.0	350 – 400	445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50	6
II	3.0 – 3.5	400 – 440	490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30	18
III	3.5 – 4.0	440 – 485	535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5	21
IV	4.0 – 5.0	485 – 570	590 – 710	3.2 – 4.0	2020 - 2060	+10 to +60	118
V	5.0 – 6.0	570 – 660	710 – 855	4.0 – 4.9	2050 - 2080	+25 to +85	9
VI	6.0 – 7.5	660 – 790	855 – 1130	4.9 – 6.1	2060 - 2090	+90 to +140	5
						Total	**177**

(CDM). The AR4 has used two strands of analysis to estimate the potential of available mitigation measures. As a first approach the various technological measures that can be taken by economic sectors have been analysed from en engineering perspective and their costs and mitigation potential in the year 2030 versus a baseline economic development have been estimated. This 'bottom-up' estimate has been compared with a 'top-down' approach, in which the mitigation potential in 2030 was derived from macro-economic/environmental models running long term stabilization scenarios. Both approaches give comparable results (figure 80.3). This observation is confirmed by Hoogwijk/van Vuuren/Boeters/Blok, Blomen/Barker/Chateau/Grübler/Masui/Nabuurs/Novikova/Riahi/de la Rue du Can/Sathaye/Scrieciu/Urge-Vorsatz/van Vliet (2008), who elaborated the IPCC approach with a more consistent baseline and another selection of models and model runs. The economic mitigation potential for carbon prices of less than 100 US$/ton CO_2-equivalent is between 16 and 31 Gt CO_2-equivalent. This amount is sufficient to reduce the projected 2030 emissions to or below the global emissions in the year 2000. Such reductions in 2030 would be consistent with stabilization below 500 ppm CO_2-equivalent in the long run.

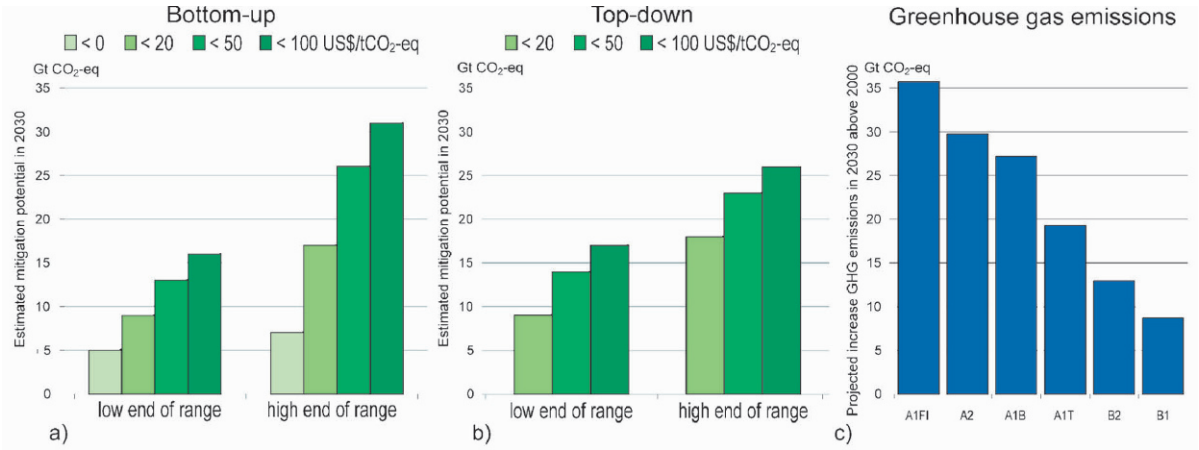
The uncertainties in the estimates reflect the ranges in assumptions on baselines, rates of technological change and factors that are specific to the 'bottom-up' or 'top-down' approach. Furthermore, uncertainties arise from the limited information for the global coverage of countries, sectors and gases (IPCC 2007b: 631).

This mitigation potential cannot be provided by one single technology or one single economic sector. If full use is going to be made of the economic mitigation potential, then all sectors will need to contribute. Figure 80.4 gives a summary of mitigation potentials and costs in economic sectors. It has been derived from the (bottom-up) technological information on a large number of technical mitigation measures. The potentials are compared to a baseline economic development and given for the year 2030.

The main mitigation technologies and practices currently available or projected to be commercialized before 2030 include:

- For the *energy supply* sector: Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; *Carbon Capture and Storage* (CCS) for gas, biomass and coal-fired electricity generating facilities.
- For the *transport sector*: More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; (second generation) biofuels; modal shifts from road transport to rail and public transport systems; non-motorized transport (cycling, walking); land-use and transport planning; higher efficiency aircrafts; advanced electric and hybrid vehicles with more powerful and reliable batteries.
- For *buildings*: Efficient lighting and day lighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycle of fluorinated gases, integrated design of commercial buildings includ-

Figure 80.3: Comparison between global economic mitigation potential and projected emissions increase in 2030. **Source:** IPCC (2007b: 625-635).



Note: Global economic mitigation potential in 2030 estimated from bottom-up (panel a) and top-down (panel b) studies, compared with the projected emission increases from SRES scenarios relative to 2000 GHG emissions of 40.8 GtCO2-eq (panel c). GHG emissions in 2000 are exclusive of emissions of decay of above ground biomass that remains after logging and deforestation and from peat fires and drained peat soils, to ensure consistency with the SRES emission results. A price of 50 US$/ton CO_2-equivalent roughly equals a price increase of 25 US$/barrel crude oil, or 12 ct/litre gasoline (50 ct/gallon), or an electricity price increase of 5 ct/kWh for electricity generated in coal fired plants, or 1.5 ct/kWh for electricity from gas fired plants.

ing technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings.

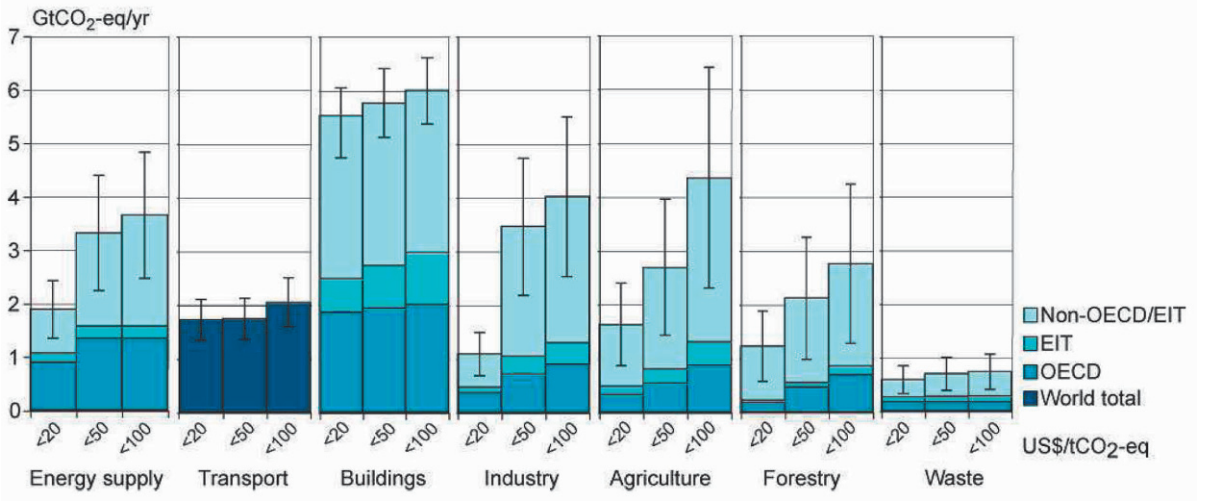
- For the *manufacturing industry*: More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO_2 gas emissions; and a wide array of process-specific technologies, CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture.
- For *agriculture*: Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH_4 emissions; improved nitrogen fertilizer application techniques to reduce N_2O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency.
- For *foresty*: Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use, tree species improvement to increase biomass productivity and carbon sequestration.
- For *waste management*: Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimization, biocovers and biofilters to optimize CH_4 oxidation.

Apart from these technical mitigation measures, there are many lifestyle and behavioural changes possible that can reduce GHG emissions. The impacts of these can, however, not yet be quantified. Examples are:

- For consumers: choosing the appropriate inside temperature at home can save a lot of heating or air-conditioning energy use; switching off lights and electrical appliances when not in use does the same.
- For employees: staff training, reward systems, regular feedback can help reduce losses in energy, steam, and hot water.
- For drivers: choosing an efficient driving style, but also choosing for appropriate alternative modes of transport such as walking, cycling or public transport.

In figure 80.4 the large economic potential at low costs for the building sector is striking. By 2030, about 30 per cent of the projected GHG emissions in this sector can be avoided with net economic benefit due to the savings made on energy use. There are, however, multiple barriers that make it difficult to realize this potential, which include the low priority for investing money that will lead to savings in the longer term, lack of reliable information, limited availability

Figure 80.4: Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. **Source:** IPCC (2007b: 632).



Notes:

1. The ranges for global economic potentials as assessed in each sector are shown by vertical lines.
2. The estimated potentials have been constrained by the availability of studies particularly at high carbon price levels.
3. Sectors used different baselines. For industry the SRES B2 baseline was taken, for energy supply and transport the World Energy Outlook 2004 baseline was used; the building sector is based on a baseline in between SRES B2 and A1B; for waste, SRES A1B driving forces were used to construct a waste specific baseline, agriculture and forestry used baselines that mostly used B2 driving forces. The estimates are based on end-use allocations of emissions, meaning that emissions of electricity use are counted towards the end-use sectors and not to the energy supply sector.
4. Only global totals for transport are shown because international aviation is included.
5. Categories excluded are: non-CO_2 emissions in buildings and transport, part of material efficiency options, heat production and cogeneration in energy supply, heavy duty vehicles, shipping and high-occupancy passenger transport, most high-cost options for buildings, wastewater treatment, emission reduction from coal mines and gas pipelines, fluorinated gases from energy supply and transport. The underestimation of the total economic potential from these emissions is of the order of 10-15 per cent.

of technology, financing requirements, and limitations inherent in buildings designs. A well known obstacle is also that building owners have little incentive to invest in highly energy efficient buildings, while those that rent a house or an office have no incentive to invest either. Especially in developing countries these barriers are more important.

In general, the share of developing countries in the global economic mitigation potential is considerable. This highlights the importance of including appropriate mechanisms for technology transfer and financing of measures in developing countries in future international climate agreements.

The total direct costs of implementing the full package of technical measures at costs lower than 100 US$/ton CO_2-equivalent as described above, amount to between 1 and 2 per cent of global GDP in 2030.[4] The macro-economic costs, i.e. the effect on the size of the economy as a whole, have been calculated for multi-gas mitigation consistent with emission trajectories towards different stabilization levels of GHG emissions in the atmosphere. These macro-economic costs are estimated for 2030 at a range between a 3 per cent decrease of global GDP, compared to a reference scenario, for the most stringent scenarios (stabilizing at 445–535 ppm CO_2-equivalent) to a small increase (i.e. benefit) compared to the baseline for a stabilization at 590–710 ppm CO_2-equivalent.

4 This is the expenditure for mitigation measures, not the macro-economic effect. It can be calculated from the data in figure 80.4, assuming all measures are taken at the highest costs per cost class. Compared to the world GDP of the SRES B2 marker scenario of 66 trillion US$ in 2030 (Nakicenovic/Alcamo/Davis/de Vries/Fenham,/Gaffin/Gregory/Grübler/Jung/Kram/La Rovere/Michaelis/Mori/Morita/Pepper/Pitcher/Price/Riahi/Reohrl/Rogner/Sankovski/Schlesinger/Shukla/Smith/Swart/van Rooijen/Victor/Zhou 2000: 561).

Even the 3 per cent reduction in 2030 compared to a baseline is relatively small: it would mean a reduction of the average yearly growth of the world economy by less than 0.12 percentage points. With GDP growth rates assumed in most models it would mean that one year later the world would be equally well off compared to a situation without measures. Of course, these results are global averages based on least cost models. In reality costs may be higher and also regionally the impacts may differ from the percentages given above. On the other hand, these calculations do not take into account the benefits of climate policies in terms of avoided impacts of climate change and the co-benefits of taking mitigation measures. Especially the co-benefits from reduced air pollution in terms of improved health as a result of actions to reduce GHG emissions can be substantial (IPCC 2007b: 670).

80.5 Policies and Instruments

Without policy action the mitigation potential will remain a potential solution for addressing climate change. There is a wide variety of national policies and instruments available to governments to create the incentives for mitigation action (IPCC 2007b: 753). The literature provides a great deal of information on the effectiveness and appropriateness of these policy instruments. However, all instruments can be designed well or poorly, and stringent or lax. In addition, all instruments must be monitored and enforced to be attractive. The administrative capacity is thus of key importance for implementing the necessary policies and measures.

To motivate producers and consumers worldwide to take action, it will be necessary to create a price for GHG emissions, often shorthanded as 'carbon-price'. This allows the costs of emissions to be factored in when taking business or investment decisions. An explicit carbon-price can be created through taxes or *emission trading systems* (ETS). The latter is rapidly becoming popular. The EU ETS (EC 2008), operational in the 27 Member States of the EU, sets emission limits for about 10,000 companies and allows the trade of emission allowances between them. Other industrialized countries like the US, Australia and New Zealand are moving in the same direction. An implicit carbon price can be established through regulations and standards that force their subjects to take measures and/or invest in technology with lower emissions.

Regulations are generally more effective than financial incentives for sectors where economic aspects play only a limited role in decision-making, such as for purchasing decisions on a car, a house and household/office appliances. This points to fuel efficiency standards, building codes and appliance efficiency standards as the preferred policy instruments to increase energy efficiency in the household and small industry sector. Regulations have also proven to be more effective in the area of promoting the use of renewable energy. Minimum renewable supply requirements (so called Renewable Portfolio Standards, popular in the US) and feed-in tariffs (a guaranteed high price for renewable electricity supply, popular in Europe and elsewhere) have a good track record (IPCC 2007b: 20 and 753ff.).

Another important finding of the AR4 is that policies that are embedded in broader socio-economic policy are more effective that free-standing climate policies. The reason is that in most countries development objectives, such as creating employment, providing adequate transport, improving health, limiting dependence on imported energy, etc are seen as more important than dealing with climate change. Integrating climate change policy in these broader socio-economic policy areas is very well possible and generally is more easily accepted and more easily implemented. This however requires a truly integrated policy view that is fully supported at the highest level of government (IPCC 2007b: 700).

Most top-down, as well as some 2050 bottom-up assessments, suggest that real or implicit carbon prices of 20 to 50 US$/t$CO_2$-eq, sustained or increased over the coming decades, could lead to a power generation sector with low-GHG emissions by 2050 and make many mitigation options in the end-use sectors economically attractive. Modelling studies show that carbon prices rising to 20 to 80 US$/t$CO_2$-eq by 2030 are consistent with stabilization at around 550 ppm CO_2-eq by 2100 (IPCC 2007b: 206, 660). For stabilization at 450 ppm CO_2-eq carbon prices by 2030 would have to be around $100/t$CO_2$ avoided. Important in this respect is the timing of the price signal or the measures: energy infrastructure has a lifetime of many decades, and choices regarding the investments in the energy sector will determine the amount of carbon dioxide emissions, and hence future climate change, for many years to come.

80.6 Conclusions

In order to cope with the threat of climate change, the UNFCCC was adopted in 1992, and entered into force in 1994. The Kyoto Protocol, limiting the emissions of the developed countries by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012, was adopted in 1997 and became operational in 2004. With the end of the first commitment period approaching, the negotiations have started, notably on Bali in December 2007, to work towards a new international climate agreement as a follow-up to the Kyoto protocol to be agreed in Copenhagen at the end of 2009.

The IPCC's Fourth Assessment Report was planned to feed relevant information into this process. The AR4 synthesis report, summarizing the three assessments, was launched just before the Bali climate conference.

The findings of the AR4 have more than any IPCC report before, played a role in these political discussions. The 'road map' as agreed in Bali, for instance, reflects, in a footnote on the first page, the contribution of IPCC working group III explicitly (UNFCCC 2008). The footnote originates in a text emphasizing the urgency to address climate change, and the text of the footnote refers to information about the need for global emissions to peak rather soon if low level stabilization is to be attained (see table 80.1 above) and information on emission reductions needed by developed and developing countries. As negotiations are very much focussed on the period till 2020, reference was also made to another finding of the AR4: the equitable distribution of efforts between developed and developing countries. Assessing a whole range of equity studies, the AR4 (IPCC 2007b: 776) concluded that for stabilization at levels of about 450 ppm CO_2 equivalent developed countries emissions would need to be reduced 25–40 per cent below 1990 values by 2020 and that developing country emissions should deviate substantially from the baseline. In a later publication by den Elzen and Hoehne (den Elzen/Hoehne 2008), this deviation was shown to be 15–30 per cent below baseline in 2020. This underlines the change in the debate that happened around 2007 whereby global warming is now considered unequivocal, and the policy discussion has moved on to the mitigation measures and the best way to implement them. The fact that at the time of the Bali conference, information on possible long-term targets was hidden in a footnote and not mentioned in the main text reflects the very controversial nature of setting these targets in light of the fear of developing countries that their development aspirations will be blocked by lack of available space to emit CO_2. At the UNFCCC meeting in Poznan, Poland, in December 2008, much attention was given to the findings regarding the 15–30 per cent below baseline for developing countries (paid by themselves, so not the result of off-sets bought by developed countries). There was no progress towards agreement on these numbers, however.

Whatever the form and extent of a post-Kyoto agreement will be, there will be a continuing need for information at all geographical levels (from municipalities to the globe) on the cost and potentials of climate mitigation measures. Remarkably, the weak points in information seem to be the same at the global and the local level: there is a need for harmonizing the methodology and the data for the residential and the service sector; more attention needs to be given to non-CO_2 greenhouse gases; the effect of behavioural changes need to be explored and its effects quantified; more data are needed on the mitigation options and mitigation potential in developing countries. Also emissions and sinks from agriculture and forestry need to be quantified more reliably. The information will be increasingly used to support governments and enterprises to reduce their 'carbon footprint', or even to become 'carbon neutral' in the long run. For supporting the national and global arena, economy-environment models can be improved by including more technological detail, by a better representation of the dynamics of taxes and expenditures, and of 'technology learning'. There is still a lack of empirical evidence on the interaction between climate policies and (sustainable) development policies, including adaptation to climate change (IPCC 2007b: 92).

The IPCC has started the preparations for a fifth assessment report due for 2013–2014, for which the scoping will start in 2009. There is still ample time for executing and publishing original research that can contribute to decreasing the risk of global climate disruptions.

81 Global Climate Change, Natural Hazards, and the Environment: an Overview of UNESCO's Activities

Walter Erdelen and Badaoui Rouhban

81.1 Introduction[1]

Under *United Nations* (UN) leadership, global climate change has been placed at the top of the international community's agenda and, to every possible extent, mainstreamed in the departments, funds, and programmes of the UN and its specialized agencies. At the 13th *Conference of Parties* (COP) of the *UN Framework Convention on Climate Change* (UNFCCC) in Bali, Indonesia, 12 December 2007, UN Secretary-General Ban Ki-Moon stated: "The latest report of the Intergovernmental Panel for Climate Change (IPCC)[2] tells us that, unless we act, there will be serious consequences: rising sea levels, more frequent and less predictable floods and severe droughts, famine around the world, particularly in Africa and Central Asia, and the loss of up to a third of our plant and animal species."[3]

Given its mission, areas of competence, and long-standing experience, the promotion of environmental protection and sustainable development is among the few overriding objectives of the *United Nations Educational, Scientific and Cultural Organization* (UNESCO). The Organization is one of the principal partners of international and intergovernmental environmental programmes and, as such, forms part of the group of "environment organizations" within the UN system. Sustainable development, including environmental issues, is a transversal theme cutting across all areas of competence of the Organization. While the major bulk of the activities are being carried out in the natural sciences and, to a somewhat lesser extent in other sectors of UNESCO, global climate change, natural hazards and environment-related activities have over the last 20 years increased and permeated various sectors of the Organization.

This chapter offers an overview on UNESCO's activities in the natural sciences that contribute to coping with global environmental and climate change, and to assessing natural hazards. This chapter does not intend to be a scientific study on UNESCO's work or to evaluate its effectiveness. It does not provide an exhaustive inventory of all relevant UNESCO activities, and it does not evaluate the impact of its action nor does it offer a comprehensive description of its results. The selected activities referred to below illustrate aspects of UNESCO' actions that are carried out by diverse units which address global climate change from different natural science angles such as the ocean sciences and climate, water sciences, ecological and earth sciences, education, social sciences and information, as well as local and indigenous knowledge.

Further work is being undertaken within UNESCO to refine a strategy for action on global climate change. In May 2008, at its 179th Session, the Executive Board of UNESCO approved in principle the overall terms of this strategy, which draws on two main pillars (UNESCO 2008a): the sound and unbiased generation and use of data, information and research concerning climate change (the knowledge base); and the application of educational tools, specific sectoral measures, and public awareness activities. This strategy aims at assisting Member States to build and maintain a requisite knowledge base; to adopt measures to adapt to the impacts of climate change; to contribute to mitigation of its causes, and to strengthen sustainable development.

1 The authors are grateful to Abdelkrim Aoudia, Salvatore Arico, Siegfried Demuth, Filippo Giorgi, Mario Hernandez, Barry James, Robert Missotten, Douglas Nakashima, Margarete Patzak, Thomas Schaaf, Hans Thulstrup, and Kristine Tovmasjana for useful comments and input on the manuscript. The authors would like to thank Kremena Nikolova and Kristine Tovmasjana for reviewing, editing, and formatting this chapter.

2 See at: < http://www.ipcc.ch/> (30 June 2008): 1 of 2

3 See at: <http://unfccc.int/meetings/cop_13/items/4049.php> (5 February 2008): 1 of 2.

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81.2 UNESCO's Mandate in Relation to Global Climate Change, Natural Hazards, and the Environment

In conducting research on climate, hazard issues, and the environment in a development context, different disciplines from the natural sciences need to join forces through interdisciplinary work to bring solutions to complex problems (Petitjean/Zharov/Glaser/Richardson/de Padirac/Archibald 2006). Within the UN framework, UNESCO has unique sectoral competences encompassing the natural, social, and human sciences, and also the fields of education, natural and cultural heritage, public awareness, and the media. Regarding the environment and climate issues, UNESCO has been active in advancing basic scientific knowledge and in promoting interdisciplinary scientific work through and among its intergovernmental and international scientific programmes. UNESCO is interestingly placed to respond to the broader challenges of such issues because of its transdisciplinary approach to international scientific cooperation. While relevant to the climate problem, many of UNESCO's programmes are concerned with objectives such as sustainable development, biodiversity conservation, adapting to the impacts of global changes on hydrological systems, natural resources management, strengthening water governance for sustainability, oceans, the conservation of natural and cultural World Heritage, indigenous knowledge systems, solid Earth science, and natural hazard assessment.

Developing an effective response to global climate change and the threat of natural disasters calls for action in virtually all of UNESCO's areas of competence. Hence, UNESCO's mandate also covers many of the scientific disciplines involved in disaster preparedness and mitigation, with many programmes in place that deal in one way or another with the study and mitigation of natural hazards, such as earthquakes, volcanic eruptions, landslides, floods, droughts, and tsunamis.

81.3 Climate Research and Oceans

In the area of climate research, UNESCO's task is to provide scientifically rigorous and unbiased reviews of the state of knowledge about climate processes and their impact on vulnerable systems, whether environmental, economic or social. The *Intergovernmental Oceanographic Commission* (IOC) of UNESCO, which began its work in 1960, is the recognized UN mechanism for global cooperation in the study of the oceans. It leads the field in ocean research. Through its IOC, UNESCO as well as the *World Meteorological Organization* (WMO) have played a central role in providing authoritative scientific and technical information that has enabled evidence-based policy and decision-making, and has informed the work of the IPCC.

Global weather and climate observation and prediction systems are a unique resource coordinated by these UN entities. IOC hosts the secretariat of, or co-sponsors the main ocean entities, such as the *Global Ocean Observing System* (GOOS), the *Global Sea Level Observing System*[4], and the *Ocean Observations Panel for Climate*, all of which seek to provide accurate descriptions of the present state of the oceans, their living resources, and the actual or likely impact of global climate change. UNESCO co-sponsors two key research and monitoring programmes that were specifically developed following world climate conferences held in 1979 and 1992. These are the *World Climate Research Programme*[5] (WCRP), and the *Global Climate Observing System*[6] (GCOS). These programmes provide rigorous and unbiased reviews of the state of knowledge on climate processes and impacts. They contribute directly to the scientific assessments of the IPCC, and to the research and monitoring needs of the UNFCCC[7].

The WCRP aims to determine the extent to which climate can be predicted, as well as the way in which human activities influence climate. The programme encompasses studies of the global atmosphere, oceans, sea and land ice, the land surface, including water and the biosphere that together constitute the Earth's physical climate system. WCRP (chap 78 by Church/Asrar/Busalacchi/Arndt) develops much of the scientific evidence on global climate change, and organizes the model simulations that form the basis of projections by the IPCC.

GCOS is a system which provides observations and promotes research for monitoring, understanding, modelling, and predicting the climate system. GCOS was established to ensure that the observations

4 See at: <http://www.gloss-sealevel.org/> (30 June 2008): p.1 of 2.

5 See at: <http://www.wmo.ch/pages/prog/wcrp/> (30 June 2008): p. 1 of 1.

6 See at: http://www.wmo.ch/pages/prog/gcos/ (30 June 2008): p. 1 of 1.

7 See at: <http://unfccc.int/2860.php> (30 June 2008): p.1 of 3.

and information needed to address climate-related issues are obtained and made available to all potential users. GCOS addresses the total climate system including its physical, chemical and biological properties, and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. Through the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology, IOC coordinates and manages the implementation of an operational ocean observing system in support of GOOS and GCOS, and reports to the UNFCCC.

UNESCO co-chairs the capacity building committee of the *Global Earth Observation System of Systems*[8], which coordinates the development of an integrated observing system for the global environment. As co-chair, UNESCO assists in fund raising, coordination and training, and in the dissemination of information and teaching materials. The Organization is equally part of the *Integrated Global Observing Strategy* which seeks to provide a comprehensive framework to harmonize the common interests of the major space-based and *in situ* systems for global observation of the Earth. Furthermore, UNESCO co-sponsors the *Global Terrestrial Observing System*[9] (GTOS) which assists in the task of detecting and managing global and regional climate variations on land. GTOS carries out observations, modelling, and analysis in support of sustainable development, and facilitates access to information for researchers and policymakers.

In work co-sponsored by UNESCO and the *International Atomic Energy Agency* (IAEA), the Abdus Salam *International Centre for Theoretical Physics* (ICTP) in Trieste, Italy, carries out research in natural climate variability and predictability as well as climate change and related impacts. These efforts aim at improving our understanding of climate predictability at seasonal to decadal scales and anthropogenic climate change, while at the same time studying the impacts of climate variability and climate change on human societies and natural ecosystems. This is done through a combined strategy of data analysis and modelling from the global to the regional scale, and mostly focuses on the regions of Africa, Asia, Europe, and South America. In this respect, the ICTP develops regional climate models, which are currently used by a wide range of scientists for many applications, such as regional scale climate change simulation and the study of the effects of aerosols and land-use change on regional climates. The ICTP also investigates the dynamics and predictability of natural phenomena such as the *El Niño Southern Oscillation*, the *North Atlantic Oscillation* and the *African and Asian Monsoon Systems*. Among the impact activities, the ICTP currently focuses on the hydrological and agricultural impacts of short-term climate anomalies and long-term climate change. Finally, the ICTP coordinates a wide network of climate scientists, mostly from developing countries, provides models and datasets and a forum to exchange information, and organizes regular training workshops both at ICTP and in developing countries.

Since the beginning of the Industrial Revolution, the oceans have absorbed approximately fifty per cent of the man-made CO_2 released into the atmosphere, greatly reducing CO_2 concentrations in the atmosphere, and attenuating its impact on climate. The *International Ocean Carbon Coordination Project*, for which UNESCO provides the secretariat, monitors these vital ocean CO_2 processes through a global network of observatories. Furthermore, the IOC and the Scientific Committee on Oceanic Research periodically assess impacts on ecosystems, coral reefs, and fisheries due to the current rapid acidification.

This is done through a symposium series on '*The Ocean in a High CO_2 World*' aimed at providing sound, unbiased scientific information to decision-makers and the general public. The first symposium results were compiled in a special issue of *The Journal of Geophysical Research*. The Global Coral Reef Monitoring Network[10], which is co-sponsored by the IOC, coordinates global monitoring and seeks to improve the management and conservation of coral reefs, which are declining rapidly in many areas because of changes in acidity, in sea-level and in maximum sea surface temperatures. The *Global Ocean Ecosystem Dynamics Programme*[11] seeks to understand how climate change affects the abundance, diversity, and productivity of marine life. It has specific projects on small pelagic fish species, oceanic top predators, and cod.

8 See at: <http://www.epa.gov/geoss/> (30 June 2008): p.1 of 2.

9 See at: <http://www.fao.org/gtos/> (30 June 2008): p.1 of 1.

10 See at:< http://www.gcrmn.org/> (30 June 2008), p. 1 of 1.

11 See at:<http://www.globec.org/> (30 June 2008), p. 1 of 1.

81.4 Water Resources

With the projected global temperature increase the global hydrological cycle is expected to intensify. As a consequence fresh water will be significantly impacted by global climate change. Availability of fresh water and frequency and severity of extreme events like floods and droughts will be deeply affected. Changes in the magnitude and frequency of extremes will have extensive impacts on water management and agriculture, and will affect human security and livelihoods, aquatic ecosystems, industry, and trigger population movement and migration. The consequences are far-reaching and are likely to be felt most strongly by the most vulnerable.

UNESCO provides the secretariat for the *World Water Assessment Programme* and leads the production team of UN agencies that comprise UN-Water and contribute in an inter-agency collaboration to the *World Water Development Report*, the UN system's triennial reference document that tracks the water-related targets of the Millennium Development Goals (UNESCO 2006). The third edition of the Report, scheduled for publication in 2009, will focus on "Climate Change and Water". The World Water Development Report supports countries in addressing the challenges and achieving the water-related goals of Agenda 21, the UN Millennium Declaration, and the Johannesburg Plan of Implementation. The Report laid the foundation for a continuous, global monitoring system for water issues.

The *International Hydrological Programme* (IHP) of UNESCO is the only intergovernmental programme of the UN system devoted to water research, water resources management, education and capacity-building. Its activities directly address adaptation to the impacts of global changes including climate change on river basins and aquifer systems, on the hydrological cycle and consequent impact on water resources and hydrological extremes, aquatic ecosystems and biodiversity, specific regions such as arid lands and urban conglomerations, and societies most vulnerable to drastic changes in water availability or quality.

Box 81.1: Other projects and programmes. UNESCO carries out other activities addressing water issues, including the following.

- *The Water Programme for Environmental Sustainability*, funded by Italy. Operating in Serbia, North Africa, Vietnam and China, the programme identifies and establishes best practices in response to climate change impacts on water resources.
- *Integrated Urban Water Modelling and Management under Specific Climates* seeks to strengthen the analytical framework for integrated urban water management, with a special focus on developing countries.
- *Groundwater Resources Assessment under the Pressures of Humanity and Climate Change*, focused on Africa, attempts to understand the role of groundwater in the global water cycle, and the impact of climate changes on aquifers. A related programme called Quo Vadis Aquifers seeks to understand the parameters that determine vulnerability of populations dependent upon groundwater resources.
- *Worldwide Hydrological Mapping and Assessments Programme* seeks to summarize information about groundwater on a global scale, to produce a groundwater map of the world, and to evaluate recharge rates under present climatic conditions and under future climate change scenarios.
- *Hydrology for Environment, Life and Policy* (HELP) promulgates the use of modern hydrological monitoring and data transfer techniques, and disseminates understanding of the relationship between global processes and regional hydrology. The information is thus transferred to the public domain and made available to water managers and policymakers.
- *Flow Regimes from International Experimental and Network Data Sets* (FRIEND) was created to develop a better understanding of hydrological variability and similarity across time and space in a changing world through a mutual exchange of data, knowledge and techniques. The programme also provides support to researchers and operational staff of hydrological services in developing countries, thereby contributing to their capacity to assess and manage their own national water resources and furthering the goal of providing a reliable supply of fresh, clean water to the world's poor. Technical output of the programme inform and impact the water policies of national governments and sharing of data between countries and the establishment of regional hydrological databases have made a lasting contribution to international cooperation.
- *Groundwater for Emergency Situations (GWES)* is a UNESCO-promoted project that considers potential water-related catastrophes, and identifies groundwater resources that could temporarily replace damaged supply systems. Devastating natural hazards or weather catastrophes may make communities entirely dependent on groundwater resources, which need to be identified, replenished artificially and safeguarded before disasters strike.

81.5 Ecological Systems

The challenge of sustainable development is to reconcile economic development with the maintenance of a healthy environment. Sustainable development, climate change, natural resource management, and biodiversity are inextricably linked. UNESCO promotes the study of environmental protection, biodiversity conservation, climate change impacts, and sustainable development through its World Network of Biosphere Reserves representing 531 sites in 105 countries (UNESCO 2007). This Network uses the buffer and transition zones of the reserves for research into innovative combinations of afforestation, reforestation, rural energy, infrastructure development, and urban planning. In support of this Network and other biodiversity research and monitoring activities, UNESCO's *Man and the Biosphere Programme* (MAB) provides the scientific basis for integrated ecological approaches for the conservation and sustainable management of ecosystems and their resource bases.

UNESCO is giving consideration to mechanisms that would promote the sustainable management of biosphere reserves by local populations, thus linking interconnected objectives in reforestation for sequestration of greenhouse gases with those for the conservation of biodiversity.

The *Millennium Ecosystem Assessment* (MA 2005) has been instrumental in qualifying and quantifying for the first time ever the status of ecosystem services and how they relate to human well-being (Leemans 2009). The MA was implemented by the main multilateral environmental conventions and a number of UN specialized agencies and programmes, and also benefited from the endorsement by and participation of the World Bank, the Global Environment Facility, and the private sector. The MA succeeded in mobilizing the interest of all these stakeholders in changes in the capacity of ecosystems to deliver key services. As a co-sponsor of the assessment, UNESCO is engaged in a follow-up process, as part of a consortium of agencies led by the United Nations Environment Programme, which aims at translating the findings of the MA into adaptation and mitigation and other management measures in support of appropriate policy responses. UNESCO, the United Nations University, and the International Council for Science are currently developing a research programme aimed at filling the gaps in scientific knowledge identified by the MA.

81.6 Natural Hazards

Global climate change and natural hazards are closely interlinked: natural hazards are becoming more intense and frequent in some regions. UNESCO has been engaged in the study of natural hazards since 1960. It plays an active role in the UN *International Strategy for Disaster Reduction*. The Organization advocates the need to shift emphasis away from a purely relief and disaster response towards a culture of preparedness and prevention. Activities contribute to the studies of hazards of geological origin, such as earthquakes, tsunamis, volcanic eruptions and landslides, and of those of hydro-meteorological origin including tropical cyclones, floods, droughts and desertification (James 2007). Efforts are supported to study the mechanisms of these hazards, to identify their distribution in time and space, and to disseminate information on their occurrence. UNESCO also deals with activities aimed at reducing risks from such hazards through design and dissemination of mitigation measures and information, education, and public awareness (UNESCO-IOC 2006). Hence, support is given to the setting up of reliable early-warning systems, to rational land-use planning, to the development of suitable building design, to the protection of educational buildings and cultural monuments, and to the improvement of environmental defences such as mangrove forests. UNESCO also contributes to the UN *Platform on Space-based Information for Disaster Management and Emergency Response*, implemented as a UN programme under the UN Office for Outer Space Affairs, which provides access to and develops the capacity of all countries to use space-based information to support disaster management.

The ICTP carries out research in solid-Earth geophysics and space geodesy aimed at improving our assessment of earthquakes, tsunamis, and volcanic hazards. The ICTP is currently focusing on the mutual relationships between climate and tectonics, and on the effects of global change in terms of a wide spectrum of natural hazards. The institution is active in pre- and post-disaster investigations, and has mapped earthquake hazards in different countries and zoned the most hazardous megacities. The ICTP transfers cutting edge methodology to developing countries through joint projects and training workshops.

Box 81.2: Priority - Gender Equality
Gender equality is one of UNESCO's two priorities and is mainstreamed into several programmes and activities. There is evidence that women are affected differently and more severely by climate change, and its impact on agriculture, natural disasters, and climate change-induced migrations. There is also a wealth of evidence indicating that women play important roles in adapting to climate change. UNESCO will address this critical consideration in information sharing and outreach in the formulation of climate change adaptation strategies and climate-related disaster preparedness efforts to ensure that women and girls are informed to participate in planning and decision-making.

UNESCO and WMO, building on past cooperative success, launched the *International Flood Initiative* (IFI) during the 2005 World Conference on Disaster Reduction in Kobe, Japan to address existing management gaps and to provide a platform for further collaborative efforts. The overall objective of the initiative is to build the capacity necessary to understand and better respond to flood hazards, vulnerabilities, and benefits. The initiative will enable countries to stimulate research, improve training in both informal and academic settings, and to promote networks among professionals[12]. It also seeks to introduce adaptation strategies appropriate for each area.

UNESCO's MAB Programme has been particularly concerned with drought and combating desertification and has made a significant contribution to the *UN Convention to Combat Desertification* (UNCCD)[13]. MAB addresses the interface between development and environment studying the impact of human activities on fragile environments such as arid, semi-arid, and drought-prone lands. Dealing with global climate change in drylands requires innovative solutions, which seek to foster science education, preserve biological diversity, and raise environmental awareness. In the same vein, UNESCO has been involved in drylands research through IHP in facilitating the development of a Regional Integrated Drought Management Centre in Sub-Saharan Africa. A project called *Global Network on Water and Development Information for Arid Lands*, seeks to strengthen the global capacity to manage water resources of arid lands through international and regional cooperation networks. Another project, *Sustainable Management of Marginal Drylands* (SUMAMAD), is aimed at tapping the traditional knowledge of indigenous populations and using this as part of a management approach that promotes economic sustainability and resource conservation. Moreover, the SUMAMAD project explores soil and water conservation in drylands and proposes site-specific alternative income generating opportunities for local communities to promote sustainable development without disrupting fragile dryland ecosystems.

81.7 UNESCO's Additional Activities

81.7.1 Earth Sciences

One of the topics of UNESCO's *International Geosciences Programme* (IGCP) on 'Global Change and Evolution of Life: Evidence from the Geological Record seeks to understand how climate change has impacted on water supplies, the environment, and human society through time. Understanding climate trends relies heavily upon the preserved geological record. By studying this record, Earth scientists are coming to an understanding of how the climate system works, how it has changed in the past, and what its future state may be like.

Changes in climate and life on Earth are preserved in the geologic record. Ice and dust records, terrestrial and ocean sediments, and past chronological changes plant and animal communities, are all part of this record. Five major and ten smaller mass extinctions have punctuated the history of life. One of the 18 IGCP projects which deals with paleo-climate change is "*The rise and fall of the Vendian Biota*". Besides its scientific research on past global change, the project is also active in organizing public outreach and education projects.

UNESCO and the *International Union of Geological Sciences* (IUGS) are joint organizers of the *International Year of Planet Earth* (IYPE)[14], declared by the United Nations General Assembly. IYPE focuses on the fundamental role of the Earth sciences, and it aims to demonstrate new and exciting ways in which

12 International Flood Initiative, 2007. (UNESCO-IHP, Paris).
13 See at: <http://www.unccd.int/> (30 June 2008): p.1 of 2.
14 See at: <http://www.yearofplanetearth.org/> (30 June 2008), p.1 of 1.

they can help future generations to meet the challenges of ensuring a safer and more prosperous world by maintaining a healthy Earth system. Anticipating IYPE during the 34th session of its General Conference in autumn 2007, UNESCO organized a major exhibition on Planet Earth with five themes: the Earth system, dynamic Earth, diverse Earth, changing Earth, and sustaining the Earth. IYPE was launched in February 2008 at UNESCO Headquarters. One of the ten themes of the Year is dedicated to past and recent climate change and geohazards. The initiative will seek to raise the awareness of the contribution to, and role of the Earth sciences in society in the minds of politicians, decision-makers, the media, and the general public.

81.7.2 Education, Communication, and the Social Sciences

UNESCO as the UN specialized agency for education has also been designated as the lead agency for the United Nations *Decade of Education for Sustainable Development* (DESD) 2005–2014, which includes climate change as a thematic priority. DESD aims at mobilizing all strata of society and available expertise in both formal and non-formal education to further the principles, values, and behaviour linked to sustainable development, and at inducing the necessary behavioural and attitudinal changes required to minimize negative climate impacts, including through education for disaster risk reduction, and climate change education. DESD has four priority areas: promoting basic education, reorienting and revising education programmes, developing public understanding and awareness, and providing practical training. Education for sustainable development is an important means of mitigating natural hazards and slowing the effects of harmful climate change. It is also a way of building global partnerships for effective action, showing people that their activities can contribute either to harmful consequences or to lasting solutions. UNESCO's Associated Schools Project Network of some 7,900 educational institutions in 176 countries is used for pilot testing of prototype materials and awareness-raising tools, providing information to educators, teachers, and students worldwide. UNESCO's programmes provide support for institutions of higher education through the UNESCO Chairs programme and the *University Twinning and Networking Scheme* (UNITWIN) Network.

UNESCO's programmes in communication and education provide a scope for much greater involvement, since education and public awareness cut across all sectors and existing activities. The role of the mass media for an engaged discussion on mitigating the impact of and adaptation to climate change is a vital element. The Organization has produced a model for journalism education at diploma, undergraduate, and post-graduate level that includes a module on "Reporting climate change: assessing coverage past and present; issues of balance and expertise in climate change debate".

UNESCO's specialization in social and human sciences provides a specific contribution within the UN system. It helps to improve understanding of the vulnerability of human beings and their natural environment, as well as the political implications of this. Contributions from natural and human and social sciences are adding to the growing scientific knowledge base on climate change, variability, and their impacts. The UNESCO social and human sciences programme, including the *Management of Social Transformation* (MOST) Programme has recently begun working to develop knowledge, research and capacity on urban policy, giving consideration to the environmental impact of uncontrolled urbanization of rural and coastal territories due to climate change-related migration and consumption. This programme, in also addressing the issue of environmentally-induced and climate-induced migration (IOM 1996, 2007), is developing tools to assess the impact of climate change on migration flows and addressing the relevance of migration policies. UNESCO's environmental ethics programme will work to improve education and awareness on the ethics of climate change, addressing questions crucial for decision-making such as how to assess the needs and rights of future generations, and how to determine what is worth protecting, and at what cost or consequence.

81.7.3 Local and Indigenous Knowledge

UNESCO seeks to reinforce international recognition of local environmental knowledge as a component of sustainable development and as a critical factor in community-level natural disaster preparedness and response. The UNESCO *Small Island Developing States* (SIDS) Programme and its *Local and Indigenous Knowledge Systems* (LINKS) Programme promote local-level observations and understanding of climate change which provide the basis for community-based adaptation measures for vulnerable popula-

tions in remote areas (Boelens/Chiba/Nakashima 2006).

In collaboration with the Office of the UN High Commissioner for Human Rights (UNHCR), and the Secretariats of the UN Permanent Forum on Indigenous Issues of the *Convention on Biological Diversity*[15], UNESCO has recently launched an internet-based discussion forum that will explore local and indigenous peoples' observations of climate change impacts and opportunities for adaptation. These insights into climate change processes at the local level will provide an important complement to large-scale scientific observations, while also strengthening the voice of vulnerable communities in international processes.

81.7.4 World Heritage Preservation

UNESCO is the leading global guardian of the world's cultural and natural heritage, and as such, is closely involved in risk assessment and rescue operations to protect natural protected areas, monuments, historic urban quarters, archaeological sites, cultural landscapes, etc. In one of its most famous actions, for example, UNESCO assisted in the safeguarding of works threatened with destruction by floods in Florence and elsewhere in Italy in 1966.

UNESCO provides support to States Parties to the Convention concerning the Protection of the World Cultural and Natural Heritage of 1972 in implementing preventive and corrective measures including to combat climate change impacts on natural and cultural world heritage, by raising awareness and sharing of knowledge and experience, developing pilot projects, and developing policy on climate change impacts on world heritage (Colette 2007a). To address the concern about climate impacts on sites of natural or cultural importance, UNESCO's World Heritage Centre has established a working group to review the nature and scale of the climate risks threatening heritage properties, and to help countries devise appropriate responses (Colette 2007b).

Within its partnerships with space agencies, space research institutions, and universities, UNESCO has recently signed an agreement with Spot Image, a subsidiary of the French space agency. This partnership aims to use Earth observations from space in order to assist the World Heritage Convention[16] with its current programme on climate change. For the purpose of using earth observation from space for World Heritage sites, UNESCO and its partners are focusing on themes like: monitoring the state of glaciers, e.g. Argentinean World Heritage glaciers in close collaboration with the Argentinean Space Agency; monitoring the state of conservation of UNESCO World Heritage tropical forests (in partnership with various space agencies and universities); assessing the status of coral reefs and eventual bleaching effects in Meso-America (UNESCO and the European Space Agency); assessing the permafrost in the Altai Mountains and associated impacts to the archaeological frozen tombs (UNESCO and University of Ghent), and monitoring the effects of increasing rainstorms (e.g. Machu Picchu and Chan Chan, Peru).

81.7.5 Mountains, Coasts, and Small Islands

Many of the world's mountain ecosystems are undergoing important environmental changes, which could affect the ability of their populations to make a living. A UNESCO-supported programme called *Global Change in Mountain Regions* (GLOCHAMORE) is working with 25 mountain biosphere reserves in all world regions and the scientific community to detect signals of global (including climate) change in representative mountain ranges of the world (Gurung 2006). More specifically, GLOCHAMORE addressed the impacts of global climate change on the biophysical environment and the socio-economic conditions of mountain communities. As a result, the GLOCHAMORE Research Strategy is a blueprint providing guidelines on how to study biophysical, social, and economic aspects (e.g. glacial melt, biodiversity, hazards, and mountain economies) in site-specific contexts using mountain biosphere reserves as study and monitoring sites. The Research Strategy aims at establishing a global study approach with a view to harmonize and compare data and research results.

UNESCO gives particular attention to environment and development issues in SIDS through a broad range of activities supporting the implementation of the *Mauritius Strategy*, adopted at the UN SIDS meeting held in Mauritius in January 2005. UNESCO brings together experts in its area of expertise to mitigate the impacts of coastal erosion and other disaster risks through interdisciplinary and intersectoral action (Hadley/Ghina 2007). The impacts of climate change on SIDS and on indigenous communities is a central area of focus in this effort. As an example, UNESCO's Sandwatch[17] initiative provides a framework whereby students, teachers, and communi-

15 See at: <http://www.cbd.int/> (30 June 2008), p. 1 of 1.

16 See at: <http://whc.unesco.org/en/conventiontext/> (30 June 2008), p.1 of 9.

ties in 37 countries are learning first hand about the direct and indirect impacts of climate change on their beaches and coasts – impacts such as rising sea levels, increasing air temperatures, and more intense hurricanes/cyclones/typhoons – and how they can work together to devise and implement approaches and projects to cope with these changes (Cambers/Ghina 2005).

Making the public more aware of the threats created by coastal erosion and sea-level rise is essential in developing an effective coping strategy, which is also the object of the UNESCO project *Mainstreaming Awareness and Mitigation of Marine-Related Hazards and Risks in Integrated Coastal Area Management.* The project is being carried out to develop guidelines on the development and integration of hazard awareness, emergency preparedness and mitigation, and adaptation practices into coastal development planning.

With technical and financial support from UNESCO and its UNITWIN, institutions of higher learning in Malta, Mauritius, the Pacific SIDS, and the Virgin Islands have set up a University Consortium of Small Island States to promote practical, high quality training and research in the fields of climate change, natural and environmental disasters, waste management, resources management, culture, and sustainable living and development.

81.8 Conclusions and Outlook

The UN system is widely acknowledged as the central multilateral framework through which the international community can address global challenges, including by providing a coherent approach to global climate change and natural disaster reduction. UNESCO is committed to play its part in fulfilling this global mission. Action in these fields increasingly depends on the active involvement and support by all major stakeholders: governments, the private sector, and the different components of civil society including scientists, educators, parliamentarians, media, local authorities, youth, women's organizations, and other non-governmental organizations. UNESCO is expected to enhance cooperation with all these major groups. Moreover, cooperation between governmental and non-governmental stakeholders will have to be fostered; UNESCO will actively contribute to this process, in particular in the context of existing mechanisms and other global and regional environment-related events and processes.

The response to global environmental and climate change and natural hazards must be science-based, benefit from comprehensive analysis, and be continuously updated by monitoring of data, trends, and new insights. Greater understanding of the scientific foundations of emerging issues and threats will require increased investment of effort. The provision of unbiased and technically sound data and information is fundamental to global environmental and climate change action: it is critical for enabling adaptation and mitigation policies. Without such information, the causes, impacts, and appropriate levels of response are open to dispute. UNESCO will further support sound and unbiased scientific research and will help translate research results into advice for policy makers and information for the general public. In this respect, the governing bodies of IOC and the advisory bodies of the international and inter-governmental scientific programmes (IGCP, IHP, MAB, and MOST) will continue to play their important roles in defining priorities for their respective contributions to global environmental and climate change issues. Furthermore, the Organization will promote interdisciplinary scientific work among its scientific programmes and interdisciplinary and multidisciplinary activities between its programmes in the sciences, education, culture, and communication.

17 <http://www.sandwatch.ca/>, 30 June 2008, p.1 of 1.

82 Climate Change and Development: UNDP's Approach to Helping Countries Build a New Paradigm

Veerle Vandeweerd, Yannick Glemarec and Vivienne Caballero

82.1 Introduction[1]

UNDP recognizes climate change as a key human development issue. Without immediate action, climate change will reverse decades of development achievements and undermine efforts to reach human security and achieve the *Millennium Development Goals* (MDGs). As the global development network of the United Nations, UNDP's goal is to align human development and climate change responses through a coordinated mix of policy and financial instruments. To achieve this, UNDP is engaging in strategic partnerships to support the efforts of developing countries and vulnerable groups to significantly scale up mitigation and adaptation action. Effective action is possible and affordable (Stern 2006). The benefits of moving towards less carbon intensive yet sustainable economies are likely to be immense, but so would be the costs of inaction (UNDP HDR 2007/2008: 8).

Calling for a new development paradigm that integrates climate change into strategies and plans at all levels, and that links the policy setting with the financing of solutions, UNDP is committed to enhance development taking into account the rapid global environmental changes in key ecosystems as well as in the economic and financial sphere (box 82.1).

The future of global human security is directly dependent on the success of the development measures put in place today by the international community. There is unprecedented scientific consensus that urgent decisive action is required now. The daily life of the poorest 40 per cent of the world's population – about 2.6 billion people – is already affected by climate change (UNDP HDR 2007/2008: 2). This segment of the population has contributed the least to global warming and is likely to be the least resilient to the impacts of climate change, such as worsening floods, droughts, crop failures, and more intense and frequent extreme weather events (IPCC 2007b: 373).

Cognizant of this critical global environmental change issue and aware of the need for a new development paradigm, UNDP is committed to empowering countries to alleviate poverty while meeting the challenges arising from a changing climate. In its role as the United Nations' global development network, UNDP aims at aligning human development and climate change management efforts by promoting mitigation and adaptation activities that do not slow socio-economic progress down but rather accelerate it.

Although the majority of efforts to tackle climate change have focused until now on reducing emissions (Schipper/Cigarán/Mckenzie Hedger 2008: 134), it is now clear, and fully accepted by the negotiators of the climate change regime, that the window of opportunity for action on adaptation is as narrow as the one for mitigation, if the MDGs (box 82.2) are to be achieved. Successful climate change management will require a remarkable scaling up of both mitigation and adaptation actions at the global, regional, national, and local levels.

This chapter discusses UNDP's strategy to help countries build a new development paradigm that effectively addresses climate change. Decades of experience in the international development arena allow UNDP to recognize climate change as a fundamental challenge with substantial implications for the entire spectrum of human development, including conflict-prone issues such as water scarcity, soil degradation, food security, poverty, and environmental migration.

1 The authors gratefully acknowledge the substantive contribution made to this paper by Luis Gómez-Echeverri, independent climate change expert, and the input provided by other UNDP experts. This paper is based on, and relies heavily on, the corporately endorsed *UNDP Climate Change Strategy* (2008), which is the result of a consultative and collaborative effort within UNDP and outside experts. The views expressed in this publication are those of the authors and do not necessarily represent those of the United Nations, including UNDP, or their Member States.

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Box 82.1: UNDP. **Source**: <www.undp.org>.

UNDP is the UN's global development network, an organization advocating change and connecting countries to knowledge, experience and resources to help their people build a better life. UNDP works in 166 countries, assisting them to identify and develop their own solutions to global and national development challenges. As they develop local capacity, they draw on the people of UNDP and our wide range of partners.

World leaders have pledged to achieve the *Millennium Development Goals*, including the overarching goal of cutting poverty in half by 2015. UNDP's network coordinates global and national efforts to reach these goals. UNDP's focus is helping countries build and share solutions to the challenges of: democratic governance, poverty reduction, crisis prevention and recovery, environment and energy, and HIV/AIDS.

UNDP helps developing countries attract and use aid effectively. UNDP encourages the protection of human rights and the empowerment of women. Its annual *Human Development Report* (HDR) focuses the global debate on key development issues, providing new measurement tools, innovative analysis and often controversial policy proposals. The global HDR's analytical framework and inclusive approach carry over into regional, national and local HDRs.

Box 82.2: Climate change threatens achieving the MDGs. **Source**: <www.undp.org/mdg>

- *MDG 1 (Poverty and hunger):* People relying on subsistence agriculture and natural resource harvesting – such as fishing, hunting, forestry – will be among those most impacted by climate change. In addition to threatening livelihoods, a change in cropping patterns will affect food security, international production and trade, and international human security (WBGU 2008: 94). These expected changes fundamentally hinder the efforts to reduce extreme poverty and hunger.
- *MDG 2 (Education):* Weather events and climate related stresses can interfere with the time and opportunity for children to attend school. Climate change also threatens to destroy or force a change of use of infrastructure such as schoolhouses, and it may increase the displacement and migration of families, thus disrupting and limiting educational opportunities.
- *MDG 3 (Gender)*: Since a disproportionate percentage of the poor are women, climate change puts them most at risk in their traditional roles as the primary users and managers of natural resources, primary caregivers and unpaid labourers (Stern 2006:114). Efforts to include women in planning processes will help ensure that their particular needs and constraints are recognized and addressed.
- *MDGs 4,5,6 (Health related):* The effects of climate change on health are particularly important in water management since floods and droughts can lead to increased vulnerability to water-borne diseases, and lack of safe drinking water and sanitation (Biemans/ Bresser/ Kabat/van Schaik 2006:30). The spread into new areas of vector-borne and air-borne diseases and heat related stresses are also expected to increase. By 2020, between 75 and 250 million people, mainly in Africa, are projected to live under increased water stress. For 2080, the figure is estimated to be as high as three billion people (IPCC 2007:194). Water scarcity can lead to conflict over resources jeopardizing human security.
- *MDG 7 (Environment):* Climate change is a lead cause of global environmental change. It will impose fundamental alterations to ecosystem structure, function and productivity. This includes a serious threat to biodiversity and the need to rethink land use and natural resource management (WBGU 2008: 5).
- *MDG 8 (Partnership):* Addressing climate change and global human security will demand unprecedented cooperation among a wide variety of actors and institutions, including scientific, business, political and advocacy communities.

This chapter proposes that these issues need to be tackled at the very core of development: strengthening institutional capacities for more cohesive and efficient governance, integrating climate change into strategic planning as well as conflict prevention efforts, and equitable economic development. In the climate change context, this implies scaling up mitigation and adaptation actions.

Discussing UNDP's vision, this chapter presents a brief review of the current climate change context for action (82.2); an overview of UNDP's ongoing activities highlighting experience with mitigation, adaptation, and existing partnerships (82.3); and a discussion on the dimensions and strategic priorities for scaled up action (82.4).

82.2 Analytical Framework

The impacts of climate change will fall disproportionately on the poor and lead to greater inequality and insecurity in developing countries (Stern 2006: 29).

Climate change intensifies existing environmental crises thereby triggering land-use and water-use conflicts as well as environmental migration (GTZ 2008: 19). The effects of climate-induced shocks on critical governance function and structure will intensify the relationship between global environment and human security. As such, these effects may disrupt institutional and political stability and magnify the propensity to conflict. For instance, human migration from arid and land-locked Burkina Faso to coastal Cote d'Ivoire – due to environmental degradation – can be linked, along with other influencing factors, to the political collapse and civil war experienced in the region (UNDP 2009: 11).

Water shortages will be exacerbated, leading to water scarcity problems, reducing access to safe drinking water and having an impact on precipitation frequency and intensity, which affects local growing seasons as well as international production and trade (UNESCO-WWAP 2003). In particular, this will be the case for the poorest and most vulnerable countries, which are already facing serious development challenges and human security threats (Brown/Hammill/McLeman 2007: 1142). Climate change will also have a harmful effect on health and it will increase the level of risk for the most vulnerable particularly to the impacts of extreme weather events and severe droughts (Epstein/Mills 2005: 9). And there is evidence that these and many other effects are already being felt in many regions of the world, for instance the resurgence of malaria in East African highlands (Cox/Hay et al 2001: 1).

The *Intergovernmental Panel on Climate Change* (IPCC 2007) stated that the world is warming and that human activity – rather than just natural variations – has contributed to current levels of warming. The IPCC concluded that regional climate patterns are changing, for instance: crop yields could increase by 20 per cent in East and South-east Asia, but decrease by up to 30 per cent in Central and South Asia; and rain fed agriculture could drop by half in some African countries by 2020. The loss of biodiversity will have additional negative effects on people's livelihoods and ecosystem stability (IPCC 2007: 280).

The 2007/2008 *Human Development Report* (HDR) estimated that stabilizing greenhouse gas concentrations in the atmosphere at a level that prevents catastrophic climate change will require a global 50 per cent reduction of greenhouse gas emissions by 2050 from 1990 levels. The report recommended that both developed and developing countries reduce their emissions. Developed countries are to cut greenhouse gas emissions by at least 80 per cent by 2050, with 20–30 per cent cuts by 2020. For major emitters in developing countries, the recommendation is to have an emissions trajectory that peaks in 2020, with 20 per cent cuts by 2050. (UNDP HDR 2007/2008)

Addressing climate change will demand unprecedented efforts and currently available financial resources are likely to be insufficient. However, as suggested by the Stern Review (2006), failure to invest in activities addressing climate change could cost the global economy up to 20 per cent of its GDP (UNFCCC 2007d; IEA 2006).

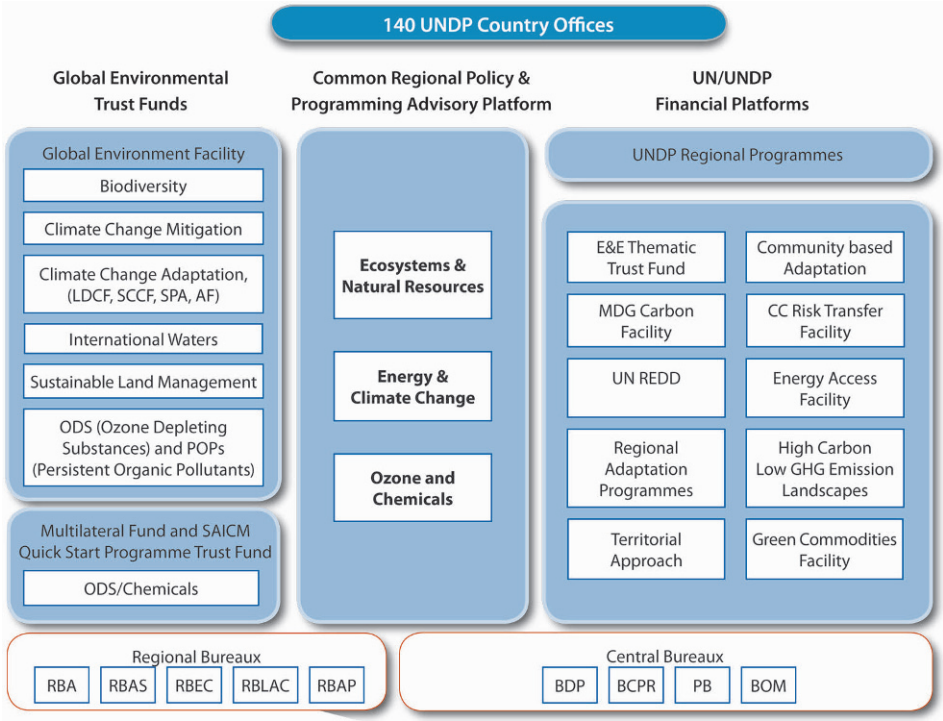
A number of major international events and agreements confirm the unequivocal consensus by the political, business, scientific, and advocacy communities to agree on a future climate change agreement as was stressed by the decisions of the UN Secretary-General's High Level Event (2007) and Summit on Climate Change (2009), by the discussion by the Security Council on the security implications of climate change impacts (2007) and the Communiqués of the G-8 Summits at Heiligendamm (2007), Hokkaido Toyako (2008) and Aquila (2009). The 'Bali Road Map' (2007), adopted by governments at the 13th *Conference of Parties* (COP-13) of the UNFCCC, established ambitious goals to be achieved by COP-15 in Copenhagen. With the Copenhagen Accord (2009), the world made essential progress towards a future international framework. While negotiations will need to continue through COP-16 in Mexico (2010), the Copenhagen Accord is the reflection of an unprecedented high-level political statement of purpose on the issue of climate change (Averchenkova UNDP 2010: 5).

The UN Secretary-General launched in February 2010 a High-Level Advisory Group on Climate Change Financing, aiming to mobilize new and innovative financial resources to reach US$100 billion annually by 2020, as agreed in the Copenhagen Accord. In the same spirit, UNDP continues to advocate for the recognition of sustainable development and poverty eradication as global priorities that need to be at the foundation of international negotiations if the world is to move forward in a path of greater climate security.

82.3 UNDP's Experience with Global Environmental Change

In accordance with its overarching mission to fight poverty, the focus of UNDP's work has been to align

Figure 82.1: Delivery of UNDP Environmental Finance Services **Source:** UNDP (2009a: 8).



sustainable human development and climate change policy responses paying special attention to the needs of the poorest and most vulnerable developing countries. Delivering environmental finance services, UNDP uses its resources to leverage new sources of environmental finance and to re-direct financial flows from public and private sectors towards environmentally sustainable practices (figure 82.1). Highlights of UNDP's results in environment for the period 2005–2009 include an estimated 413 million tonnes of CO_2 emissions avoided as a result of effective projects and 127 new protected areas covering more than 10 million hectares created in 50 countries.

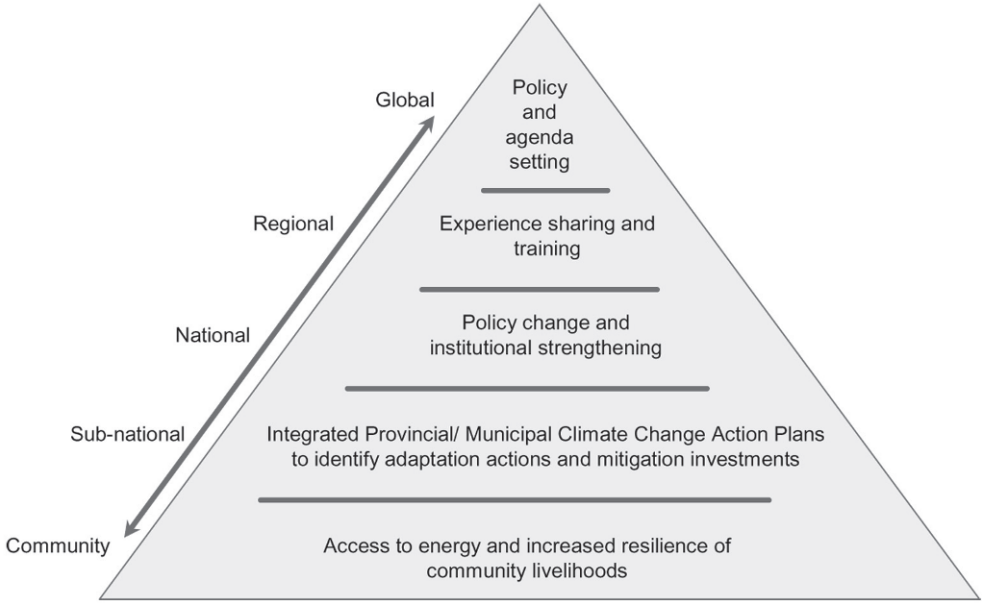
With widespread country office presence, UNDP has mobilized approximately $1.58 billion (and $3 billion in co-financing for the period 2004–2007) in over 140 countries through a diverse project portfolio that supports climate change responses at the global, regional, national, sub-national, and community/local levels (figure 82.2).

UNDP's partners comprise a variety of national, bilateral, and multilateral development agencies, financial institutions and civil society, including the World Bank, Regional Development Banks, other UN agencies, private sector, regional associations, NGOs, CBOs, faith communities and academic institutions, among others.

In partnership with the World Bank and UNEP, UNDP is an implementing agency of the *Global Environment Facility* (GEF), and also the recipient of large amounts of other funds dedicated directly and indirectly to global environmental change. With a growing climate change portfolio, integrated country level solutions are promoted in recognition of the fact that mitigation and adaptation are closely interlinked and essential to one another. For instance, reducing emissions through sustainable land management practices increases the resilience of ecosystems and in turn improves the resilience and adaptive capacities of vulnerable communities (UNDP 2009: 57). Moreover, a shift from fossil fuels to renewable energy alternatives can reduce the energy costs of oil-importing countries, reduce gender inequalities, improve health, increase energy security, provide increased access to energy for the rural poor, and reduce local environmental health impacts (UNDP 2008a: 12).

UNDP has made strides towards 'Delivering as One UN' by partnering with UNEP and committing to jointly lead the UN System in the task of incorporating climate change in development strategies and programmes at the country level. Both agencies are working in joint programmes such as the *Territorial Approach to Climate Change* (TACC), which promotes climate resilient and lower carbon territories

Figure 82.2: Support Levels for Global Environmental Change Responses. **Source:** UNDP (2008a: 27).



(box 82.7), and the *Poverty and Environment Initiative* (PEI), which mainstreams environment into national development planning.

Another step forward is the Nairobi Framework, agreed in 2006 by UNDP, UNEP, the World Bank, the African Development Bank, and the UNFCCC, with the purpose of supporting the capacity development efforts of low income countries vis-à-vis the CDM.

Launched in 2007, the UNDP-Spanish MDG Achievement Fund pursues a coordinated response of the UN system towards the achievement of the MDGs. The Fund has been supporting adaptation through an initial allocation of US$94 million, which finances inter-agency initiatives that strengthen the adaptive capacity of developing countries.

More recently, UNDP, FAO, and UNEP have inaugurated the United Nations Collaborative Programme on *Reducing Emissions from Deforestation and Forest Degradation in Developing Countries* (FAO/UNDP/UNEP: 2008). This multi-donor trust fund was established in 2008 to allow donors to pool resources and provide funding to assist developing countries in formulating and implementing national REDD strategies and mechanisms. At the national level, UN-REDD is implemented in coordination with the World Bank's *Forest Carbon Partnership Facility* (FCPF).

82.3.1 Climate Change Mitigation: UNDP's Experience

With over 15 years of experience in approximately 100 countries supporting energy efficiency and clean energy development, UNDP in partnership with GEF have been deemed particularly successful at developing countries' capacities to remove barriers to clean energy and create greater energy access for the poor. Five strategic priorities are addressed: (i) transforming market policies to promote energy efficient products and processes, (ii) increasing access to local sources of financing for renewable energy and energy efficiency, (iii) promoting power-sector policy frameworks to support renewable energy, (iv) renewable energy for poverty alleviation, (v) catalysing shifts in modes of urban transport.

The approach to mitigation has evolved from supporting technology demonstration projects, to establishing an enabling environment for direct investment towards environmentally-friendly and climate-friendly technologies (box 82.4). In the case of wind power, for example, where UNDP may have supported pilot wind farms in the past, it now focuses on the policy change and institutional development needed to promote greater private sector investment in wind energy, such as smart wind tariffs, power purchase agreements, and capitalization of pilot financial instruments (UNDP 2008a: 13).

UNDP has directly reduced CO_2 emissions from land use change, specifically from land degradation

Box 82.3: MDG Carbon Facility. **Source**: <www.mdgcarbonfacility.org>.

The MDG Carbon Facility assists developing countries to leverage carbon finance for clean energy development and sustainable land use practices. Building on UNDP-GEF market development activities and UNDP capacity development efforts for CDM and JI, the Facility provides dedicated project management services to individual project investors in emerging carbon markets. The core objectives of the Facility are: (i) up-scaling carbon finance in countries that are presently under-represented; and (ii) promoting carbon projects that contribute both to climate change risk management and to the MDGs. Once a carbon market is established and inclusive of private-sector investment and technologies conducive to long-term development, the MDG Carbon Facility is designed to exit that market as its goal of market transformation is considered accomplished (UNDP 2009: 119). UNDP proposes a three-step approach to capacity development and leveraging carbon finance:

Box 82.4: Montreal Protocol Programme. **Source**: <www.undp.org/montrealprotocol>.

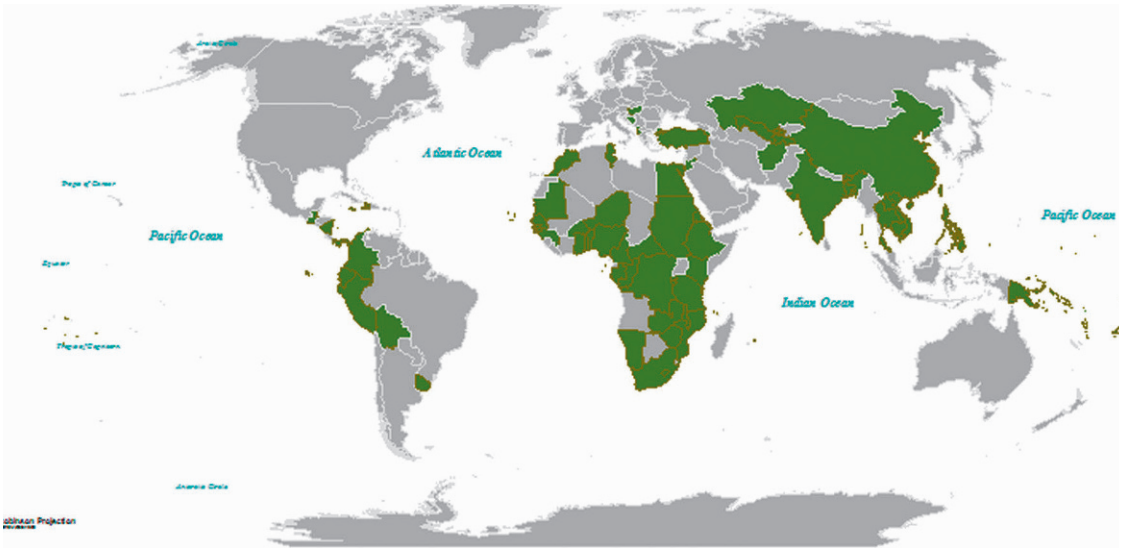
By 2010, the Multilateral Fund for Implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer (MLF), as a whole, has prevented the equivalent of between 9.7 and 12.5 gigatonnes of CO_2 from entering the atmosphere. The acceleration of the phase-out of the last group of substances – HCFCs – that are both ozone depleting chemicals as well as global warming gases was approved in 2007, and will enable the MLF to continue to play an important role in climate change mitigation. As implementing agencies, over the last 20 years UNDP has eliminated over 60,000 tonnes of ozone depleting substances that are also potent greenhouse gases, mobilizing $500 million in 100 countries to adopt strategies that preserve the ozone layer and provide climate benefits.

Box 82.5: Capacity Development for the Clean Development Mechanism. **Source**: <www.undp.org/climatechange/carbon-finance/CDM/>.

Since 2000, UNDP has implemented CDM and JI capacity development activities in over 20 countries spanning several regions (UNDP 2006: 20). The ultimate goal is to enable developing countries to take maximum advantage of the new financing opportunities provided by the CDM. In countries where adequate technical assistance and private sector involvement has been sustained over an extended period of time, significant lessons have been learnt. These countries include Brazil, China, India, Morocco, the Philippines and South Africa. In Brazil, for example, UNDP, in association with a private energy company, led a multi-agency CDM project cycle for bagasse co-generation accounting for 120,000 tonnes of CO_2 per year mitigated over a 14 year period. The project used a learning-by-doing methodology and was coordinated with public-private capacity, creating an enabling environment to policy-making. Support to knowledge sharing include the completion of a worldwide review of experience with CDM "Clean Development Mechanism: An assessment of Progress" (UNDP 2006a) and "The Clean Development Mechanism: A User's Guide" (UNDP 2003).

and deforestation, over an area of more than 1 million km^2. This was achieved through strategic support to programmes on sustainable land management and biodiversity conservation. In doing this, UNDP has been able to prove methodologies and adopt best practices to help countries develop the systemic and institutional frameworks and capacities to manage *land use and land use change* (LULUC). For example, providing support to efforts towards decentralized and participatory governance, enhanced property rights, land use planning, and transforming market systems to deliver financial payments to small farmers and other landowners maintaining on-farm ecosystem goods and services, including carbon storage (UNDP 2008a: 13).

Figure 82.3: UNDP-GEF Adaptation portfolio. UNDP has leveraged over $800 million (including grants and co-financing) for climate change resilient development in 75 countries. **Source:** Data generated from UNDP 2010 <http://ccmap.undp.org>.



82.3.2 UNDP's Role in Enhancing Countries' Adaptive Capacities

The key focus in this area has been on building adaptive capacities and increasing long-term resilience of vulnerable ecosystems and economies in developing countries at the national, sub-national, and local levels. The aim is to integrate climate change responses into national development planning processes, policy-setting, and key sustainable development practices, while identifying and leveraging financing for adaptation activities (UNDP 2005). The overall objective is to promote 'no regrets' short- and long-term coping strategies to reduce adverse impacts on vulnerable communities and countries (figure 82.3).

Support to adaptation activities spans over a wide range of cross-cutting areas, including water governance and sanitation, public health, and disaster risk management. On the latter, the focus has been on working with vulnerable communities to increase their preparedness and resilience to weather-related shocks, in particular drought risk reduction in collaboration with the *Drylands Development Centre* (DDC) and the *Bureau for Crisis Prevention and Recovery* (BCPR).

Projected climate variability induced by climate change will have an acute influence over the hydrologic cycle, which in turn will put pressure on already scarce water resources, leading to increased competition, tension and conflict, particularly over shared water basins (World Bank 2009a: 3) In this context, responsive strategies to prevent climate-induced conflicts in transboundary basins become utterly important (IPCC 2007: 442; Stern 2006: 137). Through a combined portfolio in the areas of water governance and international waters, UNDP is assisting in developing the capacity of water-stressed countries as well as countries sharing large water bodies to identify, design, and implement remedial measures and to enable stakeholders to plan around increasing water scarcity in an equitable, transparent, and peaceful manner. In this process, support has been provided for adopting a framework for cooperation in the Nile Basin, initiating legal reform in the Kura-Aras Basin, and implementing of a conflict resolution mechanism in the Mekong Basin.

At the community level, UNDP implements on-the-ground activities through dedicated facilities such as the UNDP-GEF *Small Grants Programme* (GEF/SGP/UNDP 2007) and innovative partnerships such as the *Community Based Adaptation Programme* with UNESCO and the *United Nations Volunteers* (UNV).

Since 1992, UNDP-GEF has assisted over 100 countries to meet their reporting requirements to the UNFCCC in preparing National Climate Change Vulnerability Assessments and *National Adaptation Plans of Action* (NAPAs). Based on analyses of their NAPAs, assistance will be provided to more than 30 least developed countries to facilitate access to resources from the UNFCCC *Least Developed Countries Fund* (LDCF) for priority adaptation initiatives.

Box 82.6: Methodologies and resources on adaptation. **Source**: <www.adaptationlearning.net> and <www.undp.org/climatechange/pillar_adaptation.shtml>.

Focusing its efforts on climate risk 'hot spots' where both vulnerability and hazard are high, UNDP has developed a set of resources to assist developing countries in planning adaptation through development:

Methods for adaptation

- *Adaptation Policy Framework* (UNDP 2005): comprehensive guidance for policy-makers through a structured approach to formulating and implementing adaptation strategies, policies, and measures <www.undp.org/climatechange/adapt/apf.html>.
- *Strategic Environmental Assessment Approach to Adaptation* guidance to integrate climate change into national/sectoral development planning and processes www.seataskteam.net
- *Toolkit for Designing Climate Change Adaptation Initiatives* guidance on key steps to formulate adaptation projects <www.undp.org/climatechange/adapt/program.html>.

Programming strategy

- *Thematic Areas Guidance Paper* on baseline and impact projections by region and development challenge as well as opportunities in six thematic areas. <www.undp.org/climatechange/adapt>.
- *Monitoring and Evaluation Framework*: set of indicators linked to the MDGs, to support mainstreaming of vulnerability reduction and adaptive capacity into national development <www.undp.org/climatechange/adapt/program.html>.

Knowledge management

- The *Adaptation Learning Mechanism*: a UN Inter-Agency Global Knowledge Platform that captures and disseminates experiences and good practices <www.adaptationlearning.net>.
- *Country Adaptation Profiles* for 140+ developing countries with multi-model projections, historic trends and projected future changes <http://sdnhq.undp.org/gef-adaptation/profiles/>.

82.4 Scaling Up Climate Change Action: Adopting a New Development Paradigm

A large part of UNDP's portfolio focuses on helping developing countries to create a 'carbon-enabled' environment to attract and drive direct investment toward lower carbon technologies and sustainable land management at the national and sub-national level. This entails providing support and capacity building in the areas of policy formulation, regulatory frameworks, and production of strategies that embed climate change action.

Aiming to help countries achieve market transformation at the national level, UNDP taps into the resources of the wider UN system to complement and synergize its support. UNDP will enhance synergies within the UN family of agencies harmonizing the efforts of the UN at the country level and addressing the interface between the MDGs and climate change. An agreement between the UN and the Bretton Woods institutions on climate change is urgently needed. A collaborative compact on climate change among the UN, IFIs, regional institutions, donor community, and private sector is also a necessity.

UNDP's climate change strategy identifies six key dimensions to be reached through four strategic priorities, as described in sections (82.4.1) and (82.4.2) below.

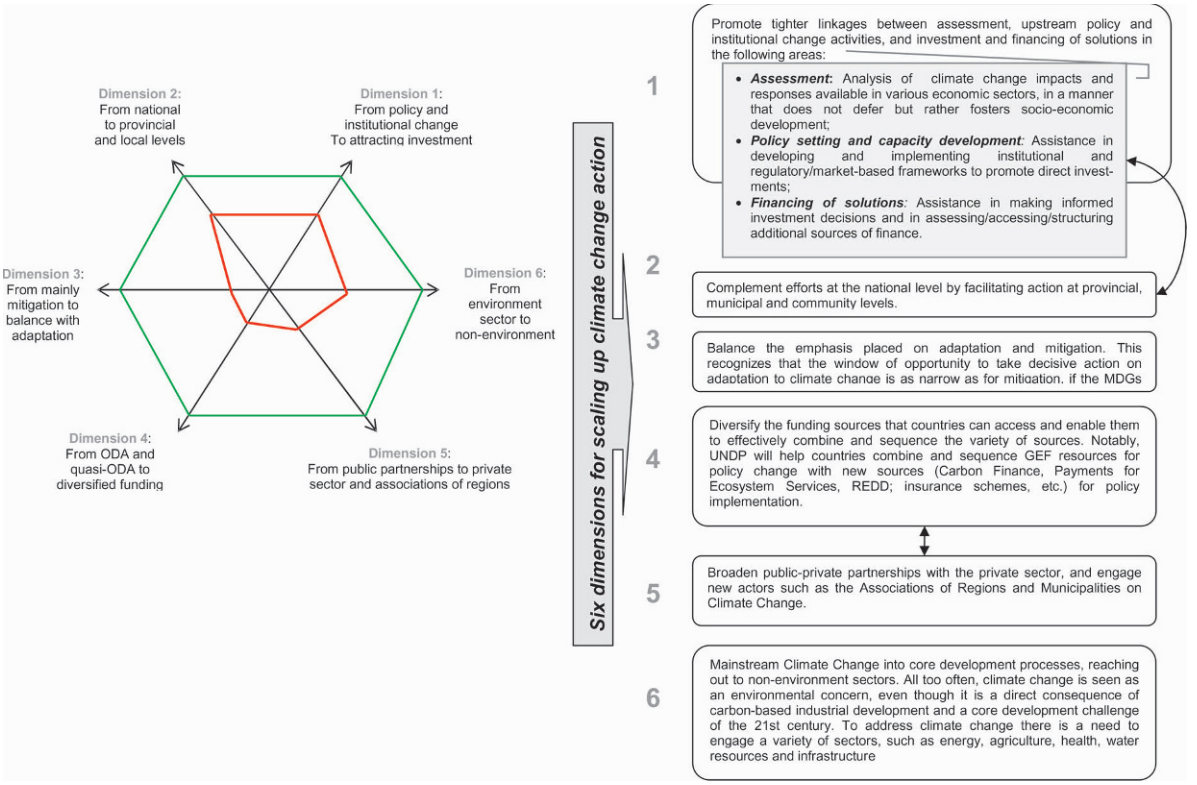
82.4.1 Six Key Dimensions for Scaling Up Climate Change Action

Figure 82.4 illustrates the scaling up of climate change actions along the six dimensions. The red lines are a qualitative description of current climate change action in a number of countries in terms of the six dimensions described above, whereas the green lines represent the scaling up required for a new development paradigm that mainstreams climate change into strategies and plans, and that links policy-setting with the financing of solutions.

82.4.2 UNDP's Strategic Priorities for Climate Change Action: Helping Countries Build the New Paradigm

Effectively integrating climate change with development work, UNDP is scaling up its on-going climate change services along these six dimensions through four strategic priorities. The first priority focuses on planning and policy, the second and third on implementation of adaptation and mitigation, and the fourth deals with mainstreaming climate change into UN programming at all levels from local to global.

Figure 82.4: Six dimensions for scaling up climate change. **Source:** Adapted from UNDP (2008: 17).



82.4.2.1 Strategic Priority 1: Strengthening the Capacity of Developing Countries to Design Integrated Climate Change Action and Investment Plans

Coordinated national policy positions will be necessary for solutions to climate change to be effective. These positions need to be developed by engaging a variety of stakeholders, including governments as well as private sector, NGOs, and civil society. For medium and small-size economies it will be imperative to receive assistance to integrate climate change in their sectoral planning, budgeting and decision-making processes, while leveraging innovative financing, and also capitalizing on any opportunities provided by emerging financing frameworks – e.g. the Copenhagen Green Climate Fund (CGCF).

Enhancing the capacity of decision-makers to assess the policy implications of international negotiations will be critical. In response, support will be provided for launching national capacity building workshops for government officials, members of civil society, NGOs, parliamentarians, and the business community.

To build the knowledge base and integrate the economics of climate change into national planning processes, in-depth sectoral and cross-sectoral economic analyses, including cost benefit analysis of alternative policy and mitigation and adaptation options need to be produced and subsequently shared globally, nationally, and sub-nationally through dedicated interactive knowledge platforms.

At the national level, activities under this strategic priority will build on climate change assessments such as National Communications to the UNFCCC, Technology Needs Assessments, and reports like the UNDP-led National Human Development Reports. These activities will complement such existing assessments with in-depth economic analyses and the engagement of a wider range of stakeholders at the subnational level (box 82.7; figure 82.5).

82.4.2.2 Strategic Priority 2: Enhancing the Long-term Adaptive Capacity of Developing Countries and Promoting Adaptation Actions

Early adaptation action generates economic benefits as it prepares communities for expected harmful impacts and can therefore reduce threats to human health, sources of livelihood, ecosystems, and infrastructure. Governments must play a pivotal role, by

Box 82.7: The Territorial Approach to Climate Change (TACC). **Source**: <www.undp.org/climatechange>.

The engagement of sub-national governments is crucial as it is estimated that decisions at this level can influence 50-80 per cent of GHG emissions and most site-dependent adaptation actions (UNDP 2009: 11). To respond to the growing demand from sub-national authorities, UNDP and UNEP will be joining efforts to enhance capacities for long-term planning at the territorial level (regions, provinces, states or municipalities). The TACC initiative encourages the creation of Integrated *Territorial Climate Plans* (ITCP) to identify and prioritize adaptation and mitigation policies, regulations and investment decisions, based on an assessment of physical and socio-economic climate change impacts through a comprehensive methodological approach (UNDP 2009: 69), as described in the diagram below.

TACC will be accompanying 50 regions in the formulation of ITCPs that respond to a dynamic, participatory and reiterative three-pronged process: (i) long-term vision that benefits the entire community, (ii) prioritization of integrated mitigation and adaptation activities around the most urgent problems, and (iii) inclusion of all relevant stakeholders within the community (UNDP 2009: 59). This work will be carried out with a new set of development partners engaging associations of regions such as: *Forum of Global Associations of Regions* (FOGAR), *Network of Regional Governments for Sustainable Development* (NRG4SD), the Northern Forum, the International Association of Francophone Regions, the Latin American Organization of Sub-National Governments, the European Assembly of Regions and a large number of national and multinational companies.

Figure 82.5: Methodologies and processes for developing an ITCP. **Source:** Glemarec (UNDP 2009: 60).

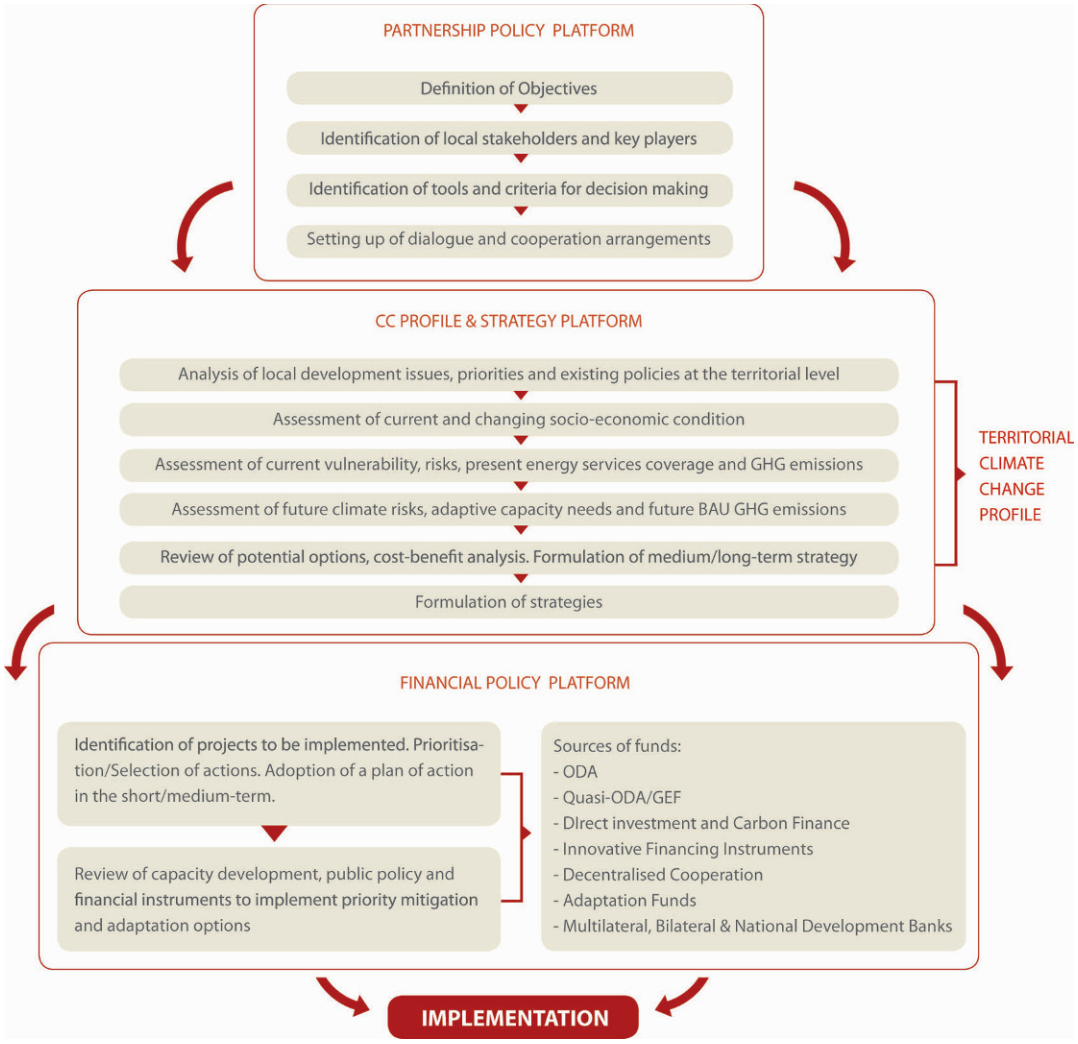
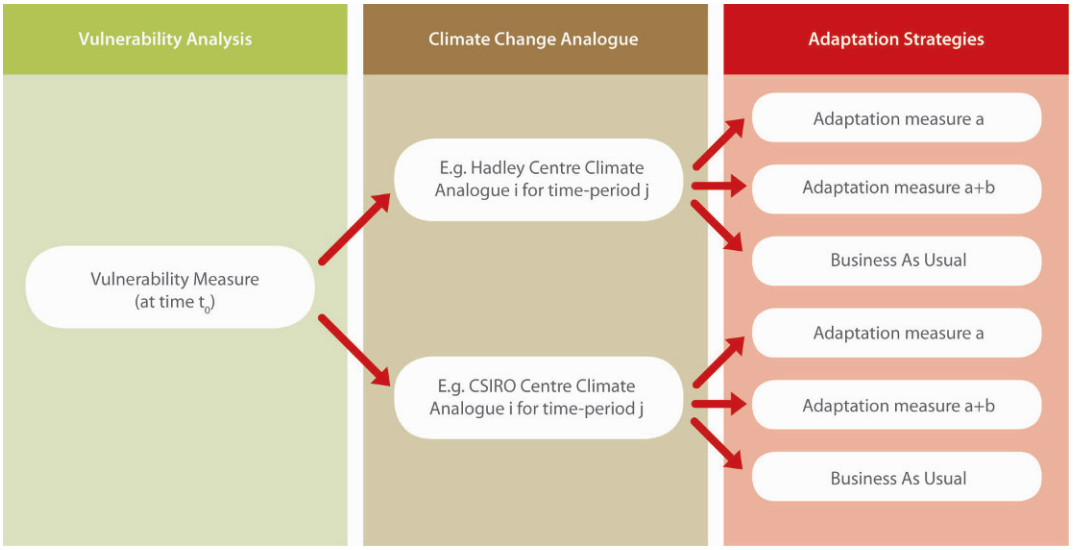


Figure 82.6: Key Steps in Assessing Adaptation Options **Source:** Kurukulasuriya/Mendelsohn (2008). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 103).



making a fact-based case for adaptation, encouraging direct investments and designing long-term policies that integrate adaptation. Developing countries can create an enabling environment to adaptation by overcoming three challenges: difficulty in getting political traction, difficulty in determining what the appropriate policy mix is and how to mainstream adaptation into national development processes, and difficulty leveraging finance to develop capacities and policies (UNDP 2008: 20).

Assistance needs to be provided to governments in addressing these challenges by carrying out economic assessments of adaptation versus inaction and determining early action incentives. In addition, it will be necessary to assess adaptation options by conducting prospective exercises to characterize future climate conditions. While dependent on available data, technical capacity and/or partnerships with Centres of Excellence, a possible alternative is to use global climate models to develop climate projections and identify climate analogues in others (UNDP 2009: 103). Figure 82.6 shows suggested key steps in characterizing future climate change conditions.

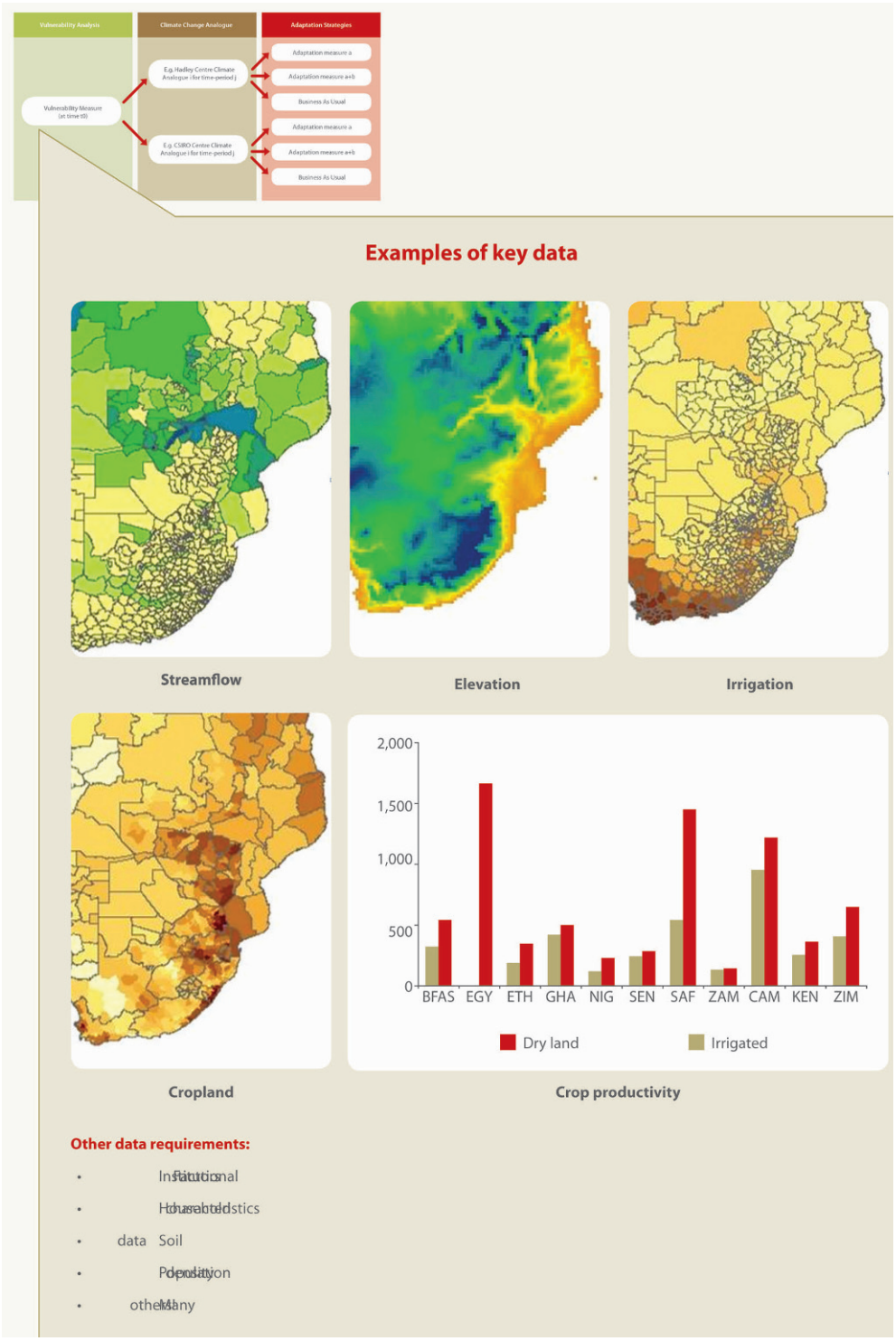
This set of actions will help countries and territories identify and prioritize short-term 'no regrets' adaptation measures, such as use of drought tolerant crops, revised land-use plans, and enhanced emergency preparedness.

To implement these adaptation responses, guidance needs to be provided for accessing dedicated funds, i.e. *Special Climate Change Fund* (SCCF), *Least Developed Countries Fund* (LDCF), and *Adaptation Fund*, and assistance for mobilizing innovative sources of funding (e.g., a tax on domestic air travel). Sustainability will be ensured by strengthening the capacity of developing countries to integrate adaptation into domestic plans, budgetary and fiscal policies, investments, and practices.

UNDP will provide most support to adaptation 'hot spots', such as LDCs and *Small Island Developing States* (SIDS). Support will move beyond isolated adaptation initiatives or projects, towards cross-sectoral programmatic approaches, with a focus on mainstreaming adaptation into development processes (box 82.6).

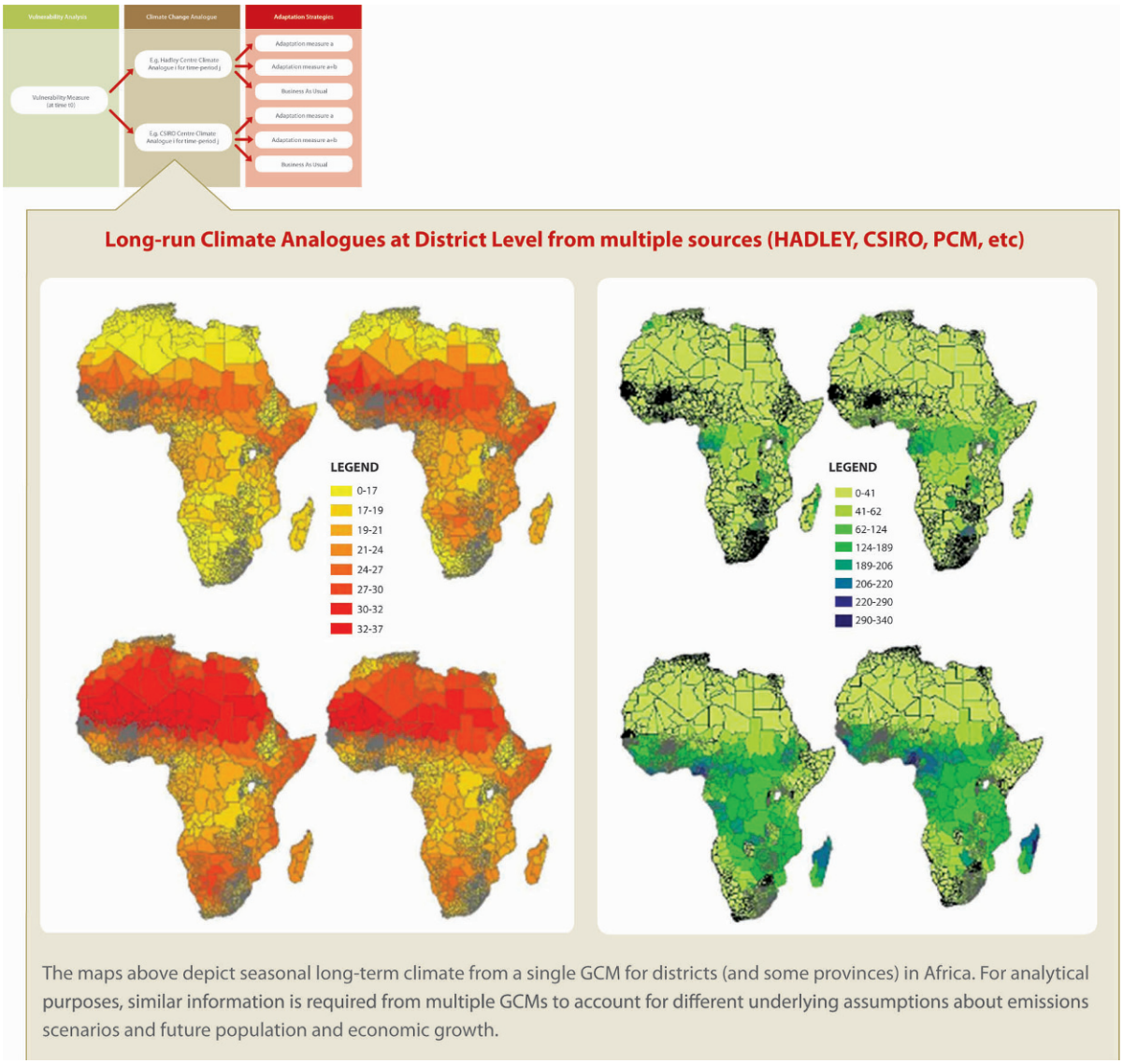
Figure 82.6 illustrates key steps in characterizing future climatic conditions using global climate models to develop climate projections and identifying climate analogues in others, following the approach suggested by Hallegatte et al (2007: 47). Assessing adaptation options requires: (i) a vulnerability analysis, (ii) a systematic analysis of the implications of alternative climate change analogues, and (iii) an analysis of key factors for adaptation strategies (e.g. income from crop production). By comparing analogue projections – in this case Hadley Centre and CSIRO Centre – it is possible to assess the vulnerability of each adaptation measure to incorrect climate projections and evaluate the likely net-benefit of a range of adaptation options (UNDP 2009: 103). The map series below (figure 82.7–82.9) provides an example on the assessment of adaptation options to cope with the impacts of climate change on African agriculture, based on research work conducted by Kurukulasuriya et al

Figure 82.7: Key Data for Vulnerability Analysis. **Source**: Kurukulasuriya/Mendelsohn (2006). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 106).



(2006). These types of maps are an example of powerful tools to convey complex information to decision-makers to raise awareness and develop planning and budgetary allocations for adaptation actions (UNDP 2009: 105).

Figure 82.8: Climate Analogues. **Source**: Kurukulasuriya/Mendelsohn (2006). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 107).

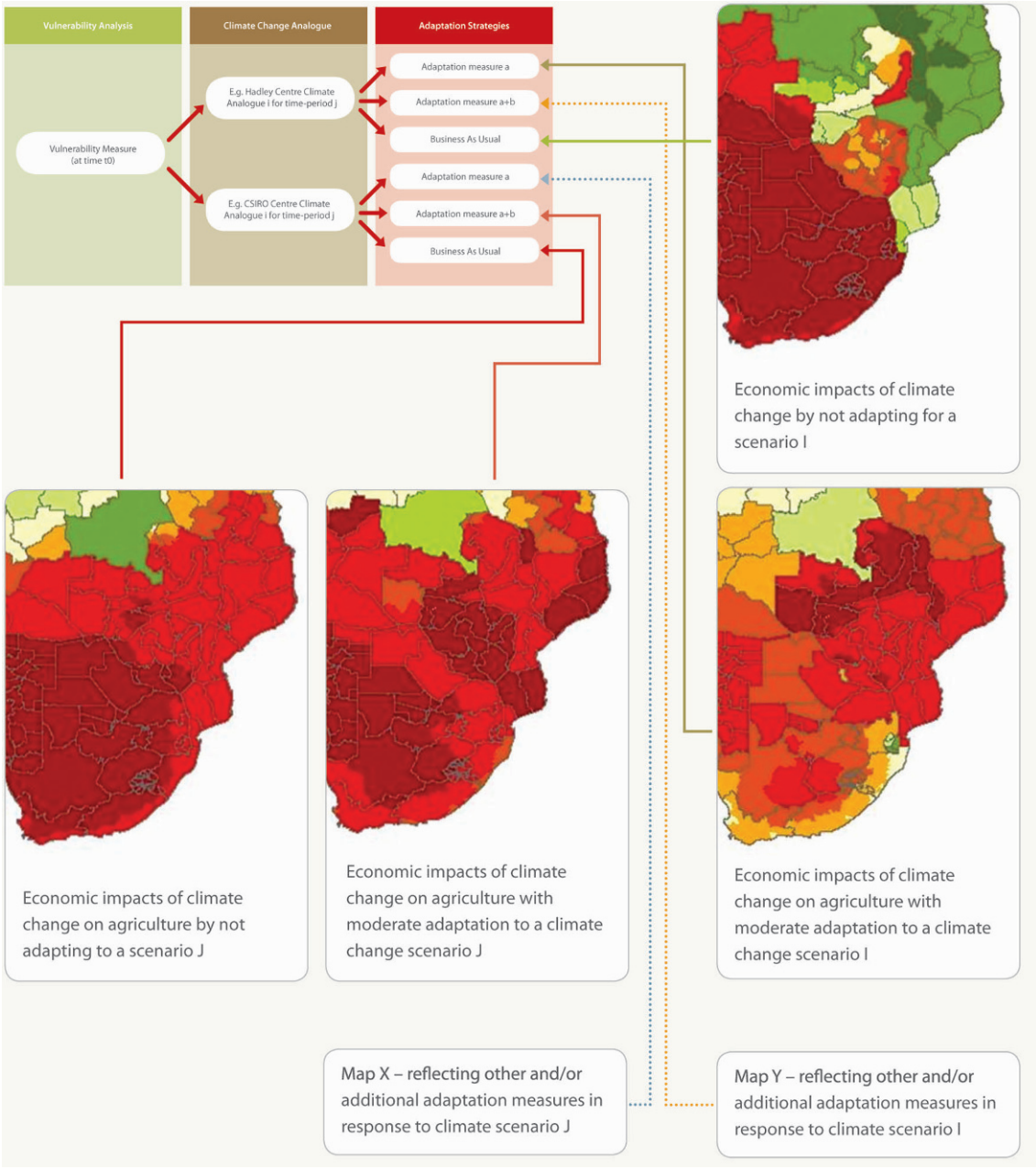


82.4.2.3 Strategic Priority 3: Enhancing the Capacity of Developing Countries to Attract and Drive Direct Private and Public Investment towards Lower Carbon Technologies and Sustainable Land Use Practices

This strategic priority aims at creating a 'carbon-enabled' environment (public policies, institutions, human resource capacities) for countries to be better positioned to access emerging sources of environmental finance (carbon finance, REDD, payment for ecosystem services, public-private partnerships, ODA, corporate social responsibility, green bonds, index insurance and weather derivatives, among others).

A substantial increase in total investment flows to developing countries will be needed for them to adopt technologies that reduce greenhouse gas emissions and do not slow-down economic growth. The rapidly expanding carbon market offers considerable potential to augment the flow of the needed finances and technologies. However, while the carbon market and other market instruments hold the promise of boosting resources in the coming years, it is evident that developing countries will need assistance to truly benefit from such opportunities. Capacity development services will play an important role in address-

Figure 82.9: Adaptation Profiles. **Source**: Kurukulasuriya/Mendelsohn (2006). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 108).



ing the disparities among countries in terms of accessing the CDM and other market instruments (UNDP 2003c: 11).

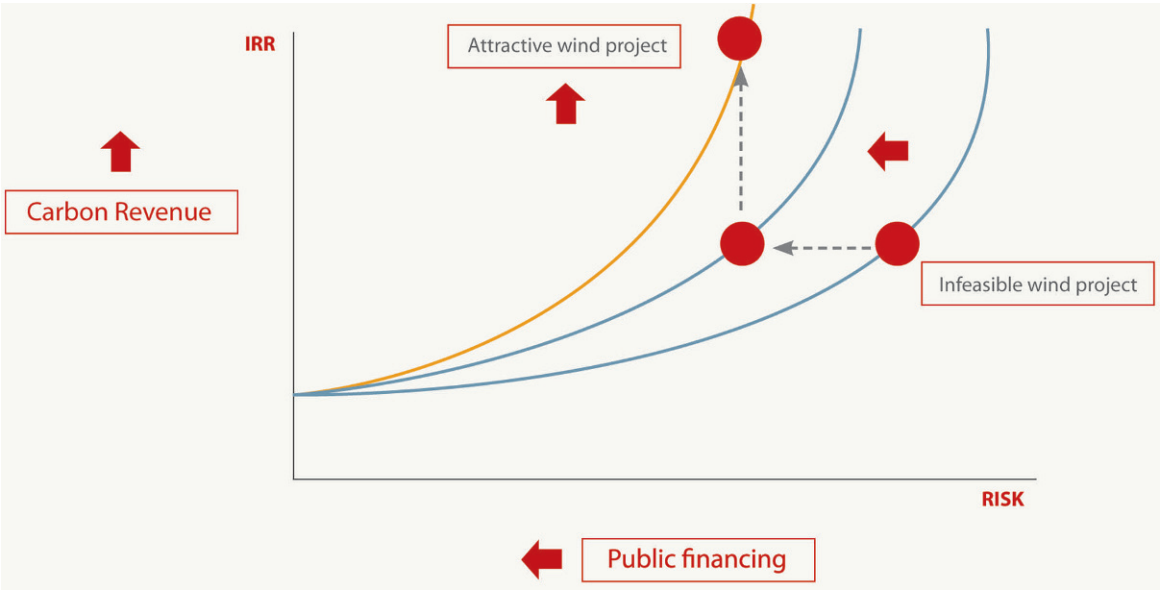
Furthermore, developing countries will need capacity development support to meet the challenge of driving massive shifts in investment patterns in a wide range of sectors, including power generation (box 82.8), industry, waste management, transport, buildings, agriculture and forestry.

In response, UNDP will help put in place effective public policies and markets to attract and drive direct investment towards lower carbon technologies. This addresses regulatory gaps, setting performance standards and codes for energy efficient infrastructure and appliances, and providing economic incentives for GHG reduction activities (smart tariffs, quotas). Assistance will also be provided to countries in implementing frameworks and investment pipelines to pro-

Box 82.8: An approach to mixing policies and financing for wind energy. **Source:** <www.undp.org/energy/>.

While wind energy is a rapidly growing technology, lessons learnt in this sector demonstrate that good wind resources alone are not sufficient to ensure sound and cost-effective development of this climate-friendly technology. The only countries that have been successful are those in which preconditions have been met through the set up of an enabling environment, comprehensive public policies and adequate financing strategies (UNDP 2009: 111). Figure 82.10 below illustrates an approach to sequencing financial instruments. In this example public finance is mobilized to remove barriers for direct investment, which reduces associated risks and makes it easier to (i) secure traditional finance for underlying projects, and (ii) access traditional finance from emerging carbon markets to increase the profitability of wind energy.

Figure 82.10: Sequencing public finance and carbon finance. **Source:** Glemarec (UNDP 2009: 112).



mote technology development, transfer, and dissemination. To help governments establish an institutional and regulatory infrastructure to access carbon finance, dedicated capacity building services should aim at operationalising *Designated National Authorities* (DNAs) and promoting solid legal frameworks such as clear ownership rights.

Encouraging innovative technological and non-technological solutions will be pivotal. UNDP will promote greater off-grid access to energy for rural communities (foundations, micro-grants, etc.), and will pilot REDD emissions reduction schemes, testing a number of alternative payment structures and benefit transfer mechanisms that reach end users in a transparent and equitable manner.

82.4.2.4 Strategic Priority 4: Integrate Climate Change into UN and UNDP Development Assistance Service Countries in Addressing Climate Change

With sustainable human development at the heart of its mandate, UNDP's core practices are all essential to addressing climate change not as a stand-alone but rather as a cross-cutting issue. Efficiently mainstreaming climate change into core activities and in its fiduciary policies will maximize opportunities to address potential risks. It will also ensure a double dividend in terms of climate change solutions and the improvement of human well-being. Moreover, it will lessen the possibility of reversing decades of technical assistance hard-won development achievements, and decrease the likelihood of threats to international human security (EC 2008: 2).

The interface of development and climate change support at UNDP is exemplified by the work of thematic areas such as *governance* (e.g. strengthening institutional capacity increases aid effectiveness); *pov-*

erty reduction (e.g. mainstreaming climate responses into PRSPs); *crisis prevention and recovery* (e.g. integration of climate change into risk reduction); and *environment and energy* (e.g. mainstreaming climate into the management of water resources, land, and biodiversity and energy access for the poor).

82.5 Concluding Remarks

Climate change has been described as a threat multiplier that may exacerbate current vulnerabilities, tensions, and conflicts in countries and regions (EC 2008: 2). Developing countries deserve particular attention, not only because they are most at risk from expected adverse impacts, but also because they offer a variety of cost-effective opportunities to reduce emissions while advancing sustainable development goals and addressing the security dimension of climate change.

However, current levels of finance channelled through the financial mechanisms of the UNFCCC, ODA, or other means, while significant, are not likely to be sufficient. The two-fold challenge is therefore to (i) find ways to attract enough direct investment to meet the needs of lower income countries so they can sustain their economic development, (ii) while driving these direct investments towards lower carbon technologies, preventing countries from being locked into unsustainable pathways for subsequent 30 to 50 years.

Stabilizing greenhouse gas concentrations at a level that prevents catastrophic climate change will require further work towards a sustainable development-centric international agreement that is universal, equitable, and cost-effective. It will be critical for developing countries to be actively engaged in the international negotiations that will define the specifics of such agreement in the reference framework of the Copenhagen Accord. Countries also need strengthened capacities to ponder the implications of the different negotiations within the context of their national sustainable development objectives.

To effectively participate in, and fully benefit from, a new climate resilient development paradigm, developing countries must engage governments, the private sector and civil society stakeholders to secure broad-based support at the local, national, regional and global level. They also need cross-sectoral coordination given that actions to promote increased resilience to the impacts of climate change and lower-GHG emissions is dependent on a wide range of sectors, such as energy, agriculture, health, water resources, and infrastructure.

Developing countries will tremendously benefit from assistance in taking immediate action to implement innovative approaches, as well as from support in assessing the most suitable opportunities under the provisions of the Copenhagen Accord and future frameworks reached by COP-16 in Mexico 2010 and beyond.

Given the opportunity to rethink the structure, logic, and potential of human development and security, the international community needs to address the challenges of climate change within the framework of a new development paradigm that sets the world on a path towards greater climate security.

83 EU Strategies for Climate Change Policy Beyond 2012

Christian Egenhofer, Arno Behrens and Anton Georgiev

83.1 Introduction

As early as 1996, the *European Union* (EU) adopted a long-term target of limiting global temperature increase to a maximum of two degrees Celsius (Egenhofer/van Schaik 2005: 2–3) above pre-industrial levels. This was reiterated over the years, most recently in the European Council of 18–19 June 2009 (European Council 2009: 11). According to the European Commission (2009a: 3) – making reference to the 4th Assessment Report by the *Intergovernmental Panel on Climate Change* (IPCC 2007, 2007a, 2007b, 2007c, 2007d) – this would require developed countries to reduce their greenhouse gas (GHG) emissions by 25–40 per cent by 2020 and 80–95 per cent by 2050 compared to 1990 levels. At the same time, developing countries would need to limit emissions growth to 15–30 per cent below baseline by 2020 (European Commission 2009a: 5). The tool to achieve this are the so-called *Nationally Appropriate Mitigation Actions* (NAMAs) mentioned in the Bali Action Plan of December 2007 (UNFCCC 2007a: 3).

The EU's stance must be understood in the context of the multilateral negotiations where the EU has traditionally played an important role. This is also the case regarding environmental issues. The EU as well as its member states have been actively promoting *Multilateral Environmental Agreements* (MEAs). In the case of climate change the EU has found itself being catapulted into leadership after US President George W. Bush pulled out of the Kyoto Protocol. While few would have bet at that time for the Kyoto Protocol to survive, active EU diplomacy ensured that Japan, Canada and Russia ratified the Protocol which entered into force in 2005. To prepare for this, the EU has adopted numerous legal texts (directives, regulations, decisions, recommendations and opinions; see Egenhofer/Kurpas/van Schaik 2009: 36–38) to fulfil its commitments. Among them have been policies to support renewable energy and to improve energy efficiency in buildings and transport. However, the centrepiece of EU climate change policy has been the EU *Emissions Trading Scheme* (EU ETS), which became operational in 2005. While these and other policies have focused on the implementation of the Kyoto Protocol commitments, in parallel the EU has been developing a new strategy to meet mid- and longer-term climate change objectives. The EU had realized that – in the absence of an US engagement – EU leadership was indispensible for reaching a global agreement on climate change. At the same time, this leadership position is regarded as an opportunity for shaping the new regime in line with the EU's climate agenda. Other benefits include the reduction of energy import dependency and the possibility to gain leadership in low-carbon technologies.

This chapter describes recent EU initiatives to achieve necessary GHG emissions reductions within the EU as well as the strategy to engage other developed and developing countries to reach a global agreement that can ensure global climate change mitigation in line with the EU objective of limiting global warming to a maximum of two degrees Celsius (83.2). Most of the analysis is concentrated on the EU ETS (83.3, 83.4) and potential implications on the competitiveness of European industry (83.5). However, the chapter also describes the intersections between climate change policy and international trade policy (83.6) and the role of low-carbon technologies (83.7). It finishes with external aspects, namely the role of and relationship with developing countries (83.8) and the EU's international negotiation position (83.9).

83.2 The Strategic Approach: Target Setting and Addressing Energy Security

EU climate change policy is based on the EU's long-term target to limit global temperature increase to a maximum of two degrees Celsius above pre-industrial levels (box 83.1). In order to achieve the medium-term

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Box 83.1: The meaning of the 2°C target. **Source**: Based on Neufeldt, van Vuuren, Isaac, Knopf, Edenhofer, Schade, Jochem and Berkhout (2009).

The EU target to limit the rise of global average temperature to 2 °Celsius above pre-industrial levels is based on the conviction that above this level the "risk of dangerous and unpredictable climate change increases significantly and costs of adaptation escalate" (European Commission 2007b: 3). In reality, however, significant impacts on the most vulnerable and exposed ecosystems and societies are to be expected even below a 2 °C temperature increase. The target is thus primarily a political statement whose credibility depends on its technical feasibility, economic viability and political manageability. In order to achieve it, GHG concentrations in the atmosphere (measured in CO_2 equivalents, CO_2e) will need to be stabilized at 450 *parts per million* (ppm). Such a stabilization level reduces the chance of overshooting the 2 °C to 50 per cent and requires global emissions to peak around 2020.

Research within the EU-funded ADAM project (*Adaptation and Mitigation Strategies: Supporting European Climate Policy*) shows that low stabilization is technically feasible. While the importance of negative emissions (i.e. bioenergy with CCS) increases with lower GHG stabilization targets, nuclear power appears to be of minor significance. The cumulative GDP losses until 2100 are estimated to be below 0.8 per cent and 2.5 per cent for the 550 and 400 ppm CO_2e scenario, respectively.

Low stabilization targets will require the EU to reduce GHG emissions in 2050 by some 60–80 per cent or more compared to 1990 levels. This will have implications for new and existing capital stock in all sectors. In buildings, energy demand for heating and cooling will need to be reduced by almost 60 per cent by 2050. The transport sector could reduce emissions by some 50–70 per cent and the industrial sector by 30–40 per cent until 2050. The energy conversion sector will need to switch to low-carbon technologies, to achieve a share of renewables of up to 70 per cent. In addition, energy efficiency measures are expected to reduce energy demand by 25 per cent by 2050.

GHG emissions reductions required of developed countries, the Council of the European Union formally adopted an integrated climate and energy package on 6 April 2009.[1] The package intends to operationalize the overall binding targets to reduce GHG emissions and to increase the share of renewable energy sources in the EU's energy mix, which were adopted by the European heads of state and government at their 8–9 March 2007 spring summit (European Council 2007: 12–21). Principle elements of the 2007 spring summit's conclusions include a set of EU targets – generally referred to as '20 20 by 2020' – and accompanying policies.

1. A binding absolute emissions reduction commitment of 30 per cent by 2020 compared to 1990 conditional on a global agreement, and a 'firm independent commitment' to achieve at least a 20 per cent reduction;
2. A binding target to reach a 20 per cent share of renewable energy sources in primary energy consumption by 2020;
3. A binding minimum target of increasing the share of renewables in each member state's transport energy consumption to 10 per cent by 2020 (this target initially focussed solely on biofuels but was later widened to include other forms of renewable energy sources);
4. A 20 per cent reduction of primary energy consumption by 2020 compared to projections (non-binding);
5. A commitment to enable the construction of up to 12 large-scale power plants using carbon capture and storage (CCS) technology.

With the aim to implement these general targets, the climate and energy package as adopted in April 2009 contains six elements, including a directive for the promotion of renewable energy sources, a revised EU ETS starting 2013, an 'effort sharing' decision setting binding emissions targets for EU member states in sectors not subject to the ETS, a regulation to reduce by 2015 average CO_2 emissions of new passenger cars to 120 g/km, new environmental quality standards for fuels and biofuels (aimed at reducing by 2020 GHG emissions from fuels by 6 per cent over their whole life-cycle), and a regulatory framework for CCS. Prior to that, the EU had already published the so-called *Strategic Energy Technology* (SET)-Plan (European Commission 2007a) to strengthen research, development and demonstration of new technologies including those relevant for addressing climate change. Finally, a review of the level and nature of allowed subsidies (or 'state aid') is ongoing.

Such an integrated approach to energy and climate change issues necessitated by various changing conditions faced by the EU. Domestic resources are dwin-

1 For a press statement on the Council's adoption of the 'climate-energy legislative package' as well as links to all of its elements, see >http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/misc/107136.pdf>.

dling at the same time that government intervention in the energy industry is on the rise in precisely those countries that could potentially fill the gap.

While many supplier countries seem unable to increase production due to a lack of investments, the fact that supplies are tightly controlled by governments in exporting countries raises the fear of 'excessive' leverage of supplier countries such as Russia. Some supplier countries are hostile towards the West. Others are politically unstable. Many reserves will take years to develop due to problems of access, investments and physical conditions. A prolonged tight market might increase political tensions and possibly some sort of 'resource nationalism'. At last, the EU realized that success in integrating Russia into a strategic energy partnership is very unlikely. Despite an institutionalized energy dialogue (since 2000) and some recent foreign investments in the Russian energy sector, the strategy aimed at opening the Russian market to European and other western enterprises and thus to gain large scale access to Russian gas and oil reserves has largely failed and this is not expected to change in the foreseeable future.

In such a scenario, the EU and its member states have been examining domestic and external policy options to move to a more sustainable and secure energy supply. This includes, amongst others, investment in renewable energy sources, pushing CCS technology for fossil and other fuels and investment in nuclear energy in member states that wish to do so. To drive down costs for these technologies, there is a need for large-scale deployment. The *International Energy Agency* (IEA 2008a: 373; 554) makes the case, for example, that renewables (except wind) experience significant capital cost reductions for each doubling of capacity, such as 15–20 per cent for *photovoltaics* (PV) and 20 per cent for solar water heaters. This justifies pro-active support policies for low-carbon technologies.

Additional advantages of the EU climate and energy package include (Jansen/Gialoglou/Egenhofer 2005: 3–6):

- The renewable energy policy can provide for technological leadership in sun-rise technologies;
- Renewable electricity can reduce long-term electricity prices and their volatility;
- Substitution of fossils combined with renewables may reduce pricing power by Russia (notably on gas); and
- The introduction of the EU ETS (*emission trading system*) led to the retention of some of the economic rent of producer countries, including Russia.

To off-set the higher prices both for industry and domestic consumers, energy efficiency is a central piece, certainly for the transition period until new technologies and new fuels become available on a large scale. With increasing prices, reducing consumption gives a reasonable prospect for keeping the energy bill constant.

There has been an additional aspect of the '20 20 by 2020' targets which is often overlooked. The first phase of the EU ETS has shown that setting a hard cap in GHG emissions in the EU is next to impossible without some sort of legally binding constraint. In a scenario of a post-2012 agreement *without* absolute caps – which is possible – it is indeed difficult to see how the EU ETS could continue to exist in a meaningful way. Member states and the European Commission would most likely not be able to impose an ambitious emissions ceiling on industry without a legally binding constraint. The '20 20' targets address this risk.

83.3 Implementation of the '20 20 by 2020' targets

The *climate and energy package* should be seen in its entirety, including its six elements as mentioned above, the SET-Plan and new state aid guidelines. However, at the heart of the agreement are the '20 20 by 2020' targets. In addition to the revised EU ETS which will allow for a 21 per cent emissions reduction compared to 2005 in sectors covered by the EU ETS (European Parliament/Council of the European Union 2009a: 63–64), the implementation of these targets has been operationalized by the introduction of legally binding national GHG emissions reduction targets (referred to as 'effort sharing', ranging from -20 per cent to +20 per cent) for all sectors not covered by the EU ET (European Parliament/Council of the European Union 2009b) – such as buildings, transport, agriculture and waste – amounting to an overall reduction of 10 per cent below 2005 levels by 2020. In terms of the renewables target, differentiated national targets for the share of renewable energy sources in final energy consumption have been introduced (European Parliament/Council of the European Union 2009c). The different national targets are shown in table 83.1.

This approach raises the level of centralization, absent in other policy areas of shared competence like

Table 83.1: National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020 and member state greenhouse gas emissions limits in non-ETS sectors for the period 2013 to 2020. **Source:** European Parliament, Council of the European Union 2009b: 147; European Parliament, Council of the European Union 2009c: 46.

Member state	Share of energy from renewable sources in gross final consumption of energy, 2005	Target for share of energy from renewable sources in gross final consumption of energy, 2020	Member state GHG emissions limits in 2020 compared to 2005 GHG emissions levels (from sources not covered by ETS)
Austria	23.3%	34%	-16%
Belgium	2.2%	13%	-15%
Bulgaria	9.4%	16%	20%
Czech Republic	6.1%	13%	9%
Cyprus	2.9%	13%	-5%
Denmark	17%	30%	-20%
Estonia	18.0%	25%	11%
Finland	28.5%	38%	-16%
France	10.3%	23%	-14%
Germany	5.8%	18%	-14%
Greece	6.9%	18%	-4%
Hungary	4.3%	13%	10%
Ireland	3.1%	16%	-20%
Italy	5.2%	17%	-13%
Latvia	32.6%	40%	17%
Lithuania	15.0%	23%	15%
Luxembourg	0.9%	11%	-20%
Malta	0%	10%	5%
The Netherlands	2.4%	14%	-16%
Poland	7.2%	15%	14%
Portugal	20.5%	31%	1%
Romania	17.8%	24%	19%
Slovak Republic	6.7%	14%	13%
Slovenia	16.0%	25%	4%
Spain	8.7%	20%	-10%
Sweden	39.8%	49%	-17%
UK	1.3%	15%	-16%

the environment. Such centralization, i.e. hard caps and binding renewable obligations has only been possible as a result of a complex burden sharing, which essentially has been based on a mixture of efficiency and equity considerations. Hard targets for the EU ETS and the non-ETS sectors as well as for renewables have been set on the basis of an 'efficiency approach', i.e. reflecting a least-cost approach for the EU as a whole, however, with some adjustment to ensure that costs for member states remain roughly similar in per-capita terms.

- *GHG reduction ('effort sharing') targets:* Countries with a low GDP per capita are allowed to emit more than they did in 2005 in non-EU ETS sectors, reflecting projected higher emissions due

to higher economic growth. According to European Commission modelling, this increases overall EU compliance costs for the 20 per cent GHG reduction target by 0.03 per cent of total EU GDP.

- *Renewables targets:* half calculated on a flat-rate increase in the share of renewable energy and the other half weighted by GDP, modulated to take account of national starting points and efforts already made.
- *In the EU ETS sector:* uniform cap across member states and allocation based on EU-wide allocation methodologies. 12 per cent of the overall auctioning rights will be re-distributed to economically weaker member states in Central and Eastern Europe. Another two per cent of the total auctioning rights will be distributed to eight countries which have already achieved significant reductions before 2005.

According to assessments by the European Commission (2008a: 22–25, 2008b: 159–163), the total direct costs of implementing the two binding 20 per cent targets could be as high as 0.6 per cent of the GDP in the year 2020, or some €90 billion. However, through the access to the *Clean Development Mechanism* (CDM) and *Joint Implementation* (JI) costs are expected to be as low as 0.45 per cent of GDP in 2020 or roughly €70 billion (European Commission 2008c: 161). Rising oil prices would also contribute to lower costs. Annual GDP growth is estimated to decrease by approximately 0.04–0.06 per cent between 2013 and 2020, which would lead in 2020 to a GDP reduction of 0.5 per cent compared to the 'business-as-usual'. These calculations do not take into account possible macro-economic benefits (in the estimated magnitude of +0.15 per cent of GDP) from the reinjection of auctioning revenues back into the economy.

With expected costs of some €70-90 billion by 2020, the complete package has been one of the most important, if not the most important piece of legislation in the EU ever. Nevertheless, there have only been limited changes to the initial Commission proposal. The reason is that governments had already given their full political support to the key elements of the package at the 8–9 March 2007 European Council. Equally important, opening one of these key elements by one member states would almost certainly have lead to an unravelling of the full package, a price too high for any member state to pay, not least because of peer pressure in EU institutions but also due to the high public support that climate change policies enjoy.

Nevertheless, there have been intense debates within the Council of Ministers and the European Parliament on a number of issues. The most important has been about costs and their distribution across member states and between industrial sectors. Funding of the 12 demonstration projects for CCS has remained contentious until the very end. Although generally the renewables directive has seen little controversy, trading rules for renewable electricity quotas were a contentious matter. Some member states with very aggressive targets and electricity utilities argued for more flexibility in trade while other member states feared a rush to the cheapest source, thereby crowding out certain technologies. EU sustainability criteria for biofuels were another hot topic as they raise important trade issues.

The most contested issue of the package became the issue of whether industries would receive their emission allowances for free or whether they would have to buy them. The existing rules where allowances are given out for free, has led to power companies charging their consumers as if they were paying a carbon price, resulting in billions of windfall profits. Auctioning emission allowances would solve this problem, but is politically controversial as it would lead to high costs for greenhouse gas emitting industries (83.4). Another dominant issue has been about the distribution of costs between industries and member states. This was to be expected given that by creating the EU ETS, the EU has created allowances that can achieve a value of anything between €30–90 billion annually in case of a CO_2 price of €15 per ton or €50, respectively. It is interesting to note that neither industry nor EU governments had at any time of the discussion contested the overall ETS emissions cap of 21 per cent by 2020 compared to 2005, as proposed by the European Commission.

Regarding GHG emissions reductions in non-ETS sectors (covering about 55–60 per cent of EU GHG emissions), the Commission proposal permitted member states to use offset credits in order to meet up to two-thirds of their emissions reductions, and the remaining part by domestic abatement measures. The December 2008 agreement additionally allows for 11 (mainly western European) countries – including Spain and Italy – to use additional offset credits to meet their non-ETS targets.

83.4 EU ETS and Development of International Carbon Markets

The EU ETS remains at the centre of EU climate change policy. Since the adoption of the original EU ETS Directive in 2003, a broad consensus has emerged in the EU to use carbon pricing in the form of emissions trading, i.e. a cap-and-trade scheme, as the foundation of its climate policy. If properly designed, the EU ETS cap-and-trade scheme will create incentives for companies to reduce emissions in the most cost-effective way, will reward carbon-efficiency and create incentives for new and innovative approaches to reduce emissions. The incentive for efficient abatement will arise from the 'opportunity costs' of using allowances. Passing through the costs of GHG emissions allowances to consumers will create incentives to reduce the demand for GHG-intensive goods. At the same time, this will increase producers' cash flows to invest in abatement technologies. In a situation whereby all competitors are subject to similar carbon constraints in well functioning markets, the EU ETS would be the most suitable tool to achieve EU and UN-based targets at the lowest possible costs. However, the original design of the system had several flaws.

Ellerman and Joskow (2008: iii), for example, argue that although "there have been plenty of rough edges", the EU ETS managed to deliver "a transparent and widely accepted price for tradable CO_2 emissions allowances" as well as the necessary "infrastructure of market institutions, registries, monitoring, reporting and verification". The scheme covers somewhat less than 50 per cent of EU CO_2 emissions from power and industry, including process emissions. The pilot phase from 2005–2007 suffered from a number of teething problems such as significant delays of registries and *National Allocation Plans* (NAPs)[2], inconsistencies in the definitions of installations, as well as issues related to monitoring, reporting, verification, and data collection. However, the most severe deficiencies of the first phase of the EU ETS included over-allocation, distorting allocation between member states and windfall profits for the power sector.[3]

- Over-allocation has largely been the result of two factors: an excessive degree of de-centralization in the implementation of the EU ETS, and the absence of a hard constraint. In their NAPs, member states pitched their caps somewhere between "lesser than the business-as-usual" and moving towards a "path consistent with the Kyoto Protocol". Most NAPs foresaw modest caps and a high dependence on projections. However, it turned out that most if not all projections were largely inflated (AEA Technology Environment/Ecofys UK 2006). This combination of modest cuts and inflated projections has lead to over-allocation of as much as 97 Mt of CO_2 out of a total of about 2.2 billion annual EU allowances, i.e. almost 5 per cent of total annual allowances (Kettner/Köppl/Schleicher/Thenius 2007).
- Allocation in the first phase of the EU ETS has lead to each member state developing its own rules, notably for allocation to new entrants and closures. These rules varied considerably between member states. This high degree of discretion for member states has increased complexity, administrative burdens and transaction costs while decreasing transparency. Moreover, industry has been able to put pressure on governments not to hand out fewer allowances than other governments.[4]
- In Europe's liberalized (regional) wholesale power market, prices are set by the marginal production costs, including the value of emissions in the allowance market. If the marginal producer is a (high-carbon) coal power generator, the power price can increase significantly as a result of the EU ETS. Low carbon electricity sources such as renewables and nuclear benefit substantially from higher power prices without incurring extra costs. This effect was intended. However, fossil-fuel generators were also able to receive considerable windfall profits. Power generators operating essentially in a domestic EU market can easily pass on additional CO_2 costs. The windfall effect occurred as a result of power generators passing on the full costs of CO_2, while having received the allowances for free. Windfall profits have been estimated to amount to as much as €13 billion annually (Martinez/Neuhoff 2005: 67).

Over-allocation has been addressed for the second phase (2008–2012) where the European Commission could impose a formula[5] to assess member states' allocation plans. As a result, the European Commission

2 Some NAPs were late as much 1.5 years.

3 See Matthes, Graichen, Repenning (2005); Swedish Energy Agency (2006); Ellerman, Buchner, Carraro (2007); Egenhofer (2007); Ellerman, Joskow (2008).

4 See Zetterberg, Nilsson, Åhman, Kumlin, Birgersdotter (2004); Matthes, Graichen, Repenning (2005).

could shave off 10 per cent of member states' proposed allocations, leaving the ETS sector short of around 5 per cent for the second period. While the expected price for allowances had been around €20–25, the economic downturn has made prices tumble.

Experiences from the initial phases and design flaws have greatly helped the European Commission to propose radical, one could even argue revolutionary changes to the EU ETS. The principal element of the new ETS is a single EU-wide cap which will decrease annually in a linear way, starting in 2013, to reach 1.720 million tonnes of CO_2 in 2020. This corresponds to an overall cap being 21 per cent lower than the verified emissions for 2005. This linear reduction continues beyond 2020 as there is no sun-set clause. In addition, there are EU-wide harmonized allocation rules, full auctioning to sectors that can pass through their costs (e.g. the power sector), partially free allocation to industry based on EU-wide harmonized benchmarks. Overall, this translates into 50 per cent auctioning, which could equal about €30 billion per annum at a price of €30 per tonne of CO_2 (Behrens/Nùñez Ferrer/Egenhofer 2008).

Starting from 2013, power companies will have to buy all their emission allowances at an auction. Contrary to the original European Commission proposal, however, the EU government leaders agreed that for existing power generators in some (mainly Eastern European) countries the auctioning rate in 2013 will be at least 30 per cent and will be progressively raised to 100 per cent no later than 2020. This means that for instance existing coal-fired power plants in Poland still get their allowances for free, but that new power plants need to buy them.

These member states successfully made the case that their situation could not be compared to the one in 'old' member states. Full auctioning in 2013 would make many of the coal-based and often inefficient power plants uneconomic, resulting in a shut-down. This would lead in the short-term to significantly higher power prices and possibly to supply shortages as existing interconnections between these countries and their neighbours would not allow for compensation. In addition, full auctioning would withdraw necessary financial resources from sometimes under-capitalized power companies that would be required to build new, more efficient and low-carbon capacity.

For the industrial sectors under the ETS, the EU agreed that the auctioning rate will be set at 20 per cent in 2013, increasing to 70 per cent in 2020, with a view to reaching 100 per cent in 2027. The original European Commission proposal included 100 per cent auctioning already by 2020 rather than 2027. Industries exposed to significant non-EU competition, however, will receive 100 per cent of allowances free of charge up to 2020. Latest indications are that the majority of industry will fall into this category.

The original EU ETS directive allowed for linking the EU ETS with other emissions trading schemes by international agreement. The new directive goes a step further by providing for different types of linking arrangements, e.g. via a treaty, an international agreement as foreseen under EU law and through a reciprocal commitment applied through domestic systems. The latter provision is innovative both internally and internationally as schemes could be linked through administrative decisions. In essence, this could mean that over time non-EU emissions trading schemes could be linked to the EU ETS, the notion being the EU ETS as a docking station for the global carbon market. This could mean that the EU model becomes the blueprint for the yet to come global emissions trading scheme. The EU is also actively in dialogue with representatives from non-EU federal or sub-federal emissions trading schemes to ensure convergence and ultimately linkability.

83.5 Competitiveness of Industry and Carbon Leakage

The EU ETS has triggered a debate on the 'competitiveness' of European industry and carbon leakage as EU climate change regulation may lead to a relocation of industry to regions where no carbon policies exist. This could actually lead to an increase in global GHG emissions and is well documented in a sizable body of literature.[6] There is an emerging EU consensus that a number of sectors could claim a risk of carbon leakage (as a combination of CO_2 being a significant factor in variable costs and being subject to international competition). The new EU ETS directive has further

5 Verified 2005 ETS emissions x GDP growth rates for 2005–2010 based on the PRIMES model x carbon intensity improvements rate for 2005–2010 + adjustment for new entrants and other changes, for example in ETS coverage.

6 See, for example, Carbon Trust (2004); Reinaud (2005, 2008); McKinsey, Ecofys (2006); Hourcade, Demailly, Neuhoff, Sato, Misato; with contributions by Grubb, Matthes, Graichen (2007); Matthes, Neuhoff (2007).

Box 83.2: Criteria to define sectors 'exposed to carbon leakage' (based on Article 10a of the revised EU ETS Directive). **Source**: European Parliament/Council of the European Union 2009a: 72-75.

Sectors or subsectors are deemed to be exposed to a 'significant' risk of 'carbon leakage' if

a.) the sum of direct and indirect additional costs induced by the ETS would lead to a substantial *increase of production costs*, calculated as a proportion of the *Gross Value Added* (GVA), of at least 5 per cent; and

b.) the *intensity of trade with non-EU countries*, defined as the ratio between total value of exports to non-EU countries plus the value of imports from non-EU and the total market size for the Community (annual turnover plus total imports), is above 10 per cent.

In addition, sectors are exposed to carbon leakage if

a.) the sum of the *increase of production cost* caused by the ETS, calculated as a proportion of the GVA, is at least 30 per cent; and

b.) the *intensity of trade with non-EU countries*, defined as the total value of exports to non-EU countries plus the value of imports from non-EU countries and the total market size for the Community (annual turnover plus total imports from non-EU countries), is above 30 per cent.

Assessments will be based on an *average carbon price according to the Commission's impact assessment* and trade, production and value added data from the *three most recent years* for each sector or sub-sector, if available.

The European Commission will assess this risk based on periodic reports (5 years) to start by 31 December 2009.

defined 'carbon leakage' to avoid ambiguity. It mandates the European Commission to draw up a list of sectors "significantly exposed to carbon leakage" (box 83.2) by the end of 2009. In addition, the Directive has identified a hierarchy of three possible measures:

1. Free allocation
2. A global sectoral agreement, i.e. a global sectoral policy for one or all of the vulnerable sectors;
3. Border-measures, e.g. imposing carbon costs on importers.

Free allocation of allowances in effect amounts to a subsidy, thereby undermining the ETS' objective to pass through full carbon costs. It could, however, be justified by the fact that carbon prices are distorted already because costs for GHG emissions cannot be passed through globally. In this case, the market structure, especially price elasticity of demand, inhibits globally-trading industries' ability to pass-through their additional costs in full or even partially. As a result (European and global) product prices will not reflect the 'opportunity costs' of allowances and therefore the EU cost of carbon. For example, if firms in a European industry cannot pass through the allowance price partly or fully, it is these firms that eventually end up 'paying' for the allowance price. Failure to pass through would erode benefits from CO_2 abatement as well as producers' competitiveness. Furthermore, it would transfer allowance value abroad and would ultimately lead to carbon leakage.

While the choice of option one (free allocation) is a pragmatic approach of 'taking the heat' out of a potentially poisonous debate, it allows only for compensation of direct effects, i.e. costs arising due to the fact that emissions need to be covered by an allowance. It does not address the vulnerabilities of those sectors that results from indirect effects, i.e. through higher input costs, notably higher power prices as a result of the ETS. Therefore, member states have been given the possibility to provide financial compensation to sectors on the Commission's lists. Currently the European Commission is adapting EC state aid guidelines to allow for this.

The European Commission under the leadership of DG Enterprise and Industry has launched a process involving industry, member states, research and stakeholders to assess as exactly as possible the vulnerability of sectors and sub-sectors. Industry has submitted very detailed data for the European Commission to assess the degree of vulnerability. There is a willingness not to hand out allowances for free to those sectors that in fact can pass through all or parts of the carbon costs. Thereby the European Commission wants to avoid another round of windfall profits, although this time *not* for the power sector but for industry.

Nevertheless, there are voices from some member states and some companies calling for the introduction of border measures. So far, these voices are few and there is an overwhelming consensus among EU industry that border measures for an export-dependent economy like the EU would be self-defeating. However, it is clear that border measures are seen by the EU as a possible legitimate means to put pressure on free-riders in the global effort to reduce GHG emissions. This has been confirmed by the Environment Council of December 2008. In addition, they could be used as a 'stick' when entering the post-2012

negotiations. There appears to be a consensus that a multi-lateral approach towards border measures in a post-2012 agreement is sensible or necessary to address free-riding.

83.6 Integrating Climate Change Policy with International Trade Policy

The analytic and policy agendas arising from climate-trade intersections are becoming more extensive, specific and tangible than is generally reflected in the literature and the policy discourse and certainly go beyond border-measures, also in the EU. Intersections include on the one hand threats to the international climate and/or trade regimes. On the other hand they offer opportunities for win-win outcomes – or even win-win-win opportunities if sustainable development criteria are included along with climate and trade. Four types of intersections have been identified (Brewer 2008).

The *first* consists of issues that have emerged or are likely to emerge soon on the WTO agenda; they typically concern familiar issues of tariffs, non-tariff barriers and subsidies concerning goods, including in renewable energy industries. Elimination of such tariffs on a list of manufactured goods was proposed jointly by the EU and US in late November 2007, a few days before the beginning of COP13 in Bali.

The *second* set of issues is focused on sector specific issues, particularly international aviation and maritime shipping, which are currently outside the WTO as well as the Kyoto Protocol but which are of intense interest in the negotiations for a post-2012 international climate regime.

Third, there are international trade and investment issues associated with technology transfers of climate-related technologies for mitigation and/or adaptation, e.g. international climate change technology cooperation agreements. Such policies to promote exports, foreign direct investments and technology transfers, especially to emerging economies have been imbedded, for instance, in US energy legislation. The Asia Pacific Partnership, for instance, includes on its agenda the reduction of barriers to trade and investment in renewable energy goods and services.

Fourth, there are offsetting border measure proposals being discussed in the EU and the US. Such measures have been discussed in the EU in the European High-Level Group on Competitiveness, Energy and Environment and the EU ETS Review and are proposed in pending climate change legislation in the US Congress. The cap-and-trade bill sponsored by Waxman and Markey that has been approved by the US House of Representatives on 26 June 2009 equally foresees such border measures. This has triggered sharp responses from India and China, which both interpret this as 'protectionism in disguise'.[7]

83.7 Towards a Technology Vision

The 'EU vision' on technology is only gradually emerging but it is generally recognized that technology plays a fundamental role in advancing efforts to address climate change on three fronts:

- accelerating the deployment of existing low-carbon technologies, both to bring down the costs of technologies and to reduce emissions, which requires more ambitious government policies;
- developing and deploying new breakthrough technologies for the longer-term (beyond 2030), which requires stepping up the speed and scale of innovation; and,
- avoiding, at the same time, the lock-in of high-carbon technologies in developing countries, i.e. estimating the incremental costs of making future (energy) investments in developing countries and emerging economies low carbon and paying for them, which requires dealing with equity issues, and amongst others, financial transfers.

Domestic responses are regarded as the backbone of technology policy for addressing climate change. Innovation is seen as offering a prospect of a competitive edge, technological leadership, export markets and employment opportunities. International collaboration is considered as being crucial in order to achieve the necessary scale, to pool resources, provide financing, encourage investment and speed up knowledge-sharing. Increasingly, the EU debate on climate technology is framed in an 'innovation and competitiveness' context. EU industrial policy such as the 2007 mid-term review (European Commission 2007c) explicitly acknowledges the need to create incentives to unlock the full potential of low carbon and resource efficient goods, technologies and services in the EU.

The EU integrated climate and energy package aims at accelerating innovation strategies and finance

7 See "China joins carbon tax protest", in: *Financial Times*, 4 July 2009: 3.

mechanisms that support the *rapid* development and deployment of promising technologies such as CCS, biomass and biotechnology, other renewables and end-use energy technologies or hydrogen systems. Yet pricing strategies through cap and trade *alone* will not be sufficient to provide long-term incentives for all the breakthrough technology development and deployment needed for the stabilization of emissions. Most recently the EU has started its own long-term technology mapping exercise through the EU's Strategic Energy Technology Plan.

Internationally, the EU – quite predictably – is ready to explore existing international initiatives both within the UNFCCC and outside to identify some key elements of a complementary global technology track in the post-2012 framework. Areas are:

1. UNFCCC-based or related initiatives such as the *Expert Group on Technology Transfers* (EGTT), the *Global Environmental Facility* (GEF) or the *Clean Development Mechanism* (CDM);
2. non-UNFCCC-based initiatives such as the G8+5 process, the Asia-Pacific Partnership on Clean Development and Climate[8], the Major Economies Forum on Energy and Climate[9] and global sectoral (industry) approaches,
3. the specific instrument of technology-based agreements, and
4. Collaborative projects at the international or bilateral level.

83.8 Climate Change and Developing Countries

According to the IEA's *World Energy Outlook 2007* (IEA 2007: 42) under a business-as-usual scenario – i.e. if governments stick with current policies – the world's primary energy needs would grow by 55 per cent between 2005 and 2030, at an average annual rate of 1.8 per cent. As fossil fuels are expected to remain the dominant source of primary energy, accounting for 84 per cent of the overall demand increase, global energy-related CO_2 emissions between 2005 and 2030 are also projected to increase. Developing countries, whose economies and populations are the world's fastest growing, contribute 74 per cent to the increase in global primary energy use in this scenario, while China and India alone account for 45 per cent. Hence, any agreement that would not commit fast growing developing countries or at least China to reductions would be ineffectual. According to the *World Energy Outlook 2008* (IEA 2008b: 48), OECD countries alone cannot put the world onto a 450-ppm trajectory, even if they were to reduce their emissions to zero. By 2020 China's energy-related CO_2 emissions are projected to be by far the largest in the world, almost double the ones from the US. India is expected to become the fourth biggest emitter after China, the US and the EU27 (IEA 2008b: 46).

However, relations between the EU and emerging economies such as Brazil, India, China, South Africa or Mexico remain largely bilateral. Co-operation in climate change and energy play an increasing role in bilateral summits. Co-operation agreements are often detailed, focussing on specific issues. In addition EU 'messages' are reinforced by cooperation of member states with emerging economies. On the contrary, the relationship with other developing countries, notably least developed ones, forms part of EU development policy. Based on the rationale that climate change will significantly affect poverty reduction efforts and that climate change thus needs to be consistently integrated into development policies, the EU has implemented an *Action Plan on Climate Change and Development* (from 2004-2008). This Action Plan was essentially aimed at supporting partner countries in four strategic priorities: i) raising the profile of climate change, ii) support for adaptation to climate change, iii) support for mitigation of climate change, and iv) capacity development. This EU Action Plan came to an end in 2008. However, as the recommendations of the EU Action Plan remain valid it will remain relevant to the Commission beyond that year. In terms of implementation, the *Global Climate Change Alliance* (GCCA), which became fully operational in 2008, has become the main element of the EU's external development action in the area of climate change. As a platform for dialogue and exchange, the GCCA supports developing countries to realize the integration of development strategies and climate change by providing regular opportunities for meetings between the EU and participating countries. Beyond dialogue and exchange, the GCCA provides technical and financial support for adaptation and mitigation measures, and for the integration of climate change into development strategies. Assistance provided under the GCCA focuses on five areas: i) developing and implementing concrete adaptation strategies, ii) reducing emissions from deforestation, iii) helping poor

8 See website at: <http://www.asiapacificpartnership.org/english/default.aspx>.

9 See website at: <http://www.state.gov/r/pa/prs/ps/2009/04/122097.htm>.

countries to take advantage of the *Clean Development Mechanism* (CDM), iv) helping developing countries to be better prepared for natural disasters, and (v) integrating climate change into development cooperation and poverty strategies. Priority will be given to adaptation, *disaster risk reduction* (DRR) and climate change integration (Behrens 2008a).

83.9 The EU Position in International Negotiations

There have been few surprises regarding the EU position in international negotiations. Within international fora, the EU position has been well documented, essentially and consistently retaining a number of key elements. They include i) a shared vision to reach the ultimate objective of the UN Framework Convention on Climate Change of stabilizing the concentration of GHG in the atmosphere (i.e. through binding medium and long-term targets), ii) deeper absolute emissions reduction commitments by developed countries, iii) fair and effective contributions or actions by developing countries, iv) an extension of the carbon market with a view of linking national markets, v) cooperation on technology research, development, diffusion, deployment and transfer, vi) efforts to address adaptation including finance and technologies for adaptation, vii) addressing emissions from international aviation and maritime transport, and finally, viii) reducing emissions from deforestation and enhancing sinks by sustainable forest management and land use practices, including the possibility to integrate them into the carbon market.

In January 2009, the European Commission 'translated' these EU aspirations into a strategy in its so-called 'Copenhagen Communication' (European Commission 2009a, 2009b, 2009c, 2009d), which sets out the lines of its negotiation strategy for Copenhagen.

Starting point is the 2 °C target, which according to the EU would require by developed countries the well-known 25-40 per cent reductions of GHG emissions by 2020 and some 80–95 per cent by 2050, as compared to 1990 levels. The EU's long-term 2050-target is by and large in line with US and other developed nations objectives. On aggregate, the EU wants 30 per cent reductions by developed countries by 2020 including domestic reductions and emissions credits. While there is little disagreement about the need for absolute reductions by developed countries, there is wide disagreement on how tough this target should be. Closely linked to this debate is the choice of the base-year for reduction targets. The Waxman-Markey bill offers by 2020 to cut US GHG emissions by 17 per cent, however, compared to 2005. This would translate into a reduction of four per cent as compared to 1990. The Japanese Prime Minister on 10 June 2009 announced a mid-term target of 15 per cent compared to 2005, which amounts to a reduction of eight per cent compared to 1990. For comparison, Germany has a reduction target close to 40 per cent compared to 1990. Even if one acknowledges that the German target has been facilitated by the collapse of East German industry, the gap is still significant.

Beyond the burden-sharing aspects between developed countries, developed countries' targets have a direct effect on developing countries' actions. The UNFCCC has laid down the principle of differentiation when it refers to 'common but differentiated responsibilities and capabilities', notably between developed and developing countries.

- 'Responsibility' typically refers to both actual and historic GHG emissions (e.g. per capita emissions or total emissions since the beginning of the industrial age). Historic emissions matter because limate change is a stock problem. Climate impacts are caused by concentrations of GHG in the atmosphere and not by current levels of emissions.[10]
- 'Capability' is related to standard economic indicators such as per capita GDP or poverty indicators. This concept recogizes the fact that dissimilar capacities exist to mitigate (and adapt to) climate change due to different welfare levels (table 83.3).

The ambition of developed countries' targets will directly influence the level of ambition by developing countries. This has consequences for the burden-sharing between different countries (be they developed and developing) but also for the achievability of stabilization pathways. As table 83.2 shows, to be able to reach a 2 °C target, global emissions need to peak between 2000 and 2015, i.e. around now. Proposed targets ahead of Copenhagen will not allow for this and rather point to a 3–4 °C target scenario.

Although developed countries are not expected to take on absolute targets, the Bali Action Plan has specified that developing countries undertake so-called *Nationally Appropriate Mitigation Measures* (NAMAs). Such NAMAs need to be "reportable, monitorable and verifiable actions" while at the same

10 CO_2 typically stays in the atmosphere for 100 years.

Table 83.2: Stabilization Scenarios. **Source:** IPPC (2007b: 15).

		Yearly global $C0_2$ emissions		
Stabilization in CO_2-concentration (ppm)	**Global mean temperature °C Increase at equilibrium**	**Must peak in period**	**Must be back at 2000 level in:**	**Per cent reduction compared to 2000**
445 – 490	2.0 – 2.4	2000 – 2015	2000 – 2030	-85 to -50
490 – 535	2.4 – 2.8	2000 – 2020	2000 – 2040	-60 to -30
535 – 590	2.8 – 3.2	2010 – 2030	2020 – 2060	-30 to +5
590 – 710	3.2 – 4.0	2020 – 2060	2050 – 2100	+10 to +60
710 – 855	4.0 – 4.9	2050 – 2080		+25 to +85
855 –1130	4.9 – 6.1	2060 – 2090		+90 to +140

Table 83.3: Key Statistics of Annex I parties. **Source:** European Commission (2009d: 23).

Total GHG excl. LULUCF and Bunker Fuels	**Ratified Kyoto**	**GDP/cap 2005[a)]**	**Change in emissions 1990 - 2005[e)]**	**Kyoto Target**	**Distance from target 2005**	**Ton CO_2 / Cap 2005[b)]**	**CO_2 intensity energy mix 2005[c)]**	**CO_2 intensity GDP 2005[d)]**
EU27	31/05/02	22.5	-8%	-		8.09	52.3	0.43
EU15	31/05/02	32.8	-2%	-8%	-6%	-	-	-
Australia	12/12/07	28.1	27%	8%	-19%	18.4	73.8	0.8
Canada	17/12/02	28.3	25%	-6%	-31%	17	48.2	0.67
Iceland	23/05/02	43.7	11%	10%	-1%	7.46	14.50	0.21
Japan	04/06/02	28.7	7%	-6%	-13%	9.5	54.7	0.24
N. Zealand	19/12/02	21.2	25%	0%	-25%	8.51	49.3	0.56
Norway	30/05/02	52.8	9%	1%	-8%	8	27.5	0.2
Russia	18/11/04	4.3	-29%	0%	29%	10.79	57.00	4.41
Switzerland	16/03/98	41.3	2%	-8%	-10%	6	39.60	0.17
Turkey	-	5.7	73%	-	-	3.04	61.4	0.89
Ukraine	12/04/04	1.5	-55%	0%	55%	6.31	49.50	6.56
USA	-	33.8	16%	-7%	-23%	19.61	59.4	0.53

a) GDP per capita in €1000, data for 2005, adapted from World Bank and Eurostat
b) Data from IEA 2007
c) ton CO_2/terajoule, data from IEA 2007
d) kg CO_2/US$ using 2000 prices and exchange rates, data from IEA 2007
e) UNFCCC data database UNFCCC website

time being conditional to developed countries providing assistance in the form of finance and technology. In addition to the overall level of developing countries' contribution, one of the most crucial international negotiations issue is how to ensure "reportability, monitoribility and verification".

The 'Copenhagen Communication' has called for the formulation of domestic low-carbon strategies by developing countries by the end of 2011 ('credible pathway') through NAMAs in *all* key emitting sectors (power, transport, energy-intensive industries, forestry and agriculture), supported by developed countries in the form of finance and technology, if NAMAs are verified. The EU has proposed to operate this through a Facilitative Mechanism for Mitigation Support entering into registry ('independent technical analysis'). While some sort of review will be needed, developing countries such as India and China are loath of excessive interference and insist on their sovereignty.

Box 83.3: The scope of finance. **Source:** Behrens (2008b, 2009).

Financial cost estimates for mitigating and adapting to climate change vary widely, depending – inter alia on the emissions reduction target and the time horizon for action. Behrens (2009) concluded that with a high level of generalization, average global costs of limiting climate change to 2 °Celsius above pre-industrial levels (i.e. mitigation costs) could be around €299 billion annually. According to UNFCCC (2007b), funds would mainly flow into the transport sector, buildings, industry and agriculture. Based on Behrens (2008b), adaptation measures may roughly add another €50-150 billion to the global climate change bill. However, due to severe limitations in estimating adaptation costs, these figures should be taken with extreme care. According to UNFCCC (2007b), the main driving forces for adaptation costs are infrastructure, agriculture, forestry and fishery, water supply and coastal zones (UNFCCC 2007b).

Roughly 50 per cent (or about €200 billion) of the additional annual costs will be required in developing countries, raising the question of absorption capacities. However, industrialized countries will need to shoulder considerably higher shares of the global costs than developing countries due to their historic responsibilities for global warming and their economic capabilities to make available sufficient private and public funding. With the private sector expected to cover the largest share of total costs, public sector contributions could be anywhere between four per cent and a third.

Ultimately, a deal in Copenhagen will have to agree on targets and financial transfers. Industrialized countries will promise to cut their GHG emissions by 2020 and make even more cuts by 2050 (always compared to 1990). For 2050, views are converging: 80–90 per cent or more will be offered by industrialized countries as it is believed that new technologies will be available to achieve this. The problem is with 2020; the EU offers 30 per cent, China wants a minimum of 40 per cent, the small island states 45 per cent, while India wants almost 80 per cent. And the US offers 4 per cent. At their summit in L'Aquila (Italy) in July 2009, the G8 countries recognized the broad scientific view that calls for a limit on global warming of 2 °C. Globally, however, such a target has not yet been accepted. This is partly so because a global target would irrevocably fix the available global carbon budget. Developing countries, notably India, argue that there is very little headroom left for increasing global GHG emissions (Egenhofer/Kjellén/Kartha/Kumar 2008: 2). Therefore, developing countries link an agreement on a global target to a binding commitment of developed countries for 'steep reductions' expressed in absolute figures.

The UNFCC estimates that developing countries will require some €74–78 billion ($92–97 billion) for mitigation and at least another €23–54 billion ($28–67 billion) for adaptation in the year 2030. Not all of these financial requirements will need to be financed by public budgets, but a good deal will. China wants 0.5–1 per cent of developed countries GDP to be used to help poor countries. The EU, normally a frontrunner on climate change has postponed a decision on finance until October 2009, or even more likely to the early December European Council meeting. One can assume that both the targets and the finance package will be agreed only in the final hours of Copenhagen.

It would, however, be misleading to say that only targets and finance matter. The agenda for Copenhagen and beyond is far broader than this. It also includes a framework and finance for adaptation, the tools to avoid further deforestation and enhance afforestation, technology transfer and the development of carbon markets – especially the shape and volume of future post-2012 flexible mechanisms such as the new CDM or Joint Implementation. In the run-up to the Copenhagen summit, some progress has been made in these fields, albeit mainly of a procedural nature.

83.10 Conclusions

With the integrated climate and energy package, the EU prepared the ground for the crucial climate negotiations in Copenhagen in December 2009. The EU and its member states have realized that EU leadership is one of the crucial elements to create momentum for these negotiations. Nothing could document EU determination to provide this leadership more than an ambitious and credible domestic climate change policy. The negotiations about the package, however, have also seen that ambitious targets create trade-offs between member states and between industrial sectors. These trade-offs were settled because there was leadership by the heads of state and government. Trade-offs were also eased because of the potential benefits of the package for energy security and the prospect to shaping the coming global climate change regime. In doing so, the EU also sees a potential to make Europe a global leader for new low-car-

bon technologies while at the same time gradually reducing its energy import dependency. Overall, EU leaders have judged that the benefits outweigh the costs. Whether they will reach the same conclusion in the case of the steep cuts that will be required in the future remains to be seen.

84 Coping with Climate Change in East Asia: Vulnerabilities and Responsibilities

Paul G. Harris

84.1 Introduction

With its extremely large population and huge landmass, East Asia is among the world's regions most vulnerable to – and increasingly responsible for – future climate change. This chapter briefly examines two issues that permeate debates about climate change policy and politics in the region: (1) the ecological and socio-economic impacts of climate change for the countries of East Asia, and (2) critical questions of international justice – what some prefer to call international equity or fairness – associated with climate change.[1]

These two overarching issues are unavoidable considerations for efforts to address climate change, and they are central to helping us understand why and how countries respond to it. Vulnerabilities to the impacts of climate change can drive concerns within countries, to be sure. But they are not the only considerations. Demands for justice affect the willingness of governments to join and implement climate change agreements, and the extent to which those demands are fulfilled can determine the ability of many countries to undertake the measures that are necessary to mitigate climate change and to deal with its adverse consequences.

This chapter reviews major scientific reports on the potential impacts of climate change in East Asia. While these reports vary somewhat in their findings and their degree of certainty, the preponderance of evidence is clear: climate change presents the region with extraordinary challenges, most of them unwelcome (84.2). The chapter then introduces some underlying ethical considerations with regard to the responsibility for climate change before summarizing how justice is part of the broader climate change regime, including the 1992 UN Framework Convention on Climate Change (UNFCCC), its 1997 Kyoto Protocol, and ongoing negotiations concerning how to build on it. The main concern here is on practical debates, their codification in international instruments, and the ways in which they are perceived by East Asian countries – and hence their impact on policy and behaviour (84.3). The conclusions are rather unpleasant. Increasing knowledge of the adverse effects of climate change has raised awareness and concern among East Asian countries, but questions of justice and responsibility mean that their worries about it do not automatically or easily translate into national action (84.4).

84.2 Threats, Vulnerabilities, and Risks in East Asia

Climate change will lead to many adverse consequences, difficult choices, and expensive adaptation measures for much of the world's population (IPCC Working Group II 2007). The countries of East Asia will not be immune to these changes, and in most cases will be among the worst affected due to their vulnerable geographies and economies. Several research reports over the last decade have sought to predict the effects of climate change for the region.

The IPCC's only full-length assessment of the *regional* impacts of climate change (IPCC 1997), reported that *temperate Asia* (including Japan, the Koreas, and most of China) experienced an average annual temperature increase of more than 1 degree Celsius in the 20th century, mostly after the 1970's, and substantial warming was expected in this century. Rainfall was predicted to change significantly in the area, with substantial declines expected in most of China (notably in the Northern provinces). Permafrost in Northeast China was expected to disappear (with release of methane, thus adding greenhouse

1 Many of these arguments were exercised in Harris (2001a, 2002b). This chapter updates regional impact scenarios described in Harris (2003a).

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gases to the atmosphere) and glaciers were expected to melt. Northern China is particularly vulnerable to expected changes in rainfall, exacerbating existing water shortages (see Nielson/McElroy 1998; Ying 2000). The area is likely to experience changing agricultural yields, with many crops likely to see reductions and a northward movement of crop zones and anticipated shortages of round wood (partly due to increased demand). Delta coastlines in China are severely threatened by sea-level rise, which will include saltwater intrusion into aquifers. Japan will not be immune; already many parts of major coastal urban areas, with millions of residents, are below the mean high-water mark. Providing protection for only some of these cities will cost tens of billions of dollars. Japan's beaches, which comprise about a quarter of its coastline, will be subject to erosion - and over half of existing beaches may disappear. Additionally, heat-related deaths throughout temperate Asia may increase sevenfold by the middle of this century.

The potential effects of climate change for *tropical Asia* (encompassing Southeast Asia) were also described in the IPCC's (1997) regional assessment. It reported that, by the 1990's, the region was already suffering from increasing pollution, land degradation, and a host of major environmental problems resulting from rapid urbanization, industrialization, and economic development. Climate change was seen to be exacerbating these problems. In this sub-region, mean surface temperatures were already up by 0.3° to 0.8° Celsius over the preceding 100 years. Among the predictions of impacts were the following: Forest cover will change, possibly increasing, and forest types may vary from those of the present. Changes in evaporation and rainfall are likely to have detrimental effects on freshwater wetlands. Coastal areas will be most greatly affected by sea-level rise and increased ocean temperatures, the latter possibly preventing coral reefs from keeping up with sea-level rise. Mangrove and tidal wetlands will have difficulty adapting due to bordering infrastructure and human activities. Greater erosion, coastal flooding, and salinization of fresh water sources are probable. Delta regions of Southeast Asian countries are particularly vulnerable, and throughout this area several million people could be displaced by sea-level rise. The costs of responding to the impacts of rising seas, in the words of the IPCC, "could be immense" (IPCC 1997: para. 6.10). Glaciers feeding the area's rivers will likely melt, and there may be yearly reductions – albeit between seasonal flooding – in the flow of snow-fed rivers, adversely affecting agriculture, hydropower generation, and urban water supplies. Agriculture will probably suffer (despite CO_2 fertilization) from temperature and moisture changes and possibly from increased pests, affecting wheat, rice, and sorghum crops (although much uncertainty, confounding planning, will obtain). According to the IPCC report, poor rural populations depending on traditional forms of agriculture or living on marginal lands are especially vulnerable. Increased vector-borne diseases such as dengue, malaria, and schistosomiasis will adversely affect human health.

The IPCC's 2001 third assessment report (IPCC Working Group II 2001) showed that Asia is potentially more vulnerable to the impacts of climate change than are some other regions of the world.[2] It concludes that the developing countries of Asia are highly vulnerable to climate change, and their adaptability is low. (Developed countries of the region [e.g. Japan] are of course less vulnerable because they are more able to adapt to climate change.) Floods, forest fires, cyclones, droughts, and other extreme events were reported to have increased in temperate and tropical Asia. The third assessment report anticipated that while agricultural productivity could increase in northern parts of Asia, food security would suffer in arid, tropical, and temperate Asia due to reduced agricultural and aquaculture productivity from warmer water, sea-level rise, floods, droughts and cyclones. Water availability may decrease in arid and semi-arid Asia and possibly increase in northern Asia, and increased incidence of vector-borne diseases and heat-stress will threaten human health. Temperate and tropical Asia should anticipate increased rainfall and floods, and sea-level rise and more intense storms could "displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia" (IPCC Working Group II 2001: 16). Some parts of Asia will see climate change effects on transport, increased demand for energy, and adverse impacts on tourism. Land-use and land-cover changes will threaten biodiversity, and sea-level rise will adversely impact coral reefs and mangrove areas that are important for fisheries.

Regional scenarios on the impacts of climate change in the IPCC's 2007 fourth assessment report (IPCC 2007) "confirm most of the key findings on impacts, vulnerabilities and adaptations for Asia" in the third assessment report (IPCC 2007: 472). *Observed* trends include increasing surface temperatures, especially during winter; decreasing annual mean rain-

2 The report does not distinguish East Asia. These findings are for Asia generally except where specified.

fall in Northeast and North China, Indonesia, the Philippines and parts of Japan; and increasing rainfall in Western China, the Changjiang Valley and along the Southeastern coast, as well as in the Philippines' western coasts (IPCC 2007: 472). Changes in extreme weather events in Asia that have been observed include "increasing tendency in the intensity and frequency of extreme weather events" (IPCC 2007: 473), including heatwaves in China, Japan, the Korean Peninsula, and Southeast Asia; intense rains and floods in China, Japan, and Southeast Asia; droughts in China and parts of Southeast Asia; and cyclones/typhoons in China, Southeast Asia, and Japan (IPCC 2007: 476). Damage in China, the Philippines, Japan, Vietnam, and Cambodia from more intense cyclones has "risen significantly" (IPCC 2007: 473). The impacts of alterations in climate trends, variability, and extreme weather events have already included adverse changes to agriculture and declines in food production, increased water shortages (including the drying up of lakes in parts of China), coastal erosion, and coastal flooding "resulting in substantial economic losses and fatalities" (IPCC 2007: 477), seawater intrusion in China's coastal plains, loss of coral reefs in Southeast and East Asian waters, fires in Southeast Asian peat lands, forest and brush fires in Indonesia, drying up of wetlands and "severe degradation of ecosystems" (IPCC 2007: 478) in China, loss of biodiversity, movement of animal and plant species to higher latitudes and altitudes, and diarrhoea-related diseases and outbreaks of cholera, hepatitis, malaria, dengue fever, and other infectious diseases "influenced by climate-related factors," such as floods and droughts, in association with other factors like lack of safe drinking water and poor sewerage (IPCC 2007: 478).[3]

The IPCC's latest assumptions about *future* impacts and vulnerabilities can bring little comfort to East Asia, not least the prediction that there will be "a significant acceleration of warming over that observed in the 20th century," particularly at higher latitudes and during winter (IPCC 2007: 478). Predictions foresee increased annual precipitation in East Asia, notably in summertime in Southeast Asia, but with a simultaneous increase in extreme weather events (e.g., intense rain and heatwaves). Japan, for example, can expect "enhanced" heatwave conditions and extreme daily precipitation, including typhoons (IPCC 2007: 479). East and Southeast Asia are likely to experience tropical cyclones that are 10–20 per cent more intense (based on 2–4 °C increase in sea surface temperatures), higher storm surges along coasts, and sea-level rise of 1-3 mm per year, above the predicted global average (IPCC 2007: 479). Key future impacts and vulnerabilities anticipated by the IPCC during this century include some good and much bad news (IPCC 2007: 479–489). The good news is that crop yields could increase up to 20 per cent in East and Southeast Asia according to some models (IPCC 2007: 479), but others point to decreased yields in some places, such as up to 40 per cent lower rice yields in parts of Japan and a fall in rain-fed rice yields by up to 12 per cent in China (IPCC 2007: 480). Indeed, rain-fed croplands in North and Northeast China will likely require more irrigation due to a water deficit, as will agriculture in much of East Asia (IPCC 2007: 482). The coastal waters of East and Southeast Asia are expected to experience a decline in fisheries production, but the predictions of how fisheries will be affected are foremost characterized by extreme uncertainty. Overall, combined with increasing demand, effects of climate change (such as increases in crop pathogens on food production in the region) are very likely to be adverse.

Water resources in the region will likely change for the worse. For example, the *maximum* monthly flow of the Mekong River will increase, leading to greater flooding in rainy seasons, but *minimum* flows will decrease, contributing to water shortages in dry seasons (IPCC 2007: 483). In other parts of the region, water cycles will change, with snowmelt run-off ending sooner and intense rains occurring over shorter periods, contributing to water shortages during much of the year (IPCC 2007: 484). Climate change will adversely affect rivers fed by glaciers. Already, glaciers in Asia are receding more quickly than in other regions, with some Chinese glaciers expected to decline by over 60 per cent and smaller glaciers expected to disappear altogether this century, with this "attributed primarily to [anthropogenic] global warming" (IPCC 2007: 493). About 250 million people in China alone could be seriously affected by melting glaciers (IPCC 2007: 483). Water quality will suffer in some areas due to salt-water intrusion from sea-level rise, and more frequent and more intense droughts (IPCC 2007: 483). Sea-level rise means that coastal areas will suffer increased erosion and seawater inundation, affecting agriculture and wetlands, while also flooding the homes of millions of people, especially in Southeast Asia (IPCC 2007: 484–485). Deltas, estuaries, and nat-

3 Many of the report's findings on climate-related trends in the region are summarized here (IPCC 2007: 475–478). Many of these environmental changes have been exacerbated by human activities.

ural ecosystems, including forests and grasslands, will suffer degradation and the effects of extreme weather events (IPCC 2007: 485–487). Other impacts directly felt by the people of East Asia are expected to be adverse (IPCC 2007: 487–489). Human health will likely be affected in a number of ways by, for example, more cases of dengue fever and increased heat mortality in China, more patients suffering from pollen disease in Japan, and increasing incidents of infectious bacterial diseases such as cholera and other waterborne diseases like dermatitis and gastrointestinal illnesses in Southeast Asia.

What comes from the IPCC and other reports on the impacts of climate change in East Asia is that many of the effects will be felt most by – and be most painful for – the poorest countries and the poorest people of the region who are generally more vulnerable and least able to cope due to poverty and existing environmental problems and resource scarcities (see Working Group on Climate Change and Development 2007). Problems of population, intensive development, overuse of resources, and degradation of the natural environment that characterize life in much of East and Southeast Asia today will be exacerbated, perhaps greatly so, by climate change. A very large number of people throughout East Asia live in low-lying coastal regions, and they are threatened by sea-level rise, land subsidence, inundation of fresh water aquifers by salt water, and more frequent and violent storms from climate change. Island countries such as Indonesia and the Philippines are especially vulnerable to climate change effects (Galvez 2003). They can expect freshwater shortages and damage to coastal areas and adjacent infrastructure, with concomitant adverse effects on tourism. Indeed, in extreme cases it may one day be necessary for some small-island Asian Pacific states to abandon their territory altogether. Representatives from these countries have for some time argued that they are *already* feeling the effects of rising oceans (UNFCCC 2007c). These effects are more than problems for people; they present developing countries with potentially existential challenges. Even those state governments overseeing strong economies and that have major resources of command at their disposal may be challenged. For example, in the case of China, "[t]he government's steering capacities could be overwhelmed by the rapid pace of modernization, environmental and social crises and the impacts of climate change" (German Advisory Council on Climate Change 2007). Weaker governments in more vulnerable countries could face these challenges and more.

Even the developed countries and regions of East Asia are unlikely to avoid harm from climate change. By way of example, reduced fish catches by Japanese fisherman have been attributed to changes in underwater currents triggered by climate change (Reuters 2001).[4] While Japan's coastlines are not as vulnerable as those of China, the Philippines, and other countries, it is reasonable to expect that it will suffer costly damage from sea-level rise, associated storm surges, and adverse weather, and it has direct interests in the health of surrounding seas and indirect interest in what happens throughout the region. And there will be adverse impacts for Japan's biodiversity, forests, agriculture, wetlands, and water systems, as well as for infrastructure and human health (Nishioka/Harasawa 1998; Working Group on Climate Change and Development 2007: 37).

Impacts are being felt in other developed countries: Australia, with the highest per capita greenhouse gases in the world, will likely see the Great Barrier Reef devastated by coral bleaching and national parks suffering major losses in biodiversity, and that already very dry continent will experience more severe drought conditions with adverse consequences for agricultural productivity and bush habitats (Working Group on Climate Change and Development 2007: 35–36). In South Korea, seasons are already being blurred, with negative impacts on flowering plants, forests and fisheries, and sea-level rise poses risks to coastal ecosystems (Working Group on Climate Change and Development 2007: 37). Even in Hong Kong, predictions see winters as vanishing within 50 years, with more hot nights trapped by concrete skyscrapers in an increasingly tropical city (Working Group on Climate Change and Development 2007: 34).

84.3 The Challenge of International Justice

It might be assumed that the key to increasing the participation of East Asian countries in the climate change regime is a function of knowledge about the problem and their capability to act. This would be a simplistic assumption. Much as people can be stubborn if they are not treated fairly, states can be as well,

4 See: Reuters: "Scientists, fishermen fear Sea of Japan slowly dying", 28 March 2001; at: <http://www.heatisonline.org/contentserver/objecthandlers/index.cfm?id=3672&method=full>.

including states in East Asia. To be sure, an increasing understanding of the regional and local effects of climate change logically influence governments' attitudes toward this problem, with the likelihood that improved understanding of adverse impacts will increase their willingness to do something about the problem. However, questions of justice and responsibility for climate change often obscure predictions about impacts or heighten resistance to action, especially when uncertainty about those impacts obtains. Developing countries of East Asia will be less willing (and less able) to address climate change if they believe that they are not being treated fairly in the context of the global regime – despite the increasingly clear dangers they face from the problem.

As suggested by the scientific findings summarized above, all countries of East Asia could suffer from climate change, although it is likely that the poor countries of the region will suffer most due to their vulnerable geographies and economies. However, it is the economically developed countries of the global North that have generated most greenhouse gases since the Industrial Revolution, and they have thereby benefited from using the global atmosphere as a sink for the harmful by-products of their economic development (Ponting 1991: 387–392, 405–406). During the negotiations for the UNFCCC, developing countries were unified in emphasizing the historical responsibility of developed countries for climate change. They agreed to participate in the climate negotiations only on the condition that they are not required to accept any substantial commitments of their own (Borione/Ripert 1994: 83–84). For developing countries in East Asia, this remains sacrosanct.

It is probably impossible to state definitively what is a 'just' or 'equitable' distribution of the burdens associated with climate change.[5] Nevertheless, the IPCC has grappled with the question (Bruce/Lee/Haites 1996). It seems unassailable that there ought to be a just and equitable distribution among countries of the benefits and burdens associated with climate change. One can say this because it is difficult to envision any reasonable person or government arguing that there ought to be an *unjust* or *inequitable* (as opposed to possibly unequal) sharing of climate change burdens. However, people and governments will disagree about the precise manner in which justice is to be operationalized. Indeed, that is much of what the continuing climate change negotiations are about.

In simple terms, justice (or equity) refers to the quality of being fair, impartial or even-handed in dealings with others. At the very least, as Henry Shue (1995) argues, justice and equity mean doing no additional harm to other countries and other people, as well as ensuring an adequate minimum for vulnerable people. International negotiators are involved in arbitrating these and other various definitions of international justice in the context of climate change. While philosophical conceptions of justice are important, and indeed they have informed the thinking of policymakers, they are often used to support demands of countries that derive from practical considerations and genuine feelings of injustice on their part. In fact, what passes for justice in the climate change regime is what governments can agree that it means.

International justice has been codified in a host of international environmental agreements, such as the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (and its amendments), the Convention on Biological Diversity, and the FCCC (Banuri 1996: 87–91; Harris 2001b: 1–88). Among the key principles in the UNFCCC is that of "common but differentiated responsibility," meaning that industrialized developed countries would take the lead in addressing the climate change problem, specifically excluding developing countries from binding greenhouse gas emissions reductions (Harris 1999). The developed countries are disproportionately responsible for historical emissions, and they have the greatest capacity to act. As the UNFCCC points out, "the largest share of historical and current global emissions of greenhouse gases has originated in developed countries" (Preamble). Thus the Convention makes few demands on the (until recently) much less responsible and usually much less capable developing countries. This exclusion of developing countries became one of the most contentious issues before and during the negotiations leading to the Kyoto Protocol – and remains so in negotiations for a post-2012 successor to the protocol.

In the spirit of common but differentiated responsibility, the first basic principle of the UNFCCC states that:

> The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties

5 This is analysed in detail in Harris (2001c), and the conceptions of equity in global environmental politics are discussed in Harris (2001b).

> should take the lead in combating climate change and the adverse effects thereof (Article 3[1]).

Thus the convention recognizes that all countries are responsible for climate change, and all should endeavour to limit the pollution that causes it. But, following the common but differentiated responsibility principle, it does not require developing countries to reduce their greenhouse gases. It instead requires the developed countries to take the "lead in modifying longer-term trends in anthropogenic emissions [of greenhouse gases] consistent with the objective of the Convention" (Article 4,2,a). The convention codifies the idea that it would be unfair to expect developing countries to limit their economic development when the wealthy countries of the world are most responsible for present concentrations of atmospheric greenhouse gases and most of the expected consequences of this pollution for the global climate in the next century.

Negotiations for the Kyoto Protocol were premised on the common but differentiated responsibility principle. The developed countries accepted this standard because they knew developing countries would not – and in many cases could not – join the climate regime and eventually limit their emissions otherwise. Throughout the international negotiations on a protocol to the UNFCCC, developing countries, often lead by China, consistently declared that they would not agree to any mandatory limitations (least of all *reductions*) in their greenhouse gas emissions until the developed countries substantially reduce theirs (see G-7 in 1997; Hatch 2003; Zhang 2003). The developing countries acted on these sentiments in the Kyoto negotiations, vetoing any language in the protocol that would call on them to make even voluntary commitments to limit their emissions of greenhouse gases (ENB 1997). Accordingly, the Kyoto Protocol requires *developed* countries to reduce their overall emissions of greenhouse gases by about 5 per cent below 1990 levels by 2012. Indeed, the Protocol is devoid of references to emissions limitations for developing countries. Rather, all its provisions apply to the developed 'Annex I' countries. In Article 10, the Protocol explicitly reaffirms common but differentiated responsibility when it states that all parties must take into account

> their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, without introducing any new commitments for Parties not included in Annex I [i.e. the developing countries].

Subsequent international negotiations attempted to hammer out the details of implementing greenhouse gas emissions cuts mandated by the Kyoto Protocol. For example, at the eighth conference of parties to the UNFCCC in 2002, the developing countries, notably China and India, reaffirmed their outright opposition to reducing their greenhouse gas emissions. Then Indian Prime Minister Atal Bihari Vajpayee pointed out that per capita emissions from his country are an order of magnitude below those of the developed countries (Vajpayee 2002). He added that developing countries will continue to increase their emissions – and ought to so that millions of poor people can be lifted out of poverty. China has consistently taken an identical position, and in the run-up to the 13th conference of the parties at the end of 2007 Chinese officials affirmed this. In the words of China's Vice Foreign Minister, Zhang Yesui, "Climate change is caused mainly by developed countries. . . . They should have the main responsibility for climate change and to reduce emissions" (McDonald 2007). This position was reaffirmed by China and other developing countries in the region as they participated in negotiations in early 2008 toward reaching agreement on a successor to the Kyoto Protocol.

Consequently, much attention has focused on *adaptation* measures, through transfers of funds and technology to developing countries to help them cope with the effects of climate change (Harris 2002a, 2003b). The result has been an alliance of sorts between the United States and some large developing countries. By shifting the focus of the climate talks to adaptation, and away from mitigation, both sides can avoid doing what they dread the most: reducing their greenhouse gas emissions. The poor countries can get more money and technology on preferential terms – assuming the agreements are carried through – and they would not be required to stop using cheap forms of energy as they develop. This seems a fair outcome because poor countries will be able to take advantage of aid from the Global Environment Facility and other funding mechanisms set up under the climate change convention, as well as funding and technology transfers through the Kyoto Protocol's Clean Development Mechanism, which allows industry in developed countries to implement emissions cuts in developing countries.

The upshot is that climate change has not been prevented and climate change will bring the most suffering to those least responsible for it, many of them living in East Asia. It is important to bear in mind that developing countries in East Asia have similar short-

term economic concerns – and domestic interests lobbying governments – which oppose greenhouse gas cuts found in the developed countries. But in addition to these interests resisting more concerted action to reduce national greenhouse emissions, they have major concerns about justice and equity. Indeed, as Japan's former ambassador for international economic and global environmental affairs has argued, assertions by the United States and some other developed countries that implementing the Kyoto Protocol to the UNFCCC will be too costly for them "could lend weight to the argument advanced by some developing countries that they are too poor to take action" (Asakai 2001).

All countries in East Asia have signed and ratified the UNFCCC. The convention calls on all of them, including the developing countries, to inventory their emissions, in addition to undertaking their 'common' responsibility to work toward addressing climate change. In many ways the developing countries of East Asia are doing this, and they are becoming more energy efficient because in so doing they derive many domestic benefits (i.e. increased energy security, reduced local environmental pollution, etc.). However, they continue to have low per capita emissions relative to the developed countries, and most of them remain relatively poor. As a consequence, they continue to refuse mandatory emissions limitations, and certainly they will not accept mandatory emissions *reductions*. China's concerns about injustices associated with climate change are indicative of the views of many developing countries, including those of East Asia (Kobayashi 2003). It wholeheartedly opposes new developing country commitments and continually demands greater action from the developed world. Even Japan supports the notion of common but differentiated responsibility because the developed countries have caused the problem and because their per capita emissions are twenty times those of the poor countries. From the Japanese perspective, it is "not right to expect developing countries to assume the same level of obligation" (Asakai 2001).

One practical manifestation of what the developing countries want, apart from not being required to reduce their greenhouse gas emissions, is increased development aid. Most developing countries of East Asia view the climate change regime as a potential source of funds and technology to assist with their sustainable development and to improve their energy security. International financial institutions, such as the World Bank, have many programmes in place to assist the developing countries in the region with, for example, energy conservation and efficiency. Japan is important in this respect, for it is a source of much of the funding (Asuka-Zhang 2003). It provides assistance to reduce emissions from energy production, which not only reduces greenhouse gases but also reduces emissions that affect Japan directly (e.g. acid rain), and its bilateral assistance is viewed more broadly by the government as a way to engage countries of the region, to show its leadership among them, and to promote the interests of Japanese industry with facilities in the region or that wish to export their environmental technologies (Asakai 2001). China has benefited greatly from the Clean Development Mechanism (Michaelowa/Asuka-Zhang/Krause/Grimm/Koch 2003). In 2006 China alone received $ 3 billion of the mechanisms $ 4.8 billion payout (Chen 2007), and by October 2007 China had 885 greenhouse gas-reduction projects garnering $ 15 billion for Chinese companies.[6]

This is not surprising because, among the countries of East Asia, China is the most important for efforts to address climate change. Its greenhouse gas emissions, particularly CO_2, will increase dramatically in coming decades, and it soon will (if it has not already) overtake the United States to be the number-one national source of greenhouse gas pollution (Netherlands Environmental Assessment Agency 2007). Nevertheless, it is important to point out where most of the blame for past emissions and observed climate change really lies: with the United States and other large developed countries, whose per capita emissions far exceed those of China and other developing countries – and indeed all countries of East Asia (if not all cities and regions within those countries).

84.4 Conclusion

Increasing knowledge of the uncertainty and adversity that will result from climate change has raised awareness and concern among East Asian countries. Climate change poses challenges for economic development and will likely harm human and international security in the region. All things being equal, one would expect this knowledge to lead to very concerted action by East Asian countries to do all that is possible to mitigate climate change. However, domestic and international politics, and even ethics, inter-

6 See: Associated Press, 2007: "Beijing won't budge on emissions despite spewing 58pc of increased carbon", in: *South China Morning Post* (10 November): A6.

vene. Concerns about justice and equity often override or obscure the concerns and considerations regarding the likely dangers and difficulties posed for all countries in the region. Strong concerns about international justice, issues that are inherent in climate change and related international politics, mean that worries about the impacts of climate change are not easily translated into national action by most East Asian countries. Indeed, governments and even many people may be willing to endure the ravages of climate change rather than join in or succumb to what they perceive to be unjust international demands for them to reduce their greenhouse gas pollution. At most they can be expected to demand help to *adapt* to the impacts of climate change, as they have been doing in ongoing international negotiations toward a post-Kyoto Protocol agreement that would simultaneously address the problem of climate change and the problem of perceived and actual injustice in this context.

In other words, without perceived (and possibly actual) justice, strong action to join global efforts to cut greenhouse gas emissions within the region is much less likely. Thus, *both* the impacts of climate change *and* concerns about related questions of justice will continue to occupy policymakers in East Asia, and both will influence their attitudes toward the climate change regime and the degree to which it is implemented in the region. This points to the need for the developed world to do much more to take the lead – and to be *seen* to be taking the lead – in cutting the pollution causing climate change *before* expecting developing East Asia to do much more.

85 Strategies for Coping with Climate Change in Latin America: Perspective beyond 2012

Ricardo Zapata-Martí

85.1 Introduction

In Latin America and the developing Caribbean countries and island territories, coping with climate change is not yet part of the development agenda and takes in many countries a back seat in the government's priorities that are more closely associated with economic growth and competitiveness, the trade agenda, poverty alleviation, uneven income distribution, and social marginalization and exclusion. The clear synergies between sound environmental policies, sustainable development, and the attainment of the *Millennium Development Goals* (MDGs) are not clearly established, just as the link between a social policy agenda and national security is just beginning to assert itself.

The issues of climate change in many instances are seen as more of an imposition from the developed world and a constraint to fast growth associated with industrialization, the exploitation of natural resources and basic raw materials such as minerals, petroleum, and expansion of large-scale agricultural production linked with the extensive use of chemical fertilizers, pesticides, and genetically modified seeds and species. Only a few countries have generated policies and mechanisms to allow environmental goods as a source of income and participate in the emerging CO_2 sinking bonds and mitigation projects. Even the designation of natural habitats as environmentally protected areas or national parks is limited given the continent's vast expanse and huge biodiversity, and in many instances it has been through foreign investors or as part of nature-for-debt processes that these have been created.

In part this is understandable given the still limited world market for environmental goods and services and the still limited – albeit fast growing – contribution to overall greenhouse gas emissions. The soon to expire Kyoto protocol has not provided sufficient incentive for the region's government and private sector investors to realize the potential that climate change mitigation can have as a means to increase the value of the region's natural capital. [1] The region has numerous examples where forest cover has been consistently reduced associated to investments on fossil energy resources exploration, the expansion of agriculture through extensive plantations and cattle farming, aggravating the deforestation directly caused by wood exploitation of its very rich and fast reducing forest cover.[2]

According to ECLAC (2009) in recent years there has been an increase in per capita emissions in almost all the countries of the region. The main contributing sectors are agriculture, change in land use, and energy consumption with about a third each. Emissions of industrial processes and waste represent less than 10 per cent. Nevertheless, emissions of *greenhouse gases* (GHG) in Latin America remain within the range of 12 per cent (including land-use change) but to remain at those levels it is clear that the region will need to invest in clean technologies and revert land-use changes to a greater extent than it is doing at present. By the same token the increasing cost of adaptation is not being incorporated in the region's development policies, thus increasing the vulnerability of both its productive and social investments.

1 At the United Nations Climate Change Conference in Bali in December of 2007, the 192 Parties to the UNFCCC agreed to launch negotiations on an agreement to step up international action on climate change in the period beyond 2012, when the first phase of the Kyoto protocol expires. The new agreement is based on four pillars: mitigation, adaptation, technology and finance, and is to be concluded in Copenhagen in 2009.

2 For an updated general description of desertification in Latin America see the WAFLA webpage; at: <http://www.wafla.com/>. For an interesting perspective on deforestation in Latin America see; Southgate and Runge (1990).

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_85, © Springer-Verlag Berlin Heidelberg 2011

A brief review of current environmental strategies and policies related to climate change describes a development profile in which sustainability is mostly a declarative principle. The discussion in Latin America and the Caribbean focused on the environmental impact of climate change, and it is only very recently that the economic implications have been addressed.[3] ECLAC (2009) has bridged the environmental and economic analysis, offering for the first time an analysis of relevant updated information till the end of 2008. This review highlights relevant economic aspects of climate change and its regional implications, as well as their link with major economic areas of concern such as international trade, fiscal implications, and additional restrictions to a rapid development growth that is not linked to an equally rapid growth in carbon consumption and greenhouse gas emissions. In 2009, climate change is beginning to be viewed as a development handicap as natural resource losses or management to adapt to the negative impacts of climate change. This publication argues that at the regional level climate change adaptation and mitigation pose an opportunity for a better quality development which will require investments in technological research and mobilize resources to access technologies that will allow for the mitigation of environmentally negative externalities of the current development process. It stresses the importance of attracting economic policy-makers and management to these issues, recognizing that the climate change adaptation and mitigation governance are still lacking. This derives from a lack of attention that climate change poses unforeseen pressures on government expenditure coupled with revenue losses.

85.2 Intra-regional Differences in Impact and Policies

There are intra-regional differences between South and Central America and between continental countries and small island states. This is mostly due to the increased consciousness of small island economies that longer and stronger hurricane seasons are linked to sea temperatures as a contributing factor, and that this is due to greenhouse gas emissions over which they have little control, and the fact that their small territories makes them extremely vulnerable. This smallness also implies that their potential contribution to mitigation is very limited both because they do not have a huge potential for gas sinks or for diversification of activities in order to reduce their vulnerability. These territories' footprints – given their remoteness and their economic sources of income linked to transport such as tourism or export of agricultural products or basic commodities – are also linked to the development of technologies that lie beyond their realm. This is not the case of larger continental territories where the potential for gas sinks is in some cases quite large. In those countries afforestation or avoided deforestation have a larger potential, and they also have a wider scope of sources of economic activity that they may diversify. A challenge for these countries is to reduce their use of non-renewable fuels, reduce their dependence on basic raw minerals and commodities and increase the value added in their productive processes, strengthen the value chain in their economies while improving their production processes by expanding clean production techniques. In Central America these strategies may be accelerated by joint regional cooperation and horizontal and vertical integration of these chains and processes.

Since the 1980's, several countries in the region have begun to adapt their legal and institutional frameworks to the new paradigm of sustainable development. All nations included the principle of environmental protection in their constitutional law, albeit to varied levels. In 14 countries, the new constitutions promulgated during the past 25 years contain environmental provisions that were inspired by ideas shaped in world *fora*. Others amended existing constitutions to incorporate environmental regulations.

Latin America and the Caribbean supported the environment agenda since the first UN Conference on the Environment and Development in Rio de Janeiro (1992) and in 2008 at a meeting in Brazil the 'Post 2012 Climate Change Framework' was discussed, and the need for a consensus on proposals on biofuels and forestry to be presented to the G8 leaders.[4] The movement from discussion and advocacy to actual policy formulation and political commitment from decision-makers, though, has not necessarily been translated into concrete actions and policies or into significant investments – either public or private – and the link between environmental concerns and

3 For a review of past regional positions see: IDB (2005, 2004). The latter report investigates the current state of the region's national institutional capacities in the area of climate change policy and the Kyoto protocol's Clean Development Mechanism. In particular, it assesses the role of the Designated National Authority

conservation and climate change has seldom been explicit.

Many countries have established general environmental legal frameworks while also trying to deal with natural resource conservation, concentrating in specific areas such as water resources, mineral resources, marine and land areas, hunting and fishing, forestry resources, and pollution hazards, as in the case of tourism, use and control of chemical products, pesticides, and coping with air pollution in large urban areas. These efforts, though, have not been linked perspectives of climate change so, despite the fact that these countries have developed national environmental plans and strategies, they are not seen as intrinsically linked or harmonized with adaptation or mitigation strategies in face of climate change. During the 1980's and 1990's, many Latin American and Caribbean countries created new environmental institutions with different status within governmental ministries, commissions, and councils. In some cases these were carved out of, or combined with, or reorganized within existing institutions. Pioneering cases at the ministerial level were Mexico, Costa Rica, Honduras, and Nicaragua although their effectiveness over time has been erratic and limited. Chile, Ecuador, Guatemala, and Peru among others created commissions (Gligo 1997) that had neither the resources nor the political clout for major change.

85.3 Discrepancy between Laws and Implementation

Based on this institutional development many rules and regulations emerged on specific environmental issues, such as mandatory environmental impact assessments for all projects and a requirement for the approval of investments, construction or industrial development and their control of hazardous wastes. In some cases environmental crimes were legally established regarding water pollution, deforestation, and fire control. The protection of natural resources with regulations on the use and access to natural resources in production processes, both industrial and otherwise, has also been legislated. Most prevalent are laws or regulation for the protection of human health from harmful environmental effects (UNEP 1993). Insufficient resources for monitoring, uneven legal practice and several exceptions have plagued the effectiveness of these legal provisions. A notable exception is the Brazilian Environmental Crimes Law of 1998.

Although laws regulating the use of natural resources often include provisions to punish non-compliance (Orozco/Acuña 1997); in many cases they do not include criminal or administrative sanctions. The root cause for this inefficient application of existing laws and regulations is not only a lack of resources and capacities to monitor compliance, but systematic implementation may have negative economic effects for the private sector and fiscal revenues. In Nicaragua pollution from domestic, industrial, and agricultural sewage is regulated but none of the rules can be properly enforced (Dourojeanni 1991).

This was stressed in the report on *Climate Change in Latin America and the Caribbean 2006* (UNEP; SEMARNAT 2006), which states that there is a "lack of information regarding how to approach adaptation" and that, in spite of the growing body of evidence, a perception prevails among policy-makers of "uncertainty regarding the interaction between climate change and other pressures." In most cases there is only a short-term planning horizon and what the report calls a "lack of mechanisms for public participation... The region has made great progress in terms of civil defence measures to deal with the disasters arising from change, but it has not done so in the area of adaptation." The impact of climate change is seen in the growing intensity and frequency of hurricanes in the Caribbean, changes in rainfall patterns, increased water levels in rivers in Argentina and Brazil, and the shrinking of glaciers in the extreme southern region of Patagonia and the Andes Mountains (Cevallos, Diego 2006).

4 On 20–21 February 2008 over 100 legislators from the G8 countries and the five larger emerging economies (Brazil, China, India, Mexico, and South Africa) gathered in Brasilia to participate in a major international forum on climate change, the GLOBE G8+5 Legislators Forum. Participating lawmakers discussed a 'Post 2012 Climate Change Framework' and a potential agreement on proposals on biofuels and forestry was sought. These initiatives developed by the G8+5 Legislators in consultation with business leaders and international experts. The papers presented touched on adaptation, market mechanisms, technology transfer, and energy efficiency. The GLOBE G8+5 Climate Change Dialogue, a unique informal initiative, was launched after the G8 Gleneagles Summit in 2005. With its broad political, international institution, and private sector support, it has successfully influenced the G8+5 governments.

85.4 Areas Where Policies Could Advance the Agenda

There are several policies the region could consider, linking adaptation, mitigation and risk reduction in facing an increase in extreme weather events. This could include measures to help communities cope with climate risks by improving human capital and better living conditions. Among these are:[5]

- *Better housing for poor people* in hazardous zones, such as flood plains, adaptation of construction techniques to local climatic conditions, culture and traditions, better use of local materials and reduced dependence on imported techniques, models and resources.
- *Improved sanitation and greater access to clean water* in poor neighbourhoods, and more efficient use of water in key areas, reduction of pollution of water sources and creation of new sources of income for the population. An urgent problem in most urban areas is waste disposal, where the economic potential is rarely considered, e.g. through conversion in energy, recycling of materials and reduction of the pollution of soil, air, and water. Upscaling has suffered from lacking technological proposals, and relied on government funding.
- *Early warning systems* combined with public education on potential hazards has been very limited and relied more on technology than on community participation. This implied little adaptation to local conditions and insufficient education on what to do with warning messages. Such warning and monitoring mechanisms could also be a crucial source of knowledge of climate indicators and their evolution over time. There is a lack of historical meteorological and climate information at the local scale.
- *Preventive actions prior to a warning* and appropriate responses when a warning is issued. Prevention should move from preparations for emergency response to an involvement of community organizations, social networks, social groups, among them women, and community design, including land-use zoning and construction techniques that are coherent with local conditions and cultures.
- *Better building codes and strict enforcement thereof* then are not to be seen as externally imposed but internally generated.
- *Better management of resources during emergencies* as part of an adaptation process, by using local providers, having necessary stockpiles, and offering an opportunity for intra-regional trade and cooperation and reducing reliance on external resources.
- *Public education programmes* should be expanded from preparedness and alert for sudden events, which are well developed in several countries, particularly in those affected by the yearly hurricane season. There is a need to prepare the population and agricultural producers for slow onset hazards, such as drought and hazards associated with changing rain patterns causing seasonal dryness leading to wildfires. Current policies often ignore a need for changing traditional planting practices associated with pre-planting burning and promoting more organic, energy efficient agri-culture, and adaptation to seasonally changing patterns, as for the recurrent El Niño/La Niña events. These cyclical events have increased return periods and cause major damage and losses through record flooding in some areas, extended drought and dryness in others, and thus aggravate climate extremes.
- *Improved weather and climate forecasting* from short to seasonal time horizons should become part of public awareness programmes with an institutional strengthening of chronically underfunded climate agencies. These institutions should strengthen their technological base and their monitoring equipment and stations should be modernized. In some countries an overlap of institutional responsibility often leads to a duplication of activities in areas where large irrigation programmes, hydroelectricity generation, and river basin commissions exist, leaving large parts of remote, less developed and more vulnerable national territories hardly monitored.
- *Partnerships among forecasters*, intermediary organizations and users to facilitate delivery, interpretation, and application of forecasts to manage climate risks. Here is a large potential for intra-regional cooperation and for reducing reliance on external sources of information which are often insufficient for local forecasting or prevention of flash flooding and preventable damage from landslides and avalanches. These agencies in large mountainous areas, as the Andes, should monitor

5 This section is based on: SEI, IUCN and IISD (2001); cited in: Simms and Reid (2006).

the dynamics of the evolution of glaciers that are rapidly shrinking in extension and volume, a major cause of climatic variations that affect the yearly cycles of rainy and dry seasons.

- *Better coastal zone planning guidelines* that recognize the flood mitigation potential of mangroves and natural wetlands should be seen both as a desirable environmental conservation practice and a risk prevention tool, increasing resilience to sea surges. Damages in coastal areas were often linked to reduced native green cover, mangrove depletion due to expanding beach surfaces and tourist structures, such as 'tropical' gardens, extended grass cover replacing native flora for golf courses, etc.
- *Watershed management and river basin monitoring*, control and restoration are an increased concern given the recent disasters due to siltation and reduction of watersheds to contain floods. This is frequently linked to a lacking integrated basin management due to deforestation, leading to a depletion of natural sources and increasing vulnerability to sudden unseasonably high rainfall that leads to landslides, debris moving downstream and causing major flooding. This is further aggravated when the normal flow is diminished by changes in the natural course, reduction of the natural coastal environment by activities such as fish ponds, tourist developments, or inappropriately built marinas and seawalls in port structures. Additionally, when these courses flow into the sea the water flow may be slowed by storm surges, increased sea level rise and changing climate patterns.

Two recent issues call for specific attention: the use of clean production techniques and a trend to promote the use of biofuels which are potentially useful in reducing the region's carbon footprint but pose equity issues and competition for use of resources.

85.5 Negative Impacts from Extreme Events

The cumulative negative impact of extreme weather events illustrates the potential impact of climate change (table 85.1).

According to CRED data for 1970 to 2008, economic damages and losses are above US$ 121,234 million, since it counts damages but not losses[6], the total affected population numbers 187,129,174 (what is larger than the primarily affected people of ECLAC[7]) and the persons killed are 265,238. CRED's database

Table 85.1: ECLAC assessments of natural hazards in Latin America and the Caribbean (1970-2008). **Source:** Zapata Martí (2005).

Period	Affected Population		Total damage and losses
	Deaths	Primarily affected persons	(millions US$, 2007 value)
1970-80	38,042	4,229,260	95,293.10
1981-90	34,202	5,442,500	115,787.02
1991-2000	32,365	2,718,452	25,027.37
2001-2008	9,400	34,505,278	58,194.79
1972-2008	114,009	46,895,490	294,302.28
Yearly average	3,167	1,302,652	8,175.06
Meteorological or climatic	49,639	39,574,403	164,125.2
Percentage of climatic of total	43.5	84.4	55.8

(figures 85.1, 85.2) covers all reported events while ECLAC is mostly based on actual assessments.

These differences do not change the observed trend for all disasters (figures 85.3, 85.4) and for climate-related or meteorological ones. For ELAC the economic impact has grown faster, what is consistent with global trends (CRED, reinsurance companies).

6 According to ECLAC's assessment, based on a stock-flow analysis, *damages* are a partial or total destruction of assets, stocks, inventories, etc. at replacement costs, while *losses* are economic flows affected as a consequence of the first. They are added to describe the total impact to document the required post-disaster resource mobilization to rebuild damaged capital and for additional investment required to rehabilitate incomes, production, and other economic flows. Both amounts cover a disaster's economic impact as certain events (e.g. drought) have minimum physical destruction and mostly cause subsequent losses. The same applies to epidemics since deaths, medical treatment and epidemiological control as well as economic flows affected by labour losses or decline in economic demand due to a drop in tourism and transport flows in affected areas are not derived from physical or capital damage.

7 ECLAC: Documents on disasters and methodology for the socio-economic and environmental impact of disasters, at: <www.eclac.cl/>; under "desastres"; at: <http://www.eclac.cl/cgi-bin/getprod.asp?xml=/noticias/paginas/4/35494/P35494.xml&xsl=/tpl/p18f.xsl&base=/tpl/top-bottom.xsl>.

Figure 85.1: Impacts of disasters in Latin America and the Caribbean (1972-2008). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.

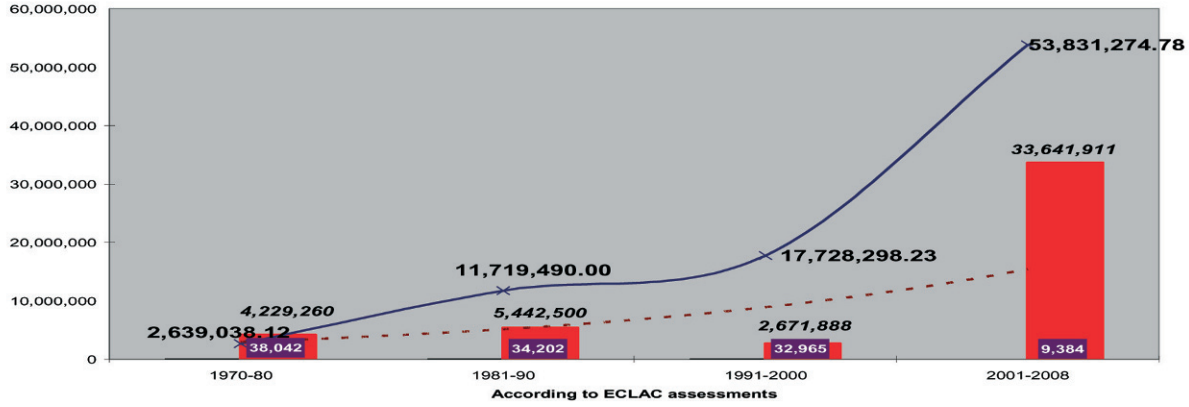
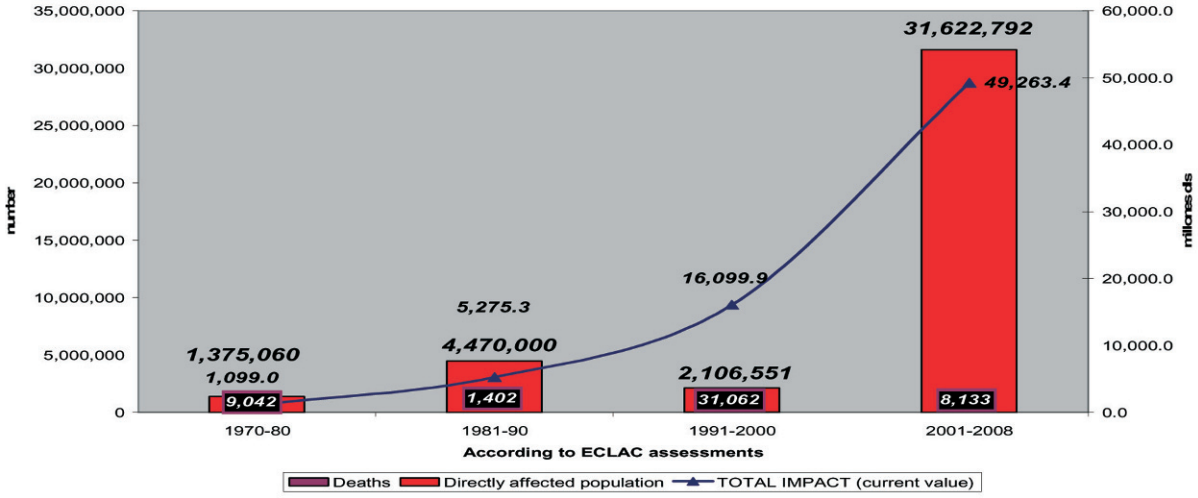


Figure 85.2: Evolution of climatic/meteorological events in Latin America and the Caribbean (1972-2008). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.



Several other negative impacts can already be observed for the Amazon (box 85.1). Charmaine Heslop-Thomas (University of West Indies, Jamaica) claimed in 2005 that dengue-carrying mosquitoes are appearing at higher altitudes leading to a significant increase in dengue fever, especially in El Niño years. Julia García Vargas (CONAM, Peru) addressed fears of a 'permanent' El Niño as sea surface temperatures remain high.

According to the fourth IPCC (2007) assessment report these long-term trends (1900–2005) have been observed in precipitation amounts over various regions. Significantly increased precipitation was observed in the eastern part of North and South America, in northern Europe and north and central Asia.

> For the next two decades, a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. ... Since IPCC's first report in 1990, assessed projections have suggested global average temperature increases between about 0.15°C and 0.3°C per decade for 1990 to 2005. This can now be compared with observed values of about 0.2°C per decade, strengthening confidence in near-term projections (IPCC 2007: 5).

The IPCC (2007a) reviewed the quantifiable impacts at the sectoral and regional level, and concluded for Latin America and the Caribbean:

Figure 85.3: Global trend of disaster impact for fatalities and economic damage. Number of people reported killed by natural disasters (1975-2008). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.

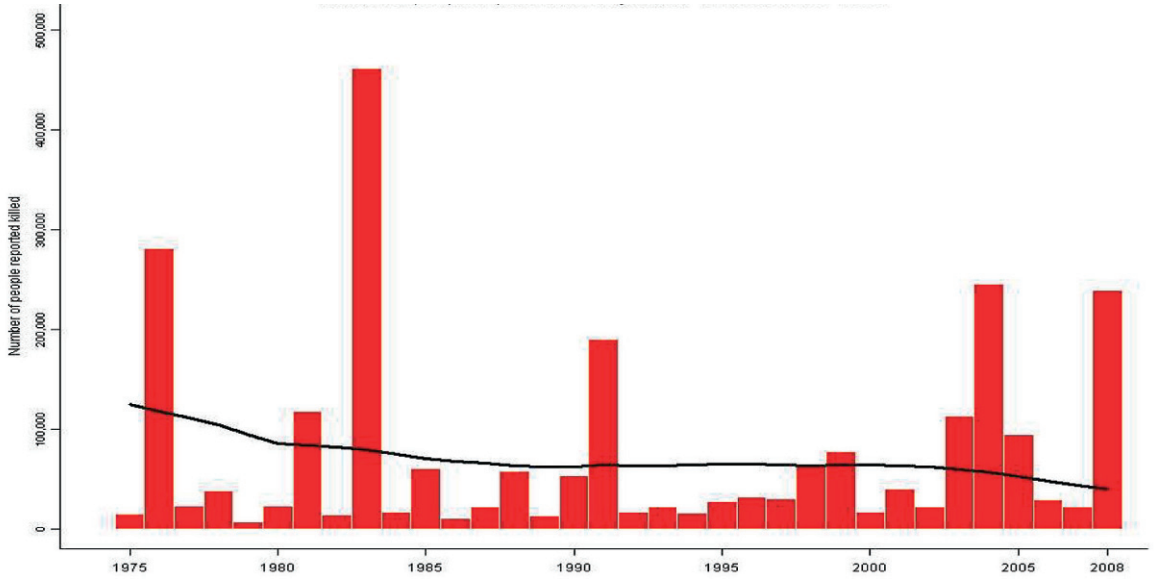
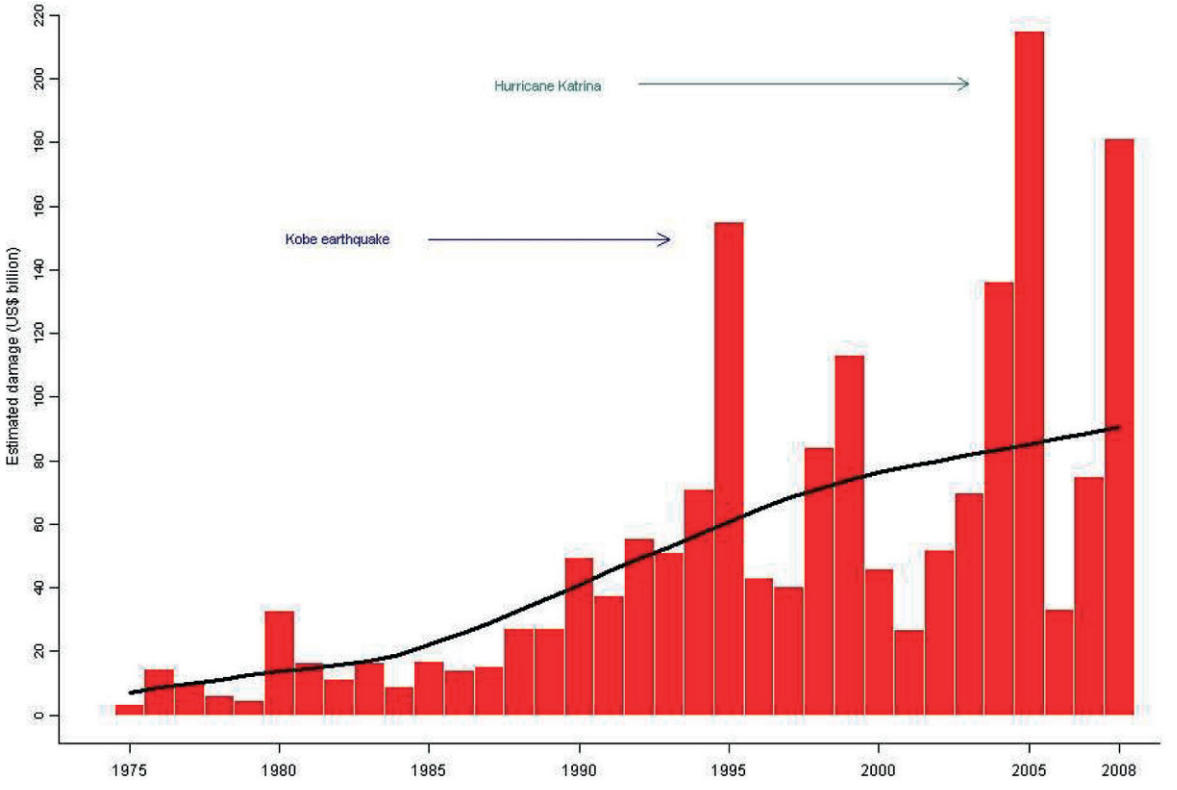


Figure 85.4: Estimated economic damage (US$ billion) caused by reported natural disasters (1975-2008). **Source:** EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium; at: <www.emdat.be>.



The annual mean warming is likely to be similar to the global mean warming in southern South America but larger than the global mean warming in the rest of the area. Annual precipitation is likely to decrease in most

Box 85.1: The destruction of the Amazon: a glaring example of the region's dilemma: concern on principle, little actions on the ground. **Source**: WWW (2007).

Climate change could speed up the large-scale destruction of the Amazon rainforest and bring the 'point of no return' much closer than previously thought. According to a study published by World Wildlife Fund (WWF 2007) almost 60 per cent of the region's forests could be wiped out or severely damaged by 2030, as a result of climate change and deforestation. The damage could release somewhere between 55.5bn–96.9bn tons of carbon dioxide into the atmosphere from the Amazon's forests and speed up global warming. Trends in agriculture and livestock expansion, fire, drought and logging could severely damage 55 per cent of the Amazon rainforest by 2030. Climate change could speed up the process of destruction by reducing rainfall by as much as 10 per cent by 2030, damaging an extra 4 per cent of the forests during that time. By the end of the century, global warming is likely to reduce rainfall by 20 per cent in eastern Amazonia, pushing up temperatures by more than 2 °C and causing forest fires. Destroying almost 60 per cent of tropical rainforest by 2030 would do away with one of the key stabilizers of the global climate system. Such damage could have a knock-on effect on rainfall in places such as Central America and India, and would also destroy livelihoods for indigenous people and some 80 per cent of habitats for animal species in the region. The 'point of no return', in which extensive degradation of the rainforest occurs and conservation prospects are greatly reduced, is just 15-25 years away - much sooner than some models suggest.

of Central America and in the southern Andes, although changes in atmospheric circulation may induce large local variability in precipitation response in mountainous areas. Winter precipitation in Tierra del Fuego and summer precipitation in south-eastern South America is likely to increase. It is uncertain how annual and seasonal mean rainfall will change over northern South America, including the Amazon forest. However, there is qualitative consistency among the simulations in some areas (rainfall increasing in Ecuador and northern Peru, and decreasing at the northern tip of the continent and in southern Northeast Brazil).

The IPCC addressed climate change impacts in Latin America and the Caribbean:

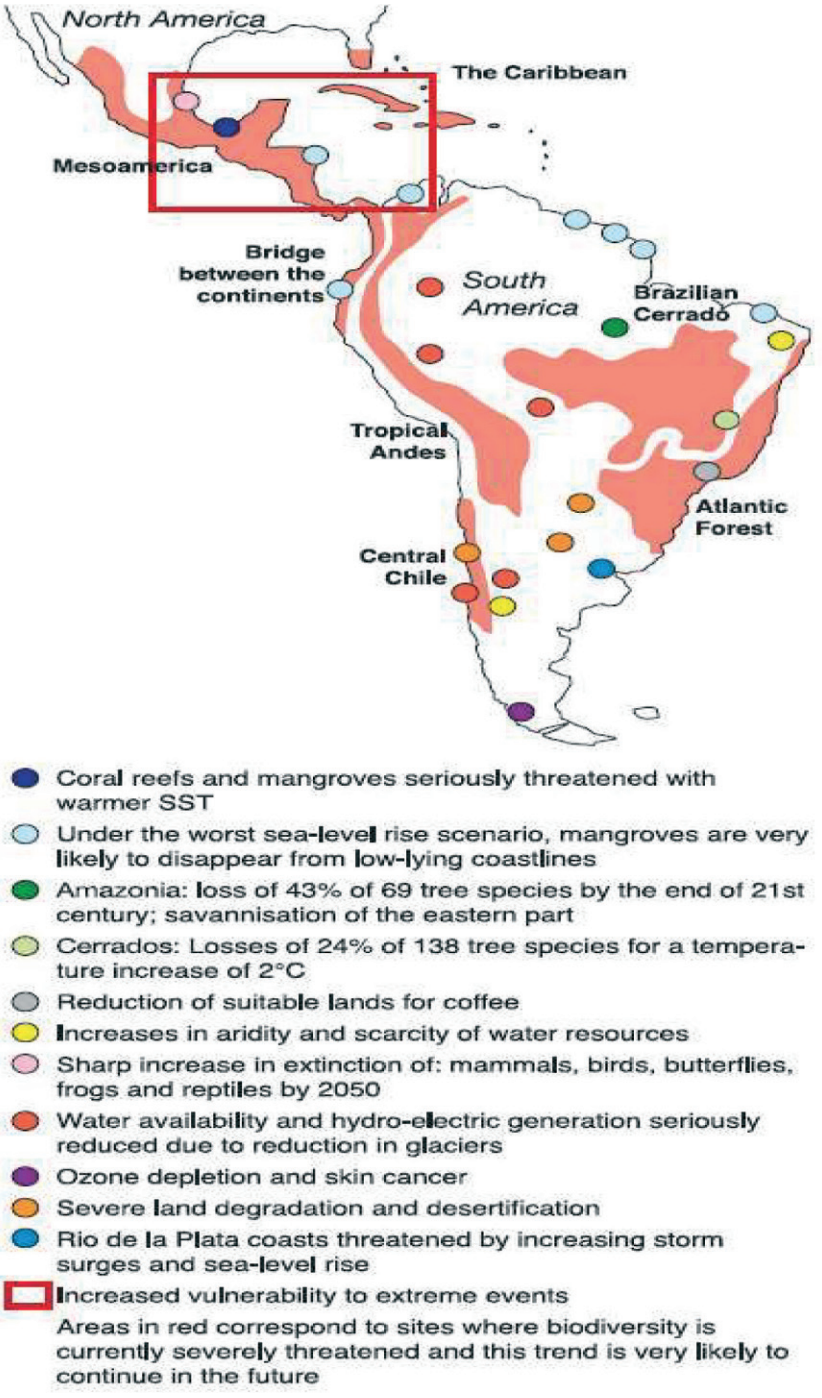
- By 2060 there is expected to be a loss in agriculture and in energy. Without adaptation, this loss could equal 1.3 per cent of the entire region's GDP. Such estimation is conservative. When all climate disasters are considered, the estimated loss is from 2 to 6 times as much (IPCC 2007: 583–611).
- Given the importance of agriculture to most of the region, climate change will have an adverse impact upon employment and trade (IPCC 2007: 583–611).
- Maize (corn) production in the Andean countries (AC), and Mexico and the Central American (MA) countries could decrease. Keith Wiebe questions whether Belize, Guyana, and Venezuela even have begun to consider seriously issues of food security (Wiebe 2002: 27–30).
- Coastal sectors (i.e. biodiversity, fisheries, tourism, and infrastructure) that are highly vulnerable to floods, sea level rise (SLR), and windstorms will very likely be damaged. The most vulnerable countries to SLR and storm surges during tropical storms and hurricanes are those of the Caribbean, Central America, Argentina, Ecuador, Mexico, Peru, Uruguay and Venezuela (IPCC 2007: 583–611).
- A large fraction of the population living west of the tropical Andes will be affected by the melting of the glaciers between 2010 and 2050. People at risk of water supply for human consumption, hydro-power and agriculture are estimated to reach about 37 million in 2020 and 50 million in 2050. Shortages are expected in Central Chile, Patagonia, Mexico, Central America, most of the Caribbean, Venezuela, the Guyanas, and Amazonian and Northeast Brazil. Particularly affected will be the cities of La Paz, Lima, and Quito (IPCC 2007: 583–611).
- Under climate change scenarios mitigation investments in safe drinking water are estimated to amount to $16,500 million (2000) during the period 2000-2015 (IPCC 2007: 583–611).

Other recent reports (Stern 2006; Nagy 2006) provide additional details. Although many case studies were carried out in the region and ongoing research will produce new evidence, Latin American governments and their delegations at climate change negotiations still lack a strategic approach to use this scientific evidence (figure 85.5).

85.6 Some Positive Actions

There are some interesting examples where climate change options and environmental degradation can generate positive initiatives instead of a negative downward cycle.

Figure 85.5: Climate change impacts in Latin America and the Caribbean. **Source:** IPCC (2007a: 606).



- According to the *Proyecto de Desarrollo Forestal*, only four percent of the Andean forests are still standing in Ecuador (DFC 2001). Progressio has been working with Ecuadorian NGOs in this region, helping 21 native Kichwa communities for 10 years. There are no irrigation systems in this area. In the case of Ecuador, one tonne of carbon costs US$0.79 cents, whilst in Holland it is US$8.04. The Dutch company FACE therefore markets carbon from Ecuador.
- Tearfund's partner MOPAWI (Mosquitia Pawisa) works in the region of La Mosquitia in eastern Honduras in several areas to facilitate an integrated sustainable development and for a conser-

Box 85.2: Progress in climate change adaptation in the Caribbean community. **Source**: Donna McRae Smith, Project Officer, CARICOM (year)..

The Caribbean community is deeply committed to the implementation of adaptation and mitigation measures to minimize the effects of climate change on the region's sustainable development. Governments, as well as the private sector, are involved in such efforts. The region is making commendable progress through ... training programmes, ... sustainable tourism and initiatives in renewable energy.

In 2002 the CARICOM Heads of Government established the Caribbean Community Climate Change Centre in Belize ... [that] coordinates its climate change activities [and] provides a range of services and products relating to research, impact assessment, response strategies and systematic observation of climate change in the region.

The CARICOM governments ... [initiated] ... the *Caribbean Planning for Adaptation to Global Climate Change* (CPACC) with the support of the *Global Environment Facility* (GEF) ... in association with the University of the West Indies and the CARICOM Secretariat. The *Mainstreaming Adaptation to Climate Change* (MACC) project is being implemented by the Caribbean Community Climate Change Centre.

The *Caribbean Environment Network* (CEN) Project, an initiative of the *Caribbean Environmental Programme* (CEP) was implemented during 1996-1999 to improve environmental quality and coastal and marine natural resource protection, by promoting the use of environmentally sound practices in the tourism industry. This project conducted training workshops and developed training manuals for a number of areas including *Improved Training and Public Awareness on Caribbean Coastal Tourism* and *Manual for Sand Dune Management in the Wider Caribbean*.

Desalination plants were constructed in Antigua and Barbuda and Barbados. In some CARICOM states, such as St. Vincent and the Grenadines, building codes require cisterns to be constructed for water capture and storage. At the regional level, the *Caribbean Environmental Health Institute* (CEHI) is encouraging member countries to practice Integrated Water Resource Management. The *Integrated Watershed and Coastal Area Management* (IWCAM) project was approved by GEF in May 2004.

The private sector is also very actively involved in energy conservation schemes. The *Caribbean Alliance for Sustainable Tourism* (CAST) assists hotels in conducting energy audits, and advocates incentives for the promotion of energy efficient technology, the development of standards and building codes and the provision of attractive interest rates for the purchase of energy efficient technology.

Other sustainable energy initiatives are ongoing in the region. With assistance from the *Global Sustainable Energy Islands Initiative* (GSEII), St. Lucia has adopted a National Sustainable Energy Plan, establishing aggressive targets for renewable and energy efficiency, and setting the stage for significant changes in the energy sector. Grenada and Dominica are developing similar plans.

Another major initiative is the *Regional Special Programme for Food Security* (RSPFS) which is spearheaded by the *Food and Agricultural Organization* (FAO) in collaboration with the CARICOM Secretariat with support from ... Italy. This project involves the CARICOM member states, and the Dominican Republic. A key aim ... is to address constraints related to increasing trade, increasing small farmer productivity, and improving food policy, food insecurity information and linkages between food product development and promotion and food and health related issues.

In October 2007, the Climate Change Centre signed a Memorandum of Understanding with the UK government to facilitate a comprehensive *Caribbean Regional Climate Change Strategy* [that] will provide the Caribbean community with a coherent and cohesive policy framework and implementation plan to guide its efforts.

Adaptation efforts in the region so far, have focused primarily on capacity building for adaptation. However, ... the adaptation activities ... [reflect] the Region's sustainable development agenda, namely the implementation of the *Barbados Programme of Action* (BPoA) and the ... *Mauritius Strategy of Implementation*. There is ... a need ... for ... a mechanism which would ... feed ... climate change adaptation issues into the sustainable development agenda.

vation of biodiversity. Thorny issues are property rights, deforestation, and forest management and ownership by indigenous people. Alternative forest concession policies and trade and environmental issues in forest production are also analysed. This introduces into the agenda the distinction between public goods and private rights (Tearfund 2005).

In a case study on the Caribbean, Donna McRae Smith documented progress on climate change adaptation in the Caribbean community (box 85.2).

The problem is one of upscaling from pilot experiences into general practice and large macro projects. Generating appropriate strategies for coping with climate change leads directly to a discussion of public goods and how these are valued in societies where market regulation and legislation are insufficient given weak institutions, lack of transparency and discretion in their application. The region's governments perceive their responsibility as different from that of industrialized developed countries.

Table 85.2: Mexico: Emissions of CO_2 ($MtCO_2$) based on IPCC categories (1990-2002). **Source:** National Ecology Institute (2006

Type of emission	1990	1992	1994	1996	1998	2000	2002
1. Energy	312,027	321,836	342,900	349,129	394,129	398,627	389,497
Fossil fuels consumption	279,864	291,046	308,932	311,197	351,760	356,796	350,414
Other emissions	32,164	30,790	33,968	38,233	42,369	41,831	39,082
2. Industrial processes	32,456	32,878	39,248	42,774	50,973	55,851	52,102
3. Agriculture	47,428	46,049	45,504	44,077	45,445	45,527	46,146
4. Waste disposal	33,357	36,935	46,862	52,895	62,656	63,220	65,584
Total without land-use change and forestry (LULUCF)	425,269	437,698	474,514	489,176	553,203	563,225	553,328

85.7 Public Goods, Market Mechanisms, and Compensation

The region is no major player in the emissions game. It is mostly concerned with the costs of adaptation to an externally generated process that requires at least concessionary cooperation resources if not actual compensation for the impact suffered:

> Latin-American and Caribbean countries only produce around five per cent of global emissions, but we are in the front row facing the consequences of climate change and suffering the impacts of the phenomenon such as the recent storms Noel and Olga. These storms took over 100 lives in the Dominican Republic and generated losses of around US$ 800 millions...We have a shared responsibility with all the countries of the planet, but not to the same degree. ... There is an ecological and historical debt towards our countries and this has to be reflected in a new agreement that provides not only clean technology, but the necessary adaptation funding (Ramírez Tejada 2008).

Some countries are adopting pioneering climate strange strategies with quantitative goals, establish concrete thresholds, and set timelines for them. Mexico's strategy – although not yet clearly funded – establishes goals for emission reductions, reforestation, energy efficiency, and for using the clean development mechanisms. An ever more ambitious strategy was adopted by Costa Rica setting a time frame to become 'carbon neutral'[8] (box 85.3).

In 2007, Mexico adopted a national climate change strategy (table 85.2).

This strategy recognizes that actions for reducing GHG emissions will not be sustainable without clear economic signals. The social costs of emissions produced by different economic agents can become economic opportunities through cooperation agreements with external actors with mandatory emissions reductions targets under the international climate change regime.

> For Mexico, the establishment of an integrated national scheme for emissions trading can be aspired to in the medium term, through a realistic, step by step process involving the strengthening of national capacities. The principle of progressive action employed in this strategy sets out the possibility of increasing by phases both the

Box 85.3: Costa Rica: A commitment to Carbon neutrality. **Source**: National Geographic; at: <http://news.nationalgeographic.com/news/2008/03/080307-costa-rica.html> (Costa Rica Aims to Be 1st Carbon-Neutral Country Stefan Lovgren in San Jose, Costa Rica, for National Geographic News, March 7, 2008) and <http://www.costaricaneutral.org/.>

Costa Rica, along with Norway and New Zealand, began fleshing out some ... pioneering plans and strategies they are developing in order to achieve climate neutrality in their own countries. Costa Rica has placed climate change at the top of its agenda arguing that a climate neutral economy is also a competitive one. Its aim is to achieve the neutrality goal by 2021 to coincide with the country's 200th anniversary of independence. The country has a series of loans and grants in place, providing financial support that pays landowners who manage forests for their carbon sequestration and storage alongside management for water production, biodiversity and scenic beauty. In 2007 Costa Rica planted more than five million trees or 1.25 per person making it the highest per capita planting in the world. Other elements of the strategy include increasing the percentage of renewable energy generation to well over 90 per cent and action on energy efficiency including energy saving appliances.

8 The entire UN system has also pledged to work towards climate neutrality under the leadership of Ban Ki-moon across all its offices and operations globally.

> number of participating sectors and the value of the carbon being traded. The scheme would operate with controlled carbon prices, set low, initially, which would be subject to periodic review until reaching equilibrium with international market prices. The phased deployment of this scheme would allow for its adaptive management to take advantage of opportunities arising from international negotiations on the climate change regime, thereby allowing optimum dividends for promoting cleaner development.[9]

What this entails in terms of costs of negative impacts to be faced or investments to be made to adapt and mitigate is a matter of ongoing research. ECLAC is conducting a series of sub regional (Caribbean and Central America) and national studies for the South American countries. From this research it is evident that coping mechanisms are scant and actual strategies both for the ongoing negotiations leading to the post Kyoto successor agreement and for national policies formulation neither have sufficient scientific nor economic foundation. Concluded studies deal with Mexico and (still unpublished) Brazil.[10] A study on the economics of climate change in Mexico[11] concludes that the expected impacts by 2100 will be at least three times higher than the cost to reduce emissions by half. Under one of the scenarios considered – with an annual discount rate of 4 per cent – the climatic impacts would reach on average 6.22 per cent of GDP while the mitigation costs to reduce emissions by 50 per cent would represent between 0.70 per cent and 2.21 per cent of GDP, estimating respectively a cost of 10 to 30 dollars per carbon/ton.

Based on this preliminary data the author concludes that it is necessary to intervene in the market to introduce appropriate signals that will make it profitable to individuals, communities, and entrepreneurs to comply with regulations and find attractive investment opportunities in adaptation and mitigation projects. According to the UNFCCC's Executive Secretary, Yvo de Boer,

> ...the world can build on experience with the emerging carbon market over the last couple of years, in particular the *Clean Development Mechanism* (CDM). This mechanism supports sustainable development and adaptation in developing countries.

At the UN Climate Change Conference in Bali (2007), it was agreed to launch the Kyoto Protocol's Adaptation Fund with financial resources coming from the CDM, this allows the development of new, innovative financial instruments. As de Boer indicated:

> In order to address climate change, we need a cleverly designed financial architecture, a plan that will spur green, low-carbon economic growth worldwide and enhanced adaptation, particularly in developing countries. ...We need a new climate change Marshall Plan that will reshape the world's future economy and redirect investment flows into a sustainable future. ... It needs to be expanded because it can unleash significant financial flows from the North for green economic growth in the South.

So the ultimate solution should be an appropriate use of laws and regulations, the use of the market to give appropriate value and signals to the goods that are publicly shared but insufficiently paid for by society, and new fiscal and economic instruments for the new additional financial and technical tools to operate

> because markets do not guarantee equal geographical distribution, do not provide support for national policies and do not provide financing for expensive mitigation options, such as carbon capture and storage.[12]

If such change of perspective does not change the region's situation by 2012, then continued declarations and political statements and small-scale discontinuous actions will occur, mostly led by external actors or impelled by extra regional global policies. This would be, once again, a missed opportunity to generate a regional, endogenously supported dynamic process that should include technological research and development, leading processes adopted and implemented at the community level.

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9 Intersectoral Commission on Climate Change, *Mexico National Strategy on Climate Change, INE, 2007.*

10 For a profile of Brazil, see: *Brazil & climate change: a country profile*, Emilio Lèbre La Rovere and André Santos Pereira, 14 February 2007.

11 "La Economía del Cambio Climático en México", SHCP, Mexico, 2009. This study was coordinated by Luís Miguel Galindo Paliza, researcher at the Universidad Nacional Autónoma de México (UNAM), at the request of the Ministry of Finance and Public Credit (Secretaría de Hacienda y Crédito Público, SHCP) and the Ministry for the Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales, SEMARNAT), with the collaboration of the Mario Molina Center, the National Ecology Institute (INE), and the Atmospheric Studies Center at UNAM. Funding was provided by the United Kingdom and the InterAmerican Development Bank. Technical support was given by the World Bank and ECLAC.

12 De Boer, op.cit., *Sixteenth Meeting of the Forum of Ministers of Latin America and the Caribbean* (Santo Domingo, Dominican Republic, 30 January–1 February), United Nations Framework Convention on Climate Change (UNFCCC)

A key message that emerges from the current situation is that there are still too few activities taken by Latin American and Caribbean countries and states to reduce the growth of their greenhouse gas emissions. Not only is there an observable trend to increase the use of fossil fuel – with coal growing faster than natural gas – but there are too few efforts to counter the rapid land-use change due to pasture, cattle farming, and crop expansion. Given the fragility of the tropical and subtropical forests and the intrusion into coastal mangroves and wetlands, also associated with urbanization and tourism, the rate of deforestation is proof of the ongoing stresses on the environment in addition to the aggravating carbon footprint in the region. Although there are some important new initiatives, such as Mexico's announced reforestation programme, the current trend will not be reversed in the short run.

Recent publications from ECLAC and the World Bank (Fajnzylber 2009)[13] indicate the region has not been actively involved in the international context, continuing the trend under the current Kyoto protocol where the region assumed no commitments (2008–2012). Ongoing negotiations require from major emerging economies and larger developing countries a more active role in adopting goals and voluntary quantitative commitments for a number of indicators, such as per capita income, emission levels, and focusing on some high-emission sectors such as cement, iron, automotive, paper mills, irrespectively whether the plants are in developed or developing countries. Noncompliance with commitments for clean technology and emission reduction processes may lead to trade barriers for imports and transportation of non-complying merchandises. These considerations need a push for compensatory mechanisms, technical cooperation for technology transfer and adaptation and specific funds for adaptation and mitigation.

13 Pablo Fajnzylber, *Desarrollo con menos Carbono: Respuestas latinoamericanas al desafío del cambio climático,* World Bank, Washington, 2009.

86 Politics of Equity and Justice in Climate Change Negotiations in North-South Relations

Ariel Macaspac Penetrante

86.1 Introduction[1]

A hardening of the front lines between developed and developing countries occurred during the COP15 meeting in Copenhagen with both sides criticizing the other for taking the climate as hostage. The G77 chief negotiator Lumumba Di-Aping compared the behaviour of developed countries to the holocaust. Several countries, particularly the poorer nations, protested blackmailing when they were coerced to sign the Copenhagen Accord, because without signing they would have been unable to access adaptation funds from richer nations. Particularly the United States was blamed for the failure of the talks because President Obama "demanded concessions while offering nothing".[2] Furthermore, Denmark was highly criticized for convening a meeting of only 26 nations in the last two days of the conference that led to the Copenhagen Accord. Khor argues that it undermined the UN's multilateral and democratic process of climate change negotiations.[3] On the other side, developing countries with emerging economies like China and India were criticized for cooperating at Copenhagen to thwart attempts at establishing legally binding targets for carbon emissions, in order to protect their economic growth. In addition, African countries were criticized by *The Australian* for their behaviour in turning COP15 into "a platform for demands that the world improve the continent's standard of living" which is out of place in environmental talks such as the meeting in Copenhagen. The same newspaper commented the comparison of the potential impact of climate change on Africans to the holocaust through the G77 chief negotiator Lumumba Di-Aping as "inane and offensive" and "demonstrates how the conference process was corrupted". The newspaper criticized as well the opposition of Sudan, Nicaragua, Cuba, Venezuela, Bolivia, and Tuvalu to "Obama's agreement" as a "demonstration how Copenhagen was about old-fashioned anti-Americanism, not the environment".

Clearly, the negotiation deadlock can be referred to the incompatibility of the behaviour between developed and developing countries which maintained the distrust between both sides. The lack of trust refers to structural faults in the international system that hinders any substantial outcome through negotiations. Furthermore, the UN as a multilateral negotiation system is increasingly perceived as being incapable to produce a sustainable, comprehensive and yet focused agreement that will effectively address climate change. The entanglement of climate change in North-South relations seems to have legitimized 'non-multilateral' approaches such as the de facto closed door negotiations on the Copenhagen Accord leading to the marginalization of non-major players in the climate change context. Some major players felt that the bargaining table must be downsized if a substantial agreement is to be achieved. The North-South divide is now blamed as the cause of the current deadlock in the negotiation process. The international system seems to have no formula to bridge the gap between North and South in the climate change negotiations.

However, the North-South divide has not been the object of conflict but rather a result of existing incompatibilities in the international system. There is a need to conceptualize the divide in such a way that the dynamics and drivers behind it can be understood.

1 The views presented in this paper do not necessarily reflect the views of IIASA staff, visitors, or National Member Organizations.

2 George Monbiot: "If you want to know who's to blame for Copenhagen, look at the US Senate", in: *The Guardian*, 21 December 2009; at: <http://www.guardian.co.uk/commentisfree/2009/dec/21/copenhagen-failure-us-senate-vested-interests> (9 March 2010).

3 Martin Khor: "Blame Denmark, not China, for Copenhagen Failure", in: *The Guardian*, 28 December 2009; at: <http://www.guardian.co.uk/commentisfree/cif-green/2009/dec/28/copenhagen-denmark-china> (11 March 2010).

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_86, © Springer-Verlag Berlin Heidelberg 2011

This chapter focuses on the politics derived from the contesting notions of equity and justice and how through such notions the implicit and latent decisions are determined. How was the North-South divide reinvigorated as a political axis and what are its implications for the negotiation process? How should this divide be addressed in future negotiations to benefit from the situation? Understanding the divide is a necessity in the strategic facilitation of the divide as a point of departure for conflictual relations. The North-South relations reflect the outcome of an identity-building process according to which decisions and behaviour are determined by identity narratives. This chapter conceptualizes the North-South divide in the climate change negotiation context through conflict analysis, where the triggers and reasons for the incompatibilities of this behaviour will be assessed, as well as their impact on the negotiation process. Understanding the divide as a conflict between 'identity groups' offers a guiding framework for the value system that determines actions of a collective group, and this leads to insights on how these 'values' can be reframed to strategically facilitate the negotiation process. This chapter introduces the 'identity contestation model' to illustrate the dynamics leading to incompatibilities in North-South relations. This model seeks to explain the diverging identity-building processes between two sides that contribute to the maintenance of the divide.

The assumption that the North-South divide points to several contesting lines in the international system builds on a theoretical framework according to which conflict manifests itself due to incompatibilities in the behaviour of developed and developing countries (86.2). This section tries to answer the question how the insufficiently conceptualized divide leads to misleading assumptions that the divide is itself delaying the negotiation process and therefore 'non-multilateral' approaches, such as the way the 'Copenhagen Accord' was reached, are legitimized. Section 86.3 suggests reframing the perception of the divide and to use the opportunities this situation provides. This reframing of the perception requires an analysis of the divide from the negotiation perspective particularly focusing on coalitions and leadership. Finally, the opportunities that could be obtained from the proper reframing of the North-South divide will be discussed in the conclusions (86.4). Such missed opportunities could be useful in pushing the process forward with the goal of a sustainable outcome for facing and coping with climate change.

86.2 Catching a Slippery Fish: The Elusive Concept of the North-South Divide

The international system is dynamic in its nature. It is constantly evolving and changing. This changing of conditions at the bargaining table represents challenges that will be addressed. What are these conditions? How do these conditions determine the 'rules of the game' at the bargaining table and therefore determine the outcome of the bargaining? Nevertheless, such desired outcomes can only be found when negotiating parties would first be able to reach a consensus on the agenda (goal) and later on another consensus on the procedure. A consensus between states implies a 'win-win' situation in which the proposed agreement involves a situation better than the status quo. No country will sign any agreement that will make itself net losers, even though this will mean the collapse of the environment, particularly when the environment remains a 'public good'. However, it should be noted that the negotiation occurs in a dynamic setting which influences strategies of actors. For instance, a win-win situation might change easily to a win-lose situation. Furthermore, a currently win-lose situation might be perceived a win-win if there will be a prospect that, in the next few years, the reached agreement will be favourable. In this regard, the perception of a win-win situation and the attitude that is determined by this perception can be changed.

In recent years, climate change has gained more attention from the public and this led to the transformation of the climate change issue from 'low politics' to 'high politics' particularly when it became evident that climate change is horizontally interlinked with other 'high politics' issues such as trade, economics, and security. Policy-makers recognized the threats to human well-being in general (Cowie 2007). Climate change impacts threaten national security and therefore have the potential to undermine the legitimacy of any state that fails to address it (Penetrante 2010). However, this transformation leads to its securitization and therefore to the increase of the complexity of the climate change issue.

The transformation leads to the expansion of the bargaining table when it comes to the number of negotiating parties striving for participation. Particularly for the developing countries, whose interest are perceived not adequately met in other multilateral negotiations such as the Doha rounds, which are exploring other platforms to voice their positions. The climate change negotiations are not anymore merely address-

ing climate change, but to push forward the nexus of 'climate change' and 'sustainable development' as an agenda item (Najam 2004: 1).

The *World Summit on Sustainable Development* (WSSD) in Johannesburg in 2002 reaffirmed the necessity to establish more coherence between trade and environment policy. However, the South remains generally suspicious of environmental issues "seeping into trade deliberations" (Najam 2004: 2) because of the general distrust that the outcome will be used by developed countries to establish further trade barriers and disguised protectionism. In the same sense, the South is suspicious of any climate change related commitments that might hinder their economic development.

Thus, a 'technical formula' based on scientific expertise will be subordinated to a 'political formula' (Penetrante 2010). Getting it done no longer means only to get it right (Zartman 2003) but now rather to get it 'accepted'. The climate change negotiations, like other negotiations, seek to produce a formula for agreement on the resolution of the problem. However, producing a formula for an agreement requires a consensus on goals which was reached in Copenhagen when the parties agreed on the 2 °C target for the maximum temperature increase. Although the 'Copenhagen Accord' is not legally binding, it sets a norm and provides a framework for further negotiations (Sjöstedt/Penetrante 2010). A formula for agreement on the resolution of the climate change problem requires a consensus on goals to enable the translation of these goals into acceptable details for implementation (Zartman/Berman 1982). Contrary to the proposal of Timothy Wirth (2010: xxxv), using a formula to allocate a reduction is a promising approach for avoiding decisions based simply on politics and power. Any formula will be subject to bargaining involving politics and power, and therefore will be inevitably exposed to politicizing and power-wrestling. Posner and Sunstein (2010: 344–345) asked, "if the North is to give financial assistance to the South, how great should this assistance be? If the South is to agree on targets, how ambitious should these targets be?" The relationship between climate change and questions of justice and fairness remains complex, and consists of additional dilemmas and challenges.

86.2.1 The North-South Divide Continues – A New Old Paradigm

The North-South divide initially represented the concept about the geographical division that is represented by the socio-economic gap that exists between the developed (North) and developing (South) countries (Hayes/Smith 1993; White 1993; Zartman 1987). It comprises the development gap between countries as described by the *Human Development Index* (HDI) and exemplified by Walter Rostow's model of development (2000). This divide was regarded as somewhat outdated, deceased, discredited, and misleading (Hardt/Negri 2000; Harris 1986; Hoogvelt 1997; Sebenius 1991; van Evera 1990) particularly in the 1990's. Nigel Harris (1986) for instance announced the disappearance of the Third World as an economic reality and ideological representation. The divide is now obsolete, because there is "no clear identification between rich and poor, have-and-have-nots, industrialized and non-industrialized" (Harris 1986: 200–202). Therefore, assumptions formulated within the premise of the North-South divide are seen as rather misleading.

This can be true, but looking from the negotiation perspective, as this chapter argues, the divide came back to the international system and determines bargaining; nevertheless, it has changed its profile. The divide in the climate change context is not anymore primarily based on the formal criteria of development to distinguish membership, but rather on identity narratives and related cognitive processes. How the countries behave depends on how they identify themselves.

As box 86.1 and box 86.2 illustrate, there are differences between the concept of the North-South divide in the trade domain and the concept of the North-South divide in the climate change context. The so-called 'threshold countries' which have formally satisfied the criteria of development and with per capita emissions above the average of EU-27 have resisted and have continuously refused formal obligations in reducing emissions. Countries such as China, Argentina, India, Indonesia, Saudi Arabia, Mexico, South Korea, South Africa, and Turkey behave as if they are still developing countries in the climate change negotiations even though they are now members of at least one of the following 'coalitions' of developed countries of the G20 (Brazil, Argentina, China, India, Indonesia, Mexico, Turkey, South Africa, and South Korea serving as G20 chair for 2010) or OECD (Mexico and South Korea).

Some of the threshold countries, such as China, have joined the G-77 coalition. Some of these countries have formally joined the North; however, they exercise 'permissive connivance' to the South, such as South Korea and Singapore. This behaviour leads to the assumption that the climate change context pro-

Box 86.1: The North in International Climate Change Negotiations. **Source**: Compiled by the author.

The 'North' in the climate change context has a different profile compared to the trade domain. The *United Nations Framework Convention on Climate Change* (UNFCCC) has classified parties as Annex I (industrialized countries and economies in transition), Annex II countries (developed countries which pay for costs of developing countries) and developing countries. Annex I countries, which have ratified the Kyoto protocol, have committed to reductions of emission levels with 1990 as baseline. Annex II countries are a sub-group of Annex I and comprise the OECD members, excluding economies in transition which are mainly the countries of the former Warsaw Pact. These countries pay for costs of developing counties. The convention has provided the possibility for developing countries to volunteer to become Annex I countries when they are sufficiently developed. Furthermore, Annex II countries can be removed from the list upon request. However, the UNFCCC distinction between developed (Annex I and II countries) and developing (non-Annex countries) does not always reflect the development status of countries. The so-called 'threshold countries' such as South Korea, Singapore, Israel, and Saudi Arabia are countries with higher per capita income, but are not listed in the list due to political considerations. Interestingly, Mexico and South Korea are members of the OECD, and Brazil, Argentina, China, India, Indonesia, Mexico, Turkey, South Africa, and South Korea are members of the G20 which is the block of the leading industrialized nations of the world. Furthermore, there are other 'political groups' among the developed countries which follow different preferences and expectations on the outcome of the negotiations. The so-called 'Kyoto light' countries which consist of the United States, Australia, Japan, and Canada push for an agreement that is for them politically viable. Another forum that could later develop to another political group is the *Asia-Pacific Economic Cooperation* (APEC), which consists of both developed and developing countries, met in November 2009 to come up with a common agenda for COP15 but they could not reach any substantial agreement and ended up lowering the expectation for Copenhagen.

Although APEC is perceived as dominated by developed countries such as the United States, Japan, Canada and Australia, it provided a representative glimpse of the succeeding COP15 meeting through a political barometer leading to 'more realistic' expectations in Copenhagen. The APEC summit tried to reach a consensus on emission targets but failed.

duced 'issue coalitions' according to which the decision over membership either to the North or to the South is determined by the issue and not by the formal criteria of development. The North-South divide in the climate change context is therefore a state of mind. If there will be no North-South divide, then it is something that will be eventually invented. Coalitions operate within the premise of the divide – e.g. G77 and China, G20, EU, etc. The divide has entered the sphere of the climate change negotiations particularly because of the horizontal inter-linkages between climate change and other negotiated issues – such as security, trade, and economics.

The North-South divide determines coalitions, hinders any effective comprehensive leadership, and leads to the bargaining of issues that are supposed to be merely means of achieving the goal of emission abatement and now becoming issues on which states are negotiating. The divide has moved the attention of negotiating parties to 'side-effects' by enlarging the bargaining table. It has established trade-offs to move across the divide and not across individual countries. On the other hand, the divide is identified as a legitimizing factor in reducing the multilateral bargaining process to 'closed-door meetings' that only involve major players. The divide motivates bilateralism for efficiency deliberations (Penetrante 2010). Particularly in the COP15, there has been a strong sense that efficiency suffers with the increase of participation of more actors. The North-South divide is regarded as a stumbling block in reaching a sustainable agreement.

The next subsection offers a conceptualization of the North-South divide, how it determines behaviour and decision-making, and what it means for the climate change negotiations.

86.2.2 Identity Politics Leading to Conflict – A Concept of the North-South Divide

The North-South divide was reinvigorated as a political axis in the climate change negotiations when it became clear that the participation of the so-called 'South' on the one hand became a precondition for the participation of the 'North' (Penetrante 2010). For instance, President George W. Bush Jr. announced during his term that the United States will not return to the negotiation table unless developing countries had also formally accepted the same responsibilities as the countries in the North in formulating mitigation targets. On the other hand, developing countries – particularly those with emerging economies such as China, India, and Brazil – have discovered resources not only to determine the agenda of the talks, but also more importantly to set the framework for talks

Box 86.2: The South in International Climate Change Negotiations. **Source**: Compiled by the author.

Although the North-South concept has been regarded as outdated, deceased, discredited and misleading (Hardt/Negri 2000; Harris 1986; Hoogvelt 1997; Sebenius 1991; van Evera 1990), it is increasingly receiving attention from experts, because it seems to gain more relevance in recent climate talks. The 'South' as an identity does not refer only to the formal criteria of development, but on how the countries historically perceive themselves. In the climate change context, countries from the South refer to the historical animosities of the North, leading to the question whether the South's identity is formed by referring to the South's experience of 'victimhood'. The identity of the South has been determined by the consciousness of trauma and victimhood that leads to claims for recognition (86.2.2). Recognition means to be able to participate in social interactions as peers (Fraser 2003). Like the North, it refers to the value of justice and fairness. To talk about the South in terms of countries lacking development is rather misleading, because many of the developing countries have a rich population with similar standards and in some cases have higher aggregated income than some developed countries. Furthermore, some threshold countries still act as developing countries such as South Korea that threatened in 1997 that it will rather leave the OECD than take binding obligations. This development calls for a 'utility-based' understanding of identity politics. In the climate change context, the South consists of developing countries without quantitative reduction obligations and to a significant extent 'receivers' of the adaptation fund. In the climate change negotiations, the South is represented by the so-called G77 and China which consists of more than 130 countries and China, and functions as the 'negotiation vehicle' of the majority of all countries narrating their real and imagined marginalization in the international system. The G77 and China serves as a forum for coordinating positions among member countries to increase negotiation leverage. The group is rather process-oriented through its long-term planning approach according to which the group seeks to influence the agenda and norm-setting processes that will eventually lead to the desired outcome. The group is complimented by other groups that act within the South premise such as AOSIS, BASIC, and for some years OPEC which focus more on specific issues and seek to determine measures to forward specific issues in the negotiation process, thus complimenting the G77 and China. Furthermore, in the last decade a regional approach has been pursued such as the African countries coordinating positions among themselves, the Caribbean countries rallying together, and Southeast Asian nations using existing regional forums to forward the climate change issue. This has been interpreted in the North as a sign of fragmentation of the South due to its diversity. However, this is again misleading, because the South is in this logic as fragmented as the North is, which themselves has maintained several forums such as the G5, G20, EU, the Economic Forum, NAFTA, etc. The diversity of interests within the South is obvious; however, process-wise the South is a force to reckon with, because the group still shares common narratives and values.

and even delay the process through issue-specific negative power. Developing countries have come to form or revive existing coalitions such as the 'G77 and China' that could match and actually challenge the resources and knowledge of the developed world. Developing countries are not anymore willing to remain in the back seat.

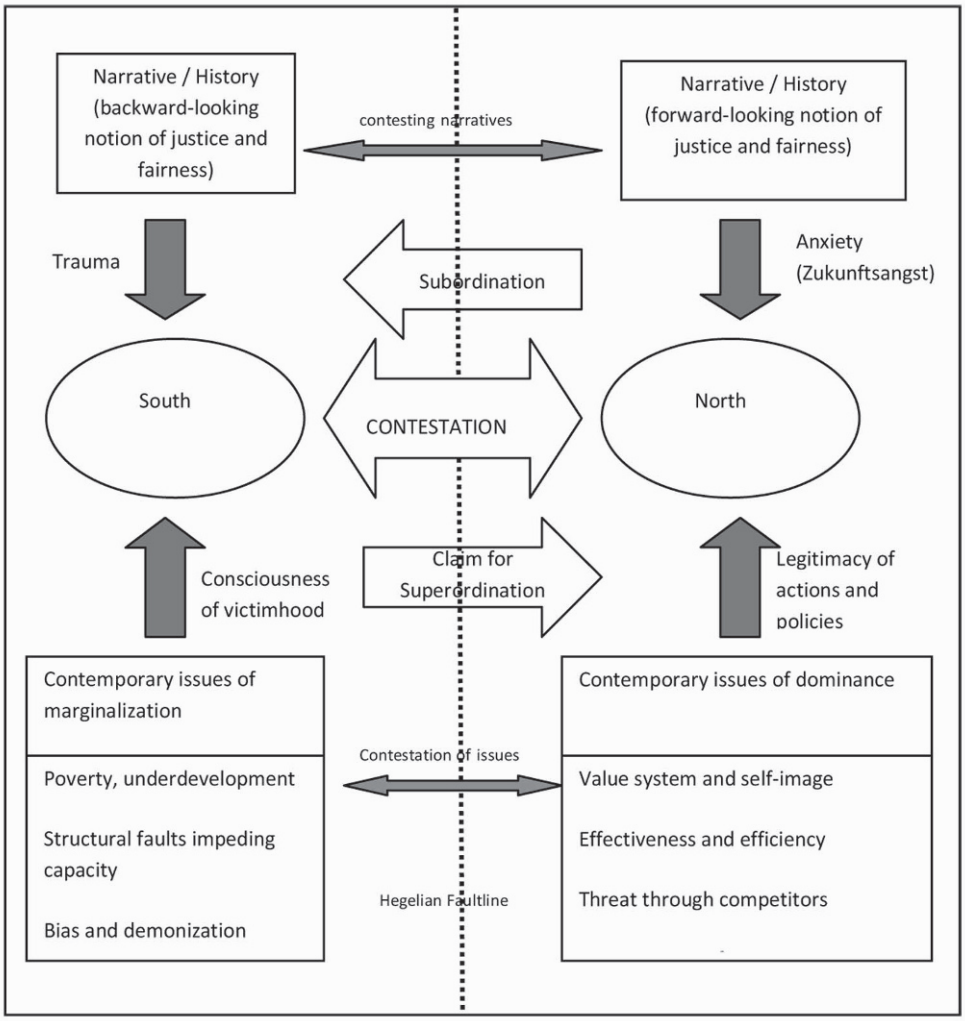
Understanding the dynamics within the premise of the North-South divide is a necessity in the strategic facilitation of the conflict between developed and developing countries. Figure 86.1 illustrates a model of the contesting identity-building processes that contain incompatibilities that should be addressed. Any outcome of any negotiation process will be determined by trade-offs across the divide reflecting the notion that where one goes depends on where one is coming from (Munton/Castle 1992; Cutler/Zacher 1992). As shown in the figure, there are several dynamics that sum up the North-South relations.

The North and the South are divided by the 'Hegelian fault line' in which the South finds itself to be in opposition to the North. This opposition was the point of departure for the identity-building process. The Hegelian fault line summarizes the conflict between the two sides. The selection from the pool of past experiences of misrecognition (trauma) legitimizes claims for full participation in the social interactions – claim of recognition (Fraser 2003). However, this claim for recognition is perceived as a 'threat' by the North, because it sees the South as potential competitors that will lessen their privilege in the current setting, if such a claim is to be granted.

According to Anstey (2006), perceptions of 'relative deprivation' or `unfair discrimination' offer fertile grounds for mobilization purposes. The struggle for recognition is conceptualized by Hegel (1977) which according to him is a circumstance where full participation is not only assumed, but actually implemented. The figure suggests that to overcome the Hegelian fault line, there is a need to move from the master-slave dialectic to full partnership.

Furthermore, particularly in the climate change negotiations, the 'weakness' of the South (based on resource-based power) is paradoxically translated into

Figure 86.1: Dynamics of identity contestation in the North-South divide. **Source:** Author.



'strength' (based on negative power, that is to delay the process). This new setting, combined with the unprecedented "assertiveness" of the South, motivated by the South's vulnerability to the adverse effects of climate change, implies a changing negotiation table. The leaked Danish text was harshly criticized by the majority of developing countries. A similar situation has happened in past negotiations such as the original text on trade and services during the GATT negotiations, which, however, did not face loud opposition from developing countries. It was a common practice that major countries determine the agenda and substance of agreements during negotiations. However, that has changed in the climate change context.

The North-South divide in the climate change context has found relevance through contesting narratives on notions of justice and fairness (Penetrante 2010). The boundary between the North and the South has been determined by positions about who should shoulder the costs of confronting climate change, both mitigation and adaptation measures. Any effective facilitation of the climate change negotiations needs to address the diverging understanding of the two sides what makes a measure just and fair (chap. 89 by Kanie/Nishimoto/Hijioka/Kameyama). As Zartman (2003: 34) states, "relevant principles of justice [are] likely to be loose, contentious, tentative, and fluctuating".

The North pursues a 'forward-looking' notion of justice and fairness. It should be noted that using the term forward-looking does not imply a positive evaluation of such a notion. It is merely the time reference of where justice and fairness are derived. According to the North, present generations should not be punished for 'crimes' they did not commit and 'crimes' that were no crimes when the actions in question

were carried out by earlier generations (Caney 2009). The forward-looking notion of justice furthermore involves the principle of intergenerational justice and fairness. The assumption that future generations of developing countries will be anyway better off in the future and in some cases will even surpass the affluence of those from developed countries, any measure that would further favour these generations will lead to distortion of a sound competition between those future generations from developed and (formerly) developing countries (Posner/Sunstein 2010; Meyer 2004). It is perceived unfair for present and future generations that mandatory cuts would be required by developed countries and not by major emitters in the developing world such as India, China and Brazil, which is the case under the Kyoto Protocol.

A just and fair measure must be based on emissions and not on the developmental status of a country. Developing countries, particularly those with emerging economies, must adopt substantial mitigation targets of their own (Buchner/Lehman 2005; Gardiner 2004). Polluters must pay – both developed and developing countries. Australia (2008: 11, 31) notes that by 2050, the per capita emissions for China is expected to be similar to those of the developed countries today. For instance, the United States 2050 per capita emission will be 23.3 tons CO_2 which is slightly higher than the 22.2 tons per capita emission of China. The behaviour and the decisions of the North are then based on 'anxiety on the future' (Zukunftsangst) that giving in today could lead to disadvantages for their future generations. The idea of giving advantages to increasingly formidable competitors is "politically toxic in many developed countries" (Wirth 2010: xxxvii).

These narratives support contemporary policies of dominance. For instance, moral values are used as a basis of arguments for intervention in the developing world. The narratives promote furthermore a relativization of 'coercive' policies such as the use of 'carrots and sticks', which both imply a disposition of superiority. 'Carrots' are built within the assumption that developed countries are the 'generous donors' and therefore can use such soft measures to pursue their own interests. 'Carrots' imply that one has something that the other needs and 'blackmailing' can change the behaviour of the other actor pointing out to dependence. 'Sticks' are built within the assumption that violent measures are legitimate when they serve the purpose and can lead to the desired end. Both carrots and sticks are legitimized by such narratives. Both policies of 'carrots and sticks' are measures that maintain dominance through the subordination of the other. Measures of subordination can be manifested for instance in COP15 when 'closed-door meetings' were held and developing countries coerced to sign the 'Copenhagen Accord' to avail funds, limiting the bargaining table to major players and therefore marginalizing the majority of the developing countries for the sake of effectiveness and efficiency.

In contrast, the discourse of the South consists of narratives on historical atrocities of developed countries to the environment. The North 'owes' from the South the environmental space it has contaminated in the last hundred years, therefore, there should be a scheme of compensation for the developing countries particularly because they are more vulnerable to the adverse effects of climate change (IPCC 2001; UNFCCC 2007e).

The decisions and behaviour of developing countries are based on the counterpart of 'Zukunftsangst' of the North and that is of 'trauma'. The identity of the South is in cognitive terms maintained by trauma (Alexander 2004). Trauma occurs when members of the collectivity feel that they have been "subjected to a horrendous event that leaves indelible marks upon their group consciousness, marking their memories forever and changing their future identity in fundamental and irrevocable ways" (Alexander 2004: 1). The trauma supports the consciousness of 'victimhood', which is first formulated during the process of understanding the contemporary issues of marginalization and calls for social responsibility of those who caused the trauma to stop the marginalization and to provide compensational measures. The consciousness of victimhood is arising from contemporary issues of marginalization, which are supported by historical narratives leading to the mobilization of countries to rally behind a coalition. There exists a general suspicion on the behaviour of the developed countries. The South then learns to resist subordination and pursues claims for subordination either through rhetoric or through delaying the process. The South maintains distrust, because of past experiences. For instance, only Scandinavian countries are sending the agreed 0.7 per cent of their GDP as *Official Development Assistance* (ODA) to developing countries. Furthermore, although the majority of developed countries do not meet their ODA obligations, they intend to classify climate funds as ODA, which implies a further reduction of development assistance for the least developed countries. It is distrustful of an approaching developed country expressing its intention to enhance capacity, but de facto calls for more dependency. For

instance, the inclusion of the IMF and the World Bank in the climate change context is perceived by most developing countries as an increase of the influence of developed countries in the context.

Figure 86.1 illustrates the diffuse dynamics of contestation between the North and the South. For instance, although both developed and developing countries speak of justice and fairness, it seems that there are still some existing gaps between their understanding of what justice and fairness mean. These gaps must be linked, if not reconciled. Understanding these dynamics enables the proper and strategic designing of facilitation measures.

86.3 The North-South Divide from the Negotiation Perspective

Gunnar Sjöstedt (1993: vii) agrees with Robert H. Pry (1993: vii–xii) who points out that international negotiations on environmental issues is a relatively recent phenomenon. The 1972 UN conference on the environment held in Stockholm has been a major landmark. This conference set the agenda for the negotiations and cooperation concerning environmental problems over the following decades (Sjöstedt 1993: 1). It also set the UN multilateral system as the procedure on how to address environmental problems. The 1992 *UN Conference on the Environment and Development* (UNCED) in Rio de Janeiro was intended to produce a new approach on the environment for the 1990's and beyond. However, in the last two decades, it became apparent that due to the inter-issue linkages environmental issues are not to be contained in one domain and will be affected by other multilateral negotiations such as the Doha trade negotiations in 2001 that have placed a limited set of trade and environmental issues on the negotiating agenda. The inter-institutional linkages call for long-term relationships between institutions leading to more constraints and more reasons for distrust on the part of developing countries.

Environmental negotiations, such as the climate change negotiations, are part of a larger process of international relations, capable of changing the relationship among nations through cooperation and joint problem-solving (Sjöstedt 1993: 4). This results in a necessity of increasing the awareness of the importance of negotiations and of the analysis of climate change through the negotiation perspective. Every negotiation has its own features, depending on the issues, actors, structure, intended outcome, and processes involved. These features also depend on power sources and power perceptions that determine strategies and the 'yes/no threshold' in the international system. As discussed in the earlier subsection, problem-solving will eventually lead to a resurfacing of incompatibilities due to diverging interests and needs of the negotiating parties. Complexities and uncertainties of negotiations on climate change represent the "different aspects of the social and political lives of nations – sovereignty, borders, the decision-making process, and the level of economic development" (Sjöstedt 1993: 7).

The development in Copenhagen in December 2009 formalized the goal for further negotiation beyond the Kyoto protocol. The 2 °C consensus will define the logical structure of further bargaining, particularly when it comes to implementation measures that would include burden-sharing in forms of emission cuts. Parties differ previously widely in terms of goals and therefore inevitably, there were widely different perceptions of the issues in conflict. Countries have varying national conditions, such as constraints through national legislation like in the United States or dependency on coal like Australia and China. Some countries do not find it difficult to commit to binding regulations, because their current emissions are not statistically significant, while some are on the verge of industrialization. Varying goals are preconditioned by varying national priorities. The next step after the 2 °C consensus (as a goal) is to find a consensus on the implementation or on the procedure how to fairly distribute the costs of facing climate change. From the negotiation perspective, there are several steps that could be taken – some more politically brilliant, some more politically blatant, to get parties to agree on what the conflict is about and to get the way towards its successful resolution or management. Reaching an agreement on the implementation of the goal of reducing the average increase of temperature to 2 °C will be bargained in a way that it will reflect power, power asymmetries, coalition-building processes, trade-offs, bargaining rules, and procedures. The North-South divide as a premise points out to the conflict areas between groups in the international system as well as to the complexities and uncertainties brought by the multilateral nature of negotiation (Zartman 1994).

86.3.1 Coalitions and North-South Relations

Coalitions are built according to the interests of negotiating parties and these interests are formulated

Box 86.3: Coalitions within the North-South Premise. **Source**: The author.

Coalition-building is an integral element of a multilateral system (Hampson/Hart 1995; Potzer/Mannix/Neale 1995; Raiffa 1982; Zartman 1994) to pursue individual interests by building a community with like-minded negotiating parties. Membership to a coalition requires identification with the group based on interests. In the climate change context, coalitions are built to serve as leverage in negotiating at the bargaining table. Interestingly, the majority of the coalitions reflect the North-South premise, because of the common interests among countries that belong to one side. Nevertheless, it should be noted, that aside from process coalitions, coalitions are also established along issues. For instance, BASIC members (Brazil, South Africa, India and China) felt that they have more in common and therefore they have decided to form a block, however, without posing a competition to the G77 and China as these countries continue to cooperate with other countries within the larger group. The United States seems to have formed a coalition with Canada, Japan and Australia, which calls for an alternative approach due to national stakes.

In the view of this author the so-called 'threshold countries' can act as facilitators between developed and developing countries. The political context of climate change negotiations aggravates any form of leadership (86.3.2). However, there is still no visible coalition among these (historically-speaking) developing countries that have reached economic development. Their membership to both the G20 and close collaboration with the G77 put them in the position to understand both sides and therefore are less biased and thus more credible. This proposed coalition should not assume leadership, because it will not have the political resources to do so, but rather to act as facilitators in the process.

within the North-South premise. Coalition-building is an integral element of a multilateral system (Hampson/Hart 1995; Polzer/Mannix/Neale 1995; Raiffa 1982; Zartman 1994) and gives rise to a number of strategies. Najam (1994, 1995), Sauvant (1981) and Weiss (1986) argue that developing countries do negotiate as a collective in most global negotiations such as in climate change. Coalitions refer to the "collective elaboration" that Moscovici (1963) describes in his social representation theory. He points to a community with a stock of shared values, ideas, beliefs, practices that function as orientation for behaviour and communication. As Polzer, Mannix and Neale (1998) argue, coalitions do not only affect the resource pool available to states, particularly smaller states, however, these resource pools are linked with compatible interests.

This section focuses on the coalition-building process within the developing countries which does not imply the lack of a similar process among the developed countries. The inter-linkage of trade and environment has induced the spillover of the G77 coalition from the trade to the climate change domain. The G77 as the main coalition of developing countries was *de jure* joined by China as well as de facto by Brazil and South Africa. The South identity has determined the negotiation positions as well as strategies of the group influencing the negotiating structure. Identity defines the frame of reference for motivations and actions of the group members (box 86.3).

Furthermore, there are other 'issue coalitions' that move within the premise of the South identity such as the *Alliance of Small Island States* (AOSIS) and the *Small Island Developing States* (SIDS). From the negotiation perspective, coalition-building is a dynamic process in which different variations of coalitions are found. In this case, states assume multiple memberships depending on a specific issue. The complexity of the climate change context leads to several constellations of alliances designed to maximize influence on the outcomes. The AOSIS as a coalition functions as an ad hoc lobby and negotiating voice for SIDS within the UN system particularly in global climate change negotiations. Although AOSIS is mostly composed of developing countries, it is not seen as an alternative to the G77 and China coalition. Aside from Palau which withdrew from the G77 in 2004, 27 of its 43 members and observers are still members of the G77 and China coalition.

The AOSIS is an issue coalition in a complex context which confirms multiple memberships in several coalitions without compromising a state membership in another coalition, particularly because the 'G77 and China' is more a 'process coalition' than an issue coalition. Issue-coalitions have their own tactics (Zartman 2003: 35) and own time frame. Other existing similar issue coalitions such as Brazil-South Africa-India-China (BASIC) block (Vidal 2010) and OPEC are not to be evaluated as indications of fragmentation of the South, but rather of issue-specific accommodation in a multilateral system. Fragmentation implies competition which is not the case between these coalitions among developing countries.

86.3.2 Leadership and North-South Relations

The divide points to the impediments in assuming effective leadership. Andresen (2010) proposes that identifying potential leaders can facilitate the negotiation process. He enumerated different types of leadership, as categorized by Underdal (1991, 1994) and Young (1991, 1998): intellectual leadership, instrumental or entrepreneurial leadership, power-based or structural leadership, and directional leadership. As shown in Copenhagen, although there were some expectations, any form of leadership was not really possible. Developed countries, particularly the United States, were expected to lead because of their contribution to the concentration of GHGs in the atmosphere. Leadership requires both the actual capacity and resources to lead, and the legitimacy to assume this role. Intellectual leadership refers to the intellectual capacity to shape the perspective of those who participate in institutional bargaining (Young 1991).

In Copenhagen, countries such as those belonging to the *European Union* (EU) tried to reframe the perspective of developing countries particularly in convincing that environmental policies must not necessarily hinder development – mitigation is not the opposite of sustainable development. However, the potential intellectual leadership of the EU is somewhat undermined by contradicting policies of union members, such as the reduction of government subsidies to the solar energy industry in Germany. Related to this is the potential directional leadership of the EU in which a directional leader sets up good examples on how to deal with an issue (Gupta/Grubb 2000). Although the EU is seen as the only possible directional leader, its potential is undermined by distrust among the developing countries, particularly when it comes to fulfilling the 'polluter pays' principle in which European countries are not prepared to contribute an amount perceived appropriate by developing countries.

Power-based or structural leadership is to some extent fulfilled by major countries like the *United States* (USA) and the EU. However, without a consensus of goal, threats, and promises between these countries, a coherent leadership seems impossible. Without knowing what is actually desired as an outcome leaves no room for power-based or structural leadership. Furthermore, without a consensus between major countries, particularly between the USA and the EU, what the outcome should look like, there can be no strategic sharing of resources that can be promised, particularly in the climate change context, when no single actor has the resource to engage in the promise-making process. Instrumental or entrepreneurial leadership refers to bringing in ideas on the agenda to reach common goals. As mentioned above, with the absence of a consensus on goals as was the case before Copenhagen and the existence of several diverging and partly competing goals, instrumental leadership is as well impeded.

86.4 Reaching a Global Deal through Negotiation – Reframing the North-South Divide at the Bargaining Table

Reframing the North-South divide is a precondition for reaching any global deal through negotiations. At the COP15 in Copenhagen, the divide was identified as the major stumbling block for reaching any agreement. The application of the conceptual framework introduced above points to the divide as understood in the operational way. The divide in the climate change context points to the positions of actors. From these positions, coalitions are established as part of the calculation of states how to achieve their interests. Positions are manifestations of interests (Fischer/Ury 1981). The agenda of the COP15 to establish a Post-Kyoto mitigation mechanism was conducive to position-taking which is from the negotiation perspective a legitimate phase of a long-term bargaining process. What was `unprecedented` at the COP15 was the assertiveness of the developing countries. This assertiveness combined with the negative power to delay the process was rather perceived as obstruction. The upcoming COP meeting in Mexico is expected to remain a 'hostage' of developing countries particularly with the lack of prospect of any procedure to overcome this divide. This chapter argues that a 'win-win' situation is not impossible at all. However, such a 'win-win' situation requires the following: flexibility at the bargaining table, and the strategic facilitation between conflicting actors.

86.4.1 Flexibility at the Bargaining Table – Bilateralism vs. Multilateralism

Bargaining is the consensual procedure to reach an agreement in the climate change context. As Rubinstein (1992) argues, bargaining is the situation where actors exchange terms on the agreement. However, as the COP15 shows, even though negotiation itself was not contested as being legitimate, the modus of the

negotiations was highly contested. Multiparty negotiations connote multilateral bargaining processes, in which countries negotiate with each of the players in the game. Although power asymmetry exists, states are regarded as equal partners. Multilateralism as a mode of negotiations involves "complex social interactions because of multiple sets of preferences" (Pozer/Mannix/Neale 1998: 42) that must be considered in designing a global agreement. This complexity motivates some actors to leave the framework and pursue alternative modes particularly when these actors perceive more efficiency in the alternative framework.

At COP15 and the events leading to this conference, some major countries such as the United States preferred the bilateral modus of negotiation, not particularly with the intention to isolate the majority of the countries, but to reduce complexity and herewith increase efficiency. For instance, the increasing frustration on the slowness of the agreement-making process led to the exclusion of the majority of the (developing) countries in drafting the Accord. Multilateralism was more or less sacrificed in exchange for efficiency. Furthermore, prior to the COP15, the United States and China reached a bilateral agreement to expand cooperation on climate change, energy, and the environment. Nevertheless, the tendency to switch to a bilateral modus of negotiation is perceived to undermine the United Nations as the international multilateral framework to reach an agreement. Bilateral agreements do not only tend to exclude the majority of countries, they also increase distrust among those excluded countries, because of the perception of a lack of transparency.

This chapter argues that the usage of the bilateral modus of negotiation in a multilateral framework requires a more pragmatic discourse. Flexibility on which modus or on which modus-mix expands the so-called *Zones of Possible Agreement* (ZOPA), which in turn provides more resources to make a 'win-win' situation more likely (Lewicki/Minton/Saunders 1999). The combination of bilateral and multilateral modi, however, faces opposition from those who felt that the previously agreed procedure of multilateral negotiations is being disregarded, particularly when those excluded have stakes on the outcome The North-South divide points to the need of starting a comprehensive discourse to enable a paradigm shift. For the upcoming COP16 in Mexico, bilateral agreements for instance between the United States and China, as well as bilateral agreements between members of specific coalitions such as the G77 are necessary for the reason that some of their interests are perceived to be only reachable through bilateral means.

86.4.2 Strategic Facilitation: The Role of Threshold States

This chapter argues that the climate change negotiations are not conducive to leadership (86.3.2). The North-South divide points to the lack of coherence in the international system when it comes to expectations in the outcome of the negotiation process. The diverging interests of countries are manifested as packages representing the different coalitions such as the G77 and G20. These coalitions imply contesting values, norms, practices, and interests between coalitions which are used as reference for identity. Leadership, however, requires a `supra-identity´, which still does not exist in the climate change context. For instance, the memory of past injustices maintains distrust to the intentions of developed countries. Leadership is impeded through contesting notions on goals and understanding of terms such as justice and fairness. Furthermore, the lack of coherence for instance among developed countries on their emission targets does not signal good examples.

This chapter argues that facilitators or mediators are needed. In Copenhagen, the Danish government acted as chair, however, not facilitative, but rather evaluative (Riskin 1994; 1996) when it drafted its own text. Future chairs could take one step backward and assume of role of mediators. In a simulation of the COP15 in the *International Institute for Applied Systems Analysis* (IIASA) in Laxenburg, Austria in 2009, the Danish government was assigned the role of mediator. The participants of the simulation mediated 'in concerto' (between G77 and China group and the G20, as well as between individual states). The facilitators strategically assumed control of the procedure in which a basis of trust and a basis of efficiency were established, because the countries could concentrate their resources in negotiating the substance, and not negotiating their understanding of procedural justice. Shuttle diplomacy proved to be effective to establish communication channels between actors. However, for the chair to effectively conduct shuttle diplomacy, it must have an overview about the interests of states. For this, it is important for the facilitator to profile interests.

Aside from the chair, the threshold states, such as South Korea and Mexico, can contribute to the facilitation of the negotiation process. Such threshold states which are members of multiple coalitions can

limit the negative externalities. The decisions made by major countries have both positive and negative effects for those countries that were excluded in the decision-making for the 'reason of efficiency'. The threshold states, although pursuing their own interests, can bridge the gap between coalitions, because their interests, values, norms, and practices reflect elements of both groups. For instance, South Korea, although it belongs to the OECD, behaves in particular contexts as a developing country. The multiple membership of these threshold countries lead to 'cross-externality' according to which externalities are now coming from both sides. Decisions made by developing countries have effects on developed countries and vice versa, which facilitates the establishment of a `grand coalition´. Functioning as core in the new grand coalition, threshold states could facilitate cooperation.

In allowing countries to take positions without moral sanctions being imposed on them, their positions could be heard. From positions, interests were derived. Coming from the interests, solutions were easier to be found. The assertiveness of the developing countries in the COP meetings is highly criticized as purely position-taking and therefore detrimental to the agreement-making process. However, as this chapter argues, position-taking is an important part of the bargaining process. Unless the developing countries perceive that they could voice out their positions (interests), there can be no moving forward in the climate change negotiations.

86.5 Conclusion: Managing Entanglement – Opportunities through Strategic Facilitation

The North-South divide has been perceived as a major stumbling block in reaching agreements to confront climate change. Politics is demonized and blamed for failures that experts propose moving away from the North-South paradigm (La Viña 1997: 189). La Viña proposes the reconsideration and rejection of the North-South divide, because negotiations within this premise will always begin with political rhetoric about the inequality in the international economy, about historical responsibility, about the need for radical restructuring of the international political and economic system, about the predisposition for suspicion of environmental issues (Najam 2004: 5), and the negotiation usually ends up with either deadlocks or unsatisfactory compromises over the core issues that have been raised. The South usually easily slips back into a defensive, risk minimizing strategy (Najam 2004: 5) and ends up in frustration for both sides. However, it should be noted that such behaviour expresses positions that are raised to pursue interests. While positions are non-compatible, interests do not necessarily debar each other. Politics as understood in the climate change negotiation context is a social reality and coping with it represents a more practical approach.

Carefully conceptualizing the North-South divide can lead to the proper understanding of the divide as an indicator and not the cause of the delay in reaching a sustainable outcome through negotiations. Reframing the divide as the reference to the structural deficiencies and not as the problem itself enables parties to address the root causes and to promote sensitivity for the needs of the other side through the exchange of perspectives. The divide is not the conflict object, but rather an indicator of the dilemmas that have plagued the international system in the context of climate change. Reframing the divide as the point of departure of the analysis of the system enables the identification of opportunities for achieving a more sustainable, focused, and yet comprehensive outcome. For instance, the divide serves as a point of reference in coalition-building. Coalitions are established on the basis of common interests, which make the negotiation process less uncertain. The divide reflects a basic function of a multilateral process which requires the building of a like-minded community of negotiating parties. Coalitions do not only serve as a 'negotiation vehicle' (Penetrante 2010) enabling the expansion of resources to pursue interests through cooperation among like-minded actors, they also serve as a channel to moderate extreme views or positions through the various deliberation rounds within coalitions before engaging talks in the international stage. Coalitions bundle interests into packages, decreasing complexity of negotiations. The divide points to the necessity of more facilitators and less of leaders in the bargaining process if a more pragmatic approach is to be pursued. It would mean for instance a chair not drafting a text, but rather a chair that mediates between groups.

The constructive usage of the North-South framing enables a future-oriented conflict management, because the divide points to the issues that must be accommodated to allow future cooperation. It sets the norm and calls for a North-South partnership. As Zartman (2003) explains, discussing the future actually means reconciling two rights, not re-addressing ancient wrong.

87 Climate Change: Long-Term Security Implications for China and the International Community

Yu Hongyuan and Paul J. Smith

87.1 Introduction[1]

Climate change has emerged as one of the top security challenges of the early 21st century (Brauch 2009; chap. 41 by Bauer; chap. 42 by Scheffran; chap. 88 by Ohta). UN Secretary-General Ban Ki-Moon stated that "climate change is altering the geopolitical landscape," as manifested by increased competition over Arctic resources, increased intra-state and interstate migration and rising sea levels.[2] Similarly, U.S. Senator John Kerry argued that "global climate change poses a real and present danger of environmental destruction and human dislocation on a scale that we've never seen."[3]

Climate change poses a security challenge on a number of levels: the individual (human) level, the state level and the level of the international system. On the individual level, the *United Nations Development Programme* (UNDP) asserted in 2007 that "climate change is the defining human development issue of our generation. ... Climate change threatens to erode human freedom and limit choice" (UNDP 2007–2008: 1). With regard to impacts on the state and governance, the United Kingdom, in its *National Security Strategy* described climate change as "potentially the greatest challenge to global stability and security, and therefore to national security" (UK 2008: 18).

Addressing some of the international security aspects of climate change, the United States' based Center for Naval Analyses described in a 2007 report some of the long-term security implications of climate change when it noted: "Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world" (CNA 1007: 6). Thus, states or regions already experiencing various social or governance challenges would be further compromised by some of the anticipated effects of climate change.

China is central to regional and global efforts to fight global warming and climate change. Any successful international effort to mitigate threats to human and national security posed by climate change must inevitably include China.[4] With a population exceeding 1.3 billion, China's economy is one of the world's largest and fastest growing. Consequently, China is experiencing widespread and often acute environmental challenges with severe local, national and regional consequences.[5] It already produces vast amounts of *greenhouse gases* (GHGs). In 2007, the Netherlands Environmental Assessment Agency asserted that due to China's low energy efficiency, the country's emissions had surpassed the US and are now ranked number one globally.[6] In addition, according to an IEA (2007) report: "Carbon dioxide emissions in China could rise to over 11 bn tonnes in 2030, compared with 8 bn tonnes in the US, about 4.5

1 The views presented here are the authors' own and do not reflect the positions of their respective governments or institutions.

2 "Remarks by United Nations Secretary-General Ban Ki-Moon to the World Climate Conference, Geneva, Switzerland," in: *Federal News Service,* 3 September 2009.

3 "Transcript of remarks by Senator John Kerry, Senate Foreign Relations Committee, Subject: U.S.-China Partnership on the Road to the U.N. Climate Change Conference 2009, National Pres Club", in: *Federal News Service,* 29 July 2009.

4 Some of these ideas and discussion of other Asian Pacific countries can be found in Harris (2004); on environmental security, see Elliott (2002: 31–52).

5 See Smil (1993); Japan Environmental Council (2000: 98-100); World Bank (1997a), at: <http:// www.worldbank.org/html/extdr/climchng/eapclim.htm> (2 April 2003).

6 Netherlands Environmental Assessment Agency: "Chinese CO2 emissions in perspective"; at: <http://www.mnp.nl/en/service/pressreleases/2007/20070622ChineseCO2emissionsinperspective.html>.

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bn tonnes in Europe (OECD countries), and just over 2 bn tonnes in India."[7]

Since the 1990's, China has paid increasing attention to environmental protection and the growing hazards posed by climate change (Schreurs 2009; Barnett 2009). In its 2008 White Paper on climate change, the Chinese government acknowledged that "China is one of the countries most susceptible to the adverse effects of climate change, mainly in the fields of agriculture, livestock breeding, forestry, natural ecosystems, water resources, and coastal zones."[8] However, China is still a developing country and in global environmental governance, it has not committed to any immediate concrete responsibility for reducing GHGs, according to the 'no regret' principle. During debates held in the UN General Assembly in November 2007, China's Liu Zhiyong stated that with regard to climate change "the principle of common but differentiated responsibilities should be observed." Moreover, Liu argued that developed countries "should meet their emissions reduction targets" while developing countries "should adopt positive measures to control their greenhouse gas emissions to the extent possible."[9]

China's current development route is based on a high growth-oriented, unsustainable, resource constrained economic model, and it faces the crucial need to promote development while joining the global struggle against climate change. Thus, as China contributes to global economic growth, it simultaneously assumes a role of being one of the largest environmental polluters in the world.

China is also important in the climate change debate because it is a leading member of the developing world that influences international environmental negotiations. If China continues in its unfettered pursuit of an energy-intensive and growth-oriented development model, its moral reputation – including its carefully-promoted "peaceful and benign rise" narrative – may become severely damaged. With these considerations in mind, this chapter examines possible consequences of climate change for the Asia Pacific region, and particularly for China (87.2), it then reviews China's climate change diplomacy and its principles (87.3), it discusses empirical findings for international and domestic implications for China and global climate change (87.4) and finally it discusses Chinese initiatives beyond 2012 (87.5).

87.2 Security Challenges of Climate Change for the Asia-Pacific Region and China

87.2.1 The Scientific Basis: IPCC Assessments

Since 1988, the world's governments began to seriously consider problems of global warming and resulting climate change.[10] It is now generally accepted that global warming is substantially influenced by human activities (IPCC 2001, 2007). Global warming in turn is causing climate change, which is resulting in rising sea levels, droughts, floods and other extreme weather events, spread of pests, harm to natural ecosystems and species, and other adverse consequences. In its Fourth Assessment Report, the IPCC (2007, 2007a, 2007b, 2007c) concluded that billions of people could face shortages of food and water and increased risk of flooding as a result of climate change.[11] Nearly all regions, including Europe, Africa, Asia and America, are anticipated to be negatively affected by some future impacts of climate change and these will pose challenges to many economic sectors (IPCC 2007a: 8–9). The 2007 IPCC synthesis report shows,

> In Asia, available fresh water will decrease by mid-century. Coastal mega-deltas will be at risk from flooding due to rising seas. Mortality due to diseases associated with floods and droughts will increase (IPCC 2007a: 8-9).

According to the Fourth Assessment Report of the IPCC,

7 "Melting Asia: China, India, and climate change", in: *The Economist*, 387,8583 (3 June 2008): 29–30.

8 [Information Office of China's State Council]: "'Full text' of China's policies, actions for addressing climate change", in: *BBC Monitoring Asia Pacific-Political*, 30 October 2008.

9 Transcripts of remarks by Amb. Liu Zhiyong to the United Nations General Assembly, 62nd Session, 20 November 2007 (A/C.2/62/SR.16): p. 14 (accessed from UN website, 21 September 2009).

10 Some of these ideas rely on Harris (2003: 3–18, 2003a: 19–39, 2002: 130–149). This chapter uses 'global warming' to refer to the enhanced greenhouse effect.

11 See: IPCC WGII (2007a: 2–6): "Many natural systems are being affected by regional climate changes. It is likely that anthropogenic warming has had a discernible influence on many physical and biological systems with observational evidence from all continents and most oceans showing temperature rises. Climate changes in many physical and biological systems are linked to anthropogenic warming".

> Future climate change is likely to affect agriculture, risk of hunger and water resource scarcity with enhanced climate variability and more rapid melting of glaciers (medium confidence). Climate change is likely to affect forest expansion and migration, and exacerbate threats to biodiversity resulting from land use/cover change and population pressure in most of Asia (medium confidence). Future climate change is likely to continue to adversely affect human health in Asia. Multiple stresses in Asia will be compounded further due to climate change. Water and agriculture sectors are likely to be most sensitive to climate change-induced impacts in Asia (IPCC 2007a: 471–473).

87.2.2 International Perspectives on the Security Dimensions of Climate Change and their Relevance for China

In June 2008, the U.S. National Intelligence Council issued a report that addressed the global security implications of climate change. Among other things, the report asserted that "climate change could threaten domestic stability in some states, potentially contributing to intra- or, less likely, interstate conflict, particularly over access to increasingly scarce water resources."[12] The report also looked at the likely impacts of climate change on specific regions. Regarding Asia, the NIC concluded that:

> In parts of Asia, extreme weather events are more frequent and severe and intense rains and floods come more often. Droughts have intensified and/or affected more areas in Central, South and Southeast Asia. Tropical storms are more frequent in the South China Sea, and the Bay of Bengal is experiencing fewer but more intense storms.[13]

A subsequent U.S. government assessment predicted the possibility of interstate conflict over water resources, such as in the Himalayan region – the water source for a number of river systems in China, Pakistan, India and Bangladesh (National Intelligence Council 2008: 66). Many of the severe consequences from climate change predicted for the Asia-Pacific region will also affect China. China may see greater weather extremes, including droughts in the north and floods in the south, and increased incidence of infectious disease, including malaria and dengue fever (Nielsen/McElroy 1998: 4–25). Hotter weather – including periodic heat-waves – will increase human mortality as indicated by historical studies from China showing a strong correlation between peak summer temperatures and death rates (Johnson/Li/Jiang/Taylor 2003). Among other prominent impacts are those to agriculture, forests and water resources (China Climate Change Country Study 1999: 107–201).

Food security in China is also likely to be threatened by long-term climate change. A separate U.S. intelligence assessment focusing exclusively on climate change impacts on China concluded that by 2030, "overall crop productivity in China could decrease by as much as 5–10 per cent if no action is taken" (National Intelligence Council 2009: 21–22). In the second half of the 21st century, the results will likely be more severe, resulting in substantial reductions in the yield of rice, maize and wheat of up to 37 per cent (National Intelligence Council 2009: 21–22).

87.2.3 Chinese Official Political and Academic Assessments of the Long-term Security Implications for China

Similar to many Western assessments regarding the security implications of climate change, Chinese official documents also acknowledge such risks. For example, in the foreword of its White Paper on *China's Policies and Actions for Addressing Climate Change*, the Information Office of China's State Council acknowledged that

> as a developing country with a large population, a relatively low level of economic development, a complex climate and a fragile eco-environment, China is vulnerable to the adverse effects of climate change, which has brought substantial threats to the natural ecosystems as well as economic and social development of the country.[14]

One of the Chinese government's primary concerns is the possibility of an increased incidence of natural disasters that may be linked to climate change. In its most recent disaster prevention White Paper, issued in May 2009, the government asserted that "China is one of the countries in the world that suffers the most natural disasters," some of which are tied to extreme weather events.[15] Moreover, such "extreme weather phenomena are increasing along with global climate

12 Statement by Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the U.S. National Intelligence Council, U.S. House Permanent Select Committee on Intelligence, U.S. House Select Committee on Energy Independence and Global Warming, 25 June 2008.

13 *Ibid.*: 5.

14 [Information Office of China's State Council]: "'Full text' of China's policies, actions for addressing climate change", in: *BBC Monitoring Asia Pacific-Political*, 30 October 2008.

changes."[16] China anticipates increased disaster risks that may be tied to increased flooding, droughts, heat waves, forest and grassland fires and insect infestation, among other effects.[17] In addition, according to the Chinese Government, climate change "will also produce far-reaching impacts on society, economy and other fields, and cause huge losses to the national economy."[18]

Food security, which is often characterized as a national security issue in China, may be undermined by climate change. Yin Chengjie, vice chairman of the Agriculture and Rural Affairs Committee of the *National People's Congress* (NPC), recently stated that the government must remain focused on food security in the long run "because grain is not only a commodity, but also a strategic material for a country of 1.3 billion people."[19] Nevertheless, according to the Chinese White Paper "climate change has already produced visible adverse effects on China's agriculture and livestock-raising sectors."[20] In the long-term, the government expects the overall future impact of climate change on the country's agricultural sector (including livestock breeding) to be "mainly adverse."[21]

Along with its impact on food security, climate change is also likely to undermine water security throughout China, which is already acknowledged as being a major ecological concern in the country (chap. 57 by Gao/Hu). The White Paper asserts that "climate change has already caused changes in the distribution of water resources all over China" and more ominously it predicts that "future climate change will have a great impact on the temporal and spatial distribution of water resources" in a number of ways.[22] Moreover, climate change will likely intensify the drought trend in northern China.[23]

Sea-level rise linked to climate change is also expected to have profound and pernicious consequences for China. The Chinese *Climate Change White Paper* asserts that the country has witnessed an increasing trend of sea-level rise during the past 30 years, "which has caused seawater intrusion, soil salinization and coastal erosion" among other effects.[24] The government also fears that continued sea-level rise "will undermine the capacity of public drainage facilities in coastal cities, and impair the functions of harbours."[25]

87.3 Projections of China's Energy Consumption by 2030

In 2006, China overtook the United States to become the largest CO_2 emitter in the world. By 2020 China's average per capita energy consumption is expected to match the current global average, meaning that China alone will account for almost one third of the world's total GHG emissions between 1990 and 2020 (Harris/Yu 2005). Thus, China clearly matters when it comes to global efforts to mitigate climate change. Without substantial efforts on the part of China to limit future carbon emissions, any measures undertaken by other countries to address the climate change question will be negated – hence, the importance of China's approach to climate change and its role in international negotiations.

87.3.1 China's Economic Development and Projections Until 2020 and 2030

Carbon emissions from developing countries have been growing rapidly. In its *World Energy Outlook 2006*, the International Energy Agency pointed out that the economies and population of developing countries were growing faster than those of the wealthier nations, "shifting the centre of gravity of global energy demand." It estimated that more than 70 per cent of the increase in global primary energy demand between now and 2030 would come from developing countries.[26]

15 [Information Office of China's State Council]: "'Full text' of China's white paper on disaster prevention, 9 May", in: *BBC Monitoring Asia Pacific-Political*, 12 May 2009.
16 *Ibid*.
17 *Ibid*.
18 [Information Office of China's State Council]: "'Full text' of China's policies, actions for addressing climate change", in: *BBC Monitoring Asia Pacific-Political*, 30 October 2008.
19 Yuan Ye: "Food Security in a Generation", in: *Xinhua*, 16 September 2009; at: < http://news. xinhuanet.com/english/2009-09/16/content_12064354.htm> (17 September 2009).
20 [Information Office of China's State Council]: "'Full text' of China's policies, actions for addressing climate change", in: *BBC Monitoring Asia Pacific-Political*, 30 October 2008.
21 *Ibid*.
22 *Ibid*.
23 *Ibid*.
24 Xinhua News Agency: "China National Action Plan on Climate Change", at: <http://news. xinhuanet.com/politics/2007-06/04/content_6196300.htm> (3 March 2008).
25 *Ibid*.

As one of the world's major economic powers, China is vital to regional and global efforts to fight global warming particularly in the Post-Kyoto climate negotiation era. Due to its high economic development and low energy efficiency, in the early 1990's China became the second largest source of GHGs, and recently (2006) it reached the number one spot according to a Netherlands environmental agency.[27] By 2020 China's average per capita energy consumption will match the current global average, meaning that China alone will account for almost one-third of the world's total GHG emissions between 1990 and 2020 (Harris/Yu 2005). As the general amount increases, we should also see that the emissions intensity of carbon dioxide related to China's average GDP will begin to decrease. According to the International Energy Agency, China's average emissions intensity related to GDP is 5.47 kg CO_2/dollar (prices of 2000).

In 2004, the ratio fell to 2.76 kg CO_2/dollar, dropping 49.5 per cent. Meanwhile, the average level globally dropped 12.6 per cent and for members of the *Organization for Economic Cooperation and Development* (OECD) by 16.1 per cent within a two to three year timeframe. The national average GDP energy consumption dropped 1.79 per cent from 2005 to 2006, and also dropped 3.66 per cent from 2006 to 2007. China's economy has managed to flourish despite the limitations in energy supply. Moreover, the former and current leadership all recognize the imperative of balancing the environment and energy consumption.

Premier Wen Jiabao stressed that energy use per unit of GDP must be reduced by 20 per cent from 2005 to 2010. Under these new circumstances, the Chinese government is shifting from the past development principle of "fast and healthy growth" to "healthy and fast growth."[28] With these objectives in mind, the Chinese government has issued its *Energy Conservation Law* (1997) and the *Renewable Energy Law of the People's Republic of China* (2005).

87.3.2 Western Projections of China's Energy Consumption

China's role in contributing to climate change is related to its energy-intensive economic structure. China's transition from a light manufacturing economy to one featuring more energy-intensive industries—including iron, steel, cement, chemicals and aluminium—is a major factor behind this trend. China accounts for about 35 per cent of world steel production and about 50 per cent of the world's production of cement. These industries and associated activities are "laying a foundation for ... a consumption-led Chinese energy challenge down the road."[29] Chinese consumers' increasing tendency to purchase automobiles and air conditioners, among other products, is establishing the basis for China's future energy challenge.[30]

Based on current projections, therefore, fossil fuels are expected to remain a key part of China's energy mix, with oil playing an increasingly prominent role. According to the IEA's (2007: 79) projections, global oil demand is expected to grow by 1.3 per cent a year, from 83.7 million barrels per day in 2005 to 98.5 million barrels per day in 2015, and 116.3 million barrels per day in 2030. Roughly 42 per cent of this increased demand will come from India and China, while China will account "for the biggest increase in oil demand in absolute terms of any country or region" (IEA 2007: 79).

In the future, the expansion of China's transportation sector is expected to sharply increase the country's demand for oil. By the year 2030, automobile ownership is predicted to increase from 27 million

26 N. Gopal Raj: "Meeting the challenge of climate change", in: *The Hindu*, 23 May 2007.

27 "China overtakes U.S in greenhouse gas emissions", in: *New York Times,* 20 June 2007; at: <http://www.nytimes.com/2007/06/20/business/worldbusiness/20iht_emit.1.6227564.html>.

28 "Official says China attaches importance to climate change", in: *Industry Updates*, 25 April 2007.

29 This paragraph relies on: "Transcript of remarks by Mr. Trevor Houser, Director, Energy and Climate Practice, Rhodium Group, Session One of a Council on Foreifn Relations Symposium on China and Climate Change and Findings of CFR's Independent Task Force on Climate Change, Subject: Chinese Energy and Climate Strategy", in: *Federal News Service,* 24 June 2008; at: <http://www.cfr.org/publication/16630/symposium_on_china_and_climate_change_session_one.html> (5 October 2007).

30 This paragraph relies on: "Transcript of remarks by Mr. Trevor Houser, Director, Energy and Climate Practice, Rhodium Group, Session One of a Council on Foreign Relations Symposium on China and Climate Change and Findings of CFR's Independent Task Force on Climate Change, Subject: Chinese Energy and Climate Strategy", in: *Federal News Service,* 24 June 24 2008; at: <http://www.cfr.org/publication/16630/symposium_on_china_and_climate_change_session_one.html> (5 October 2007.).

cars in 2004 to 400 million by 2030 (US DOD 2008: 10). Consequently, oil consumption in China is expected to rise from about 7.58 million barrels of oil per day currently to 10–12 million barrels per day by the year 2015, the majority of which is expected to be imported (US DOD 2008: 10). Currently, China imports 53 per cent of the oil that is consumed (US DOD 2008: 10).

Similar to oil, the demand for coal is also projected to rise from 4,154 *million tons of coal equivalent* (Mtce of 2005) to 7,173 Mtce in 2030, with demand from China and India accounting for three-quarters of the projected increase to 2030. Coal is the basis of China's power generation infrastructure; eighty per cent of the electricity generated in China can be linked to coal, which is also tied to approximately 80 per cent of all of China's CO_2 emissions (US DOD 2008: 10).

Most Western experts believe that for the foreseeable future – at least 30 years – this fundamental reliance on coal will remain, if not increase dramatically (IEA 2007). By 2030, coal will constitute 63 per cent of China's energy demand mix (IEA 2007). The dominant role of coal in China's energy mix complicates China's ability to achieve certain abatement objectives. As the Chinese government articulated in its 2008 White Paper: "[China's] coal-dominated energy mix cannot be substantially changed in the near future, thus making the control of greenhouse gas emissions rather difficult."[31]

87.3.3 China's Long-term Economic and Energy Projections and Planning

China has strengthened its laws, regulations, policies, systems and management mechanisms to actively address climate change, and has also created a strong institutional, policy and market environment for low-carbon development of enterprises. Since the 8th Five-year Plan (1991–1995), global climate change has been a priority in plans for the state energy plan. According to its 11th Five-year Programme, China will accelerate the pace of building a resource-efficient and environmentally-friendly society, and promote the harmonization of economic development with its population, resources, and the environment. China issued its *National Action Plan on Climate Change* in June 2007, in which the Chinese government established the following goals to 2010: 1) to reduce energy consumption by 20 per cent; 2) to increase the share of renewables (including large-scale hydropower) to 10 per cent of primary energy supply; 3) to increase coal-bed methane production to 10 bn cubic meters a year; and 4) to promote nuclear power development.[32]

In view of its industrial structure and capacity, China carried out industrial upgrades, eliminated outdated production capacities, and focused on energy efficiency. More importantly, a range of tools has been used to help establish the market mechanism and industrial systems, such as encouraging technical innovation, promoting legislation, changing consumption patterns and establishing a carbon market. At the same time, China has also adjusted its trade policy by restricting the export of high energy consumption products and by expanding the import of manufactured goods. Technological innovation is the most important long-term strategy to deal with climate change.

At the technical level, Chinese science and technology have provided some good tools to address climate change. China is vigorously developing energy-saving and energy efficient technologies, renewable energy and new energy technologies, and clean coal. Other technologies China is exploring and utilizing include advanced nuclear energy, carbon capture and storage, bio-sequestration and carbon sequestration. The development of each energy technology may cost as much as one trillion U.S. dollars each.

China has also emphasized public education to enhance awareness on the low-carbon issue. Experience has shown that effective social participation is the basis for a transition to a low-carbon economy. Low-carbon consumption needs to become part of social consciousness, and China needs to guide people in ways to save energy and reduce carbon emissions. China is encouraging government and social organizations to participate in its emerging low-carbon economy. Through their economies of scale, they can promote the transition to environmental protection at a relatively low cost. China also aims to promote the concept of low-carbon lifestyles for individual citizens, to ensure that the low-carbon transition is universal. In China, low-carbon living is still hampered by a lack of social infrastructure. China has therefore continued to strengthen civic education to avoid a high-carbon lifestyle in the future.

31 Xinhua News Agency: "China National Action Plan on Climate Change"; at: <[http://news.xinhuanet.com/politics/2007-06/04/content_6196300.htm> (3 March 2008).

32 *Ibid.*

In addition to its current (and projected increase) reliance on fossil fuels, China – as noted above – is also expanding the renewable and alternative categories of its overall energy mix. The 2008 White Paper seeks to raise the proportion of renewable energy sources (wind, solar and hydropower) to 10 per cent (total consumption) of the overall energy mix by the year 2010. Recent initiatives by the Chinese government – including calls to substantially expand solar and wind power capacity – suggest that this goal will be achieved or exceeded.[33] The Chinese government also announced plans to expand nuclear energy (doubling its original goal), with the ultimate objective of achieving a capacity of 70 gigawatts by the year 2020.[34]

87.4 China's Domestic Climate Change Policy

Recognizing the increasing challenge posed by climate change – and China's central role within this issue – the Chinese government has responded by engaging in 'climate change diplomacy' that operates on several levels. Broadly speaking, China's climate change diplomacy has sought to further several goals, namely, to protect China's sovereignty and national interests; to acquire foreign aid and technical assistance; to promote China's economic growth based on a *Scientific Outlook on Development*; and to enhance its role as a responsible great power and as the leader of the developing world (Economy 1998: 264). To cope with these agendas, China has responded incrementally towards growing external influences, particularly to the requirements of the *United Nations Framework Convention on Climate Change* (UNFCCC).

China's energy intensity – defined as the "ratio of energy consumption to a measure of the demand for services"[35] – is only a fifth of that of the European Union. But China is seeking to find a model that will allow it to resolve the conflicts between energy consumption and environmental degradation. As noted earlier, China is developing a diverse mix of energy resources, and is putting in place a system that will supply stable, economical and clean energy. China is also working hard to develop a recycling economy so that it will garner the highest possible economic and social benefits with the lowest possible energy consumption.

First, China has consistently pursued the goal of relying on its domestic resources and constantly increasing the domestic supply of energy. China is not only a major energy consuming country, but also a major energy producer. Since the 1990's, China has obtained more than 90 per cent of its energy from domestic sources (93 per cent in 2005) and the potential of its domestic energy supply is still great.[36] From 1980 to 2001, on average, China's GDP growth rates have been around 10 per cent, with approximately a five per cent growth rate in energy consumption.

China's economy has managed to thrive despite limitations in energy supplies and the recognition by former and current leaders that China must seek to balance environmental concerns with energy priorities. Deng Xiaoping pointed out that energy efficiency was essential to achieving economic goals in China. Recent external assessments suggest that China is already more energy efficient than many of its counterparts in the developing world. However, this assessment also indicated that China's energy use has grown much faster than its GDP since the end of 2001, putting China's development goals and global climate change struggles in jeopardy.[37]

Second, as part of the national law building process, after the 1992 Earth Summit, the Chinese government devised a national sustainable development plan based on the summit's "Agenda 21" objectives. As part of its implementation, the government adopted – as described earlier – the *Energy Conservation Law* (1997) and the *Renewable Energy Law of the People's Republic of China* (2005). Since the Eighth Five-year plan (1991–1995); global climate change has been listed as a priority for the state energy plan. With the 11th Five-Year programme (2005–2010), China has accelerated the pace of building a resource-efficient and environmentally-friendly society, and has promoted a harmonization of economic development with its population, resources, and its environment. This will ideally reduce energy consumption per unit of GDP by some 20 per cent by the end of the 11th FYP period

33 "Testimony by Barbara Finamore, China Program Director, Natural Resources Defense Council, before the Committee on House Select Energy, Independence and Global Warming", in: *CQ Congressional Testimony,* 4 March 2009.

34 "China eyes massive hike in atomic energy target: state media", in: *Agence France Presse,* 4 February 2009.

35 See Energy Information Agency glossary: <http://www.eia.doe.gov/emeu/efficiency/ee_gloss.htm>.

36 China State Council Information Office: "China's Peaceful Development Road"; at: <http://english.peopledaily.com.cn/200512/22/eng20051222_230059.html> (12 October 2006).

37 Interview of Hongyuan Yu with Mark Levine of the Lawrence Berkeley National Laboratory on 27 July 2007.

in 2010. Furthermore, China issued its *National Action Plan on Climate Change* in June 2007, and its government has selected these goals to be achieved by 2010:

1. Reducing energy consumption by 20 per cent;
2. Increasing the share of renewable energy (including large-scale hydropower) to 10 per cent of its primary energy mix;
3. Increasing coal-bed methane production to 10 billion cubic metres a year; and
4. Promoting nuclear power development.[38]

Third, in terms of institution-building, to specifically address the issue of climate change, in 1998 the State Council of the Chinese government created the *National Coordination Committee for Climate Change* (NCCCC). The committee was given responsibility for coordinating and formulating various policies related to climate change. In 2007, the Chinese government set up a national leading group for climate change headed by Premier Wen Jiabao, Vice Premier Zeng Peiyan and State Councillor Tang Jiaxuan. While encouraging and pursuing economic development, the government has simultaneously adopted various measures to cope with climate change and to improve the ecological environment in line with the country's national sustainable development strategy. China has also appointed a special representative for climate change negotiations within the Ministry of Foreign Affairs.

87.4.1 China's Climate Diplomacy Practice

The development of the UNFCCC requires an active involvement of China which plays a proactive role in the so-called 'China + G77' negotiation bloc. Three stages in this regime building process may be distinguished:

1. Prior to 1992 before the *United Nations Framework Convention on Climate Change* (UNFCC) was signed: This stage focused on international consensus-building to create the foundations of a climate change regime.
2. Between the 1992 Rio Summit and the 1997 Kyoto Conference: This stage focused on the adoption of legally binding goals for reducing GHG emissions relying on three flexible Kyoto mechanisms: CDM, JI and ET.
3. Since the 1997 Kyoto conference: This stage focused on the implementation and ratification of Kyoto Protocol.

Table 87.1: Chronological development of the international climate regime.

1992	Earth Summit in Rio de Janeiro: Over 150 countries adopt the UNFCCC and are committed to achieving a "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system."
1994	Entry into force of the UNFCCC.
1995	First Conference of the Parties (COP 1) in Berlin: Adoption of the Berlin Mandate with 'Common but differential responsibilities' for developing countries (China + Group of 77)
1997	At COP 3 in Kyoto: Over 160 countries sign the Kyoto Protocol. Industrialized signatories commit to binding GHG reductions of a global average of 5.1 per cent below 1990 levels for the period of 2008-2012.
1998	COP 4, Buenos Aires: Parties set deadline to decide on Kyoto rules on the implementation of reducing of GHG in developing countries.
2001	COP7, Marrakech: 165 nations endorse the Marrakech consensus and adoptguidelines for implementing the Kyoto Protocol.
2002	The Second World Summit on Sustainable Development in Johannesburg in September 2002. COP8, New Delhi: China ratified the Kyoto protocol.
2005	COP11 and MOP1Montreal: The Kyoto protocol enters into force. The Montreal Action Plan extends the Kyoto Protocol beyond its 2012 expiration date and to negotiate deeper cuts in GHG emissions.
2007	COP-13 and MOP-3, Bali: The negotiation focuses on the post 2012 framework on GHG reduction and adopts the Bali Plan of Action
2009	COP-15 and MOP-5, Copenhagen: prospective adoption of the post 2012 climate change regime.

Since the 1990's, China has been actively involved in the foundation, negotiations and implementation of the UNFCCC and its Kyoto Protocol. During the first stage, from 1990 to mid-1992, China worked with other countries to draft and negotiate the UNFCCC. China made an important contribution to the consen-

38 Xinhua News Agency: "China National Action Plan on Climate Change", 7 June, 2007; at: <http://news.xinhuanet.com/politics/2007-06/04/content_6196300.htm> (13 September 2008).

sus on the principle of "common but differentiated responsibilities" which allowed the UNFCCC to enter into force in 1994. The convention was adopted in principle by China on 9 May 1992 and it was formally opened for signature at the *UN Conference on Environment and Development* (UNCED) in June 1992 in Rio de Janeiro, where it was signed by 155 countries, including China.[39] China's National People's Congress ratified the UNFCCC in November 1994.

The greatest subsequent challenges for China in the conferences of the parties to the UNFCCC were the Kyoto Protocol and the so-called three flexible mechanisms for its implementation, such as the *Clean Development Mechanism* (CDM), the *Joint Implementation* (JI, whereby countries with legal reduction obligations (Annex I countries) can offset their emissions with projects in other countries) and *International Emissions Trading Schemes* (IETS) (Cooper 1998: 66–80). The EU urged China and other developing countries to join this environment trading system.

The third stage covers the period since late 1997, when the parties to the UNFCCC approved the Kyoto Protocol, up to the present. During this period, Chinese diplomacy has focused on two issues: 1) on how to improve international environmental trading mechanisms and 2) on preventing the Kyoto Protocol from becoming a failure due to its rejection by the U.S. Government. At the *World Summit on Sustainable Development* (WSSD) in Johannesburg in 2002 former Chinese Prime Minister Zhu Rongji transmitted the Chinese ratification of the Kyoto Protocol.[40] China has shown great interest in the flexibility mechanisms. Chinese president Hu Jintao argued in the 2007 at the APEC Summit that:

The UNFCCC and its Kyoto Protocol constitute the legal basis of international cooperation on climate change and are the most authoritative, universal and comprehensive international frameworks for the issue.[41]

China's approach to the UNFCCC can be understood in the context of five important stages between COP8 (2002 in New Delhi) and COP12 (2006 in Nairobi):

- First, the UNFCCC provides a fundamental and effective framework for international cooperation in response to this growing phenomenon. What is particularly significant for China is the enshrinement within the Convention of the 'principle of common but differentiated responsibilities'.
- Second, China argues that climate change countermeasures should be implemented within the framework and spirit of 'sustainable development'.
- Third, the role of technology in combating climate change should be emphasized.
- Fourth, equal consideration should be given to mitigation and adaptation.
- Fifth, the international community should adopt concrete measures to mitigate climate change.[42]

At the 2007 APEC Summit, Chinese President Hu Jintao put forward four proposals for tackling climate change:

1. Cooperation is indispensable for global efforts to tackle climate change;
2. Efforts are needed to pursue sustainable development, as climate change is ultimately a development issue and it can only be addressed in the course of sustainable development;
3. The United Nations Framework Convention on Climate Change should be upheld as the core mechanism for addressing climate change. The Convention and its Kyoto Protocol provide the legal foundation for international cooperation on climate change and are the "most authoritative, universal and comprehensive international framework for the issue;"[43]
4. Major efforts should be pursued to promote technological innovation as a means of mitigating climate change.[44]

39 UNFCCC: "Issues: A Brief History of the Climate Change Process" (Bonn: UNFCCC Secretariat); at: <http://www.UNFCCC.int/cop7/briefhistory.html> (12 November 2006).

40 Jiang Weixin, "Presentation in the Cop8", in: *Renmin Ribao*, 11 November 2002. Elizabeth Economy (1998: 264) argues that "China took a significant step forward at the UN World Summit on Sustainable Development in Johannesburg when it announced that it had ratified the Kyoto Protocol to curb greenhouse gas emissions."

41 China Ministry of Foreign Affairs; at: <http://www.mfa.gov.cn/eng/zxxx/t366696.htm>.

42 Office of China National Coordination Committee on Climate Change, "Statement by Mr. Jiang Weixin at the Joint High-level Segment of COP12", "Statement by H. E. Mr. Liu Jiang, head of the Chinese Delegation at the Sixth Conference of the Parties to the UNFCCC"; at: <http://www.ccchina. gov.cn/en/> (3 October 2007).

43 China Ministry of Foreign Affairs, at: <http://www.mfa.gov.cn/eng/zxxx/t366696.htm>.

44 China Ministry of Foreign Affairs, at: <http://www.mfa.gov.cn/eng/zxxx/t366696.htm>.

87.4.2 Principles of China's Climate Diplomacy

China's substantial GHG emission rate, which now ranks first in the world, makes the effectiveness of the UNFCCC heavily dependent on concrete and tangible action on the part of China. Moreover, other developing countries (G 77 + China) hope that China will assume a leadership role in protecting their interests in negotiating the UNFCCC. The perceived and actual differences between developing and developed countries in their economic development levels and political objectives have created a serious divergence over the means and priorities needed to reduce GHG emissions. This has led to the principle of 'common but differentiated' development becoming the collective philosophy of China + G77.[45] As a result, certain interactions between China and the UNFCCC members and secretariat have occurred.

First, China joined with other developing countries to demand that developed countries should reduce their GHG emissions. It also rejected most market-based international mechanisms for emission reductions advocated by developed countries, and demanded assistance for developing countries' climate change programmes (Linnerooth 1999: 59). In its 2008 White Paper, the Chinese government argued that "developed countries should be responsible for their accumulative emissions and current high per-capita emissions and take the lead in reducing emissions, in addition to providing financial support and transferring technologies to developing countries."[46]

In particular, China has joined with India in reiterating its outright rejection of GHG emission cuts for developing countries, arguing that increased emissions are required for developing countries to lift their populations out of poverty. Despite the nominal self-positioning of China in the so-called "developing gang," interestingly, there was an instance of spontaneous cooperation between the US, China and developing countries in the UNFCCC negotiations. Specifically, China agreed with the US that employing adaptation measures – transfers of funds and technology from developed to developing countries to help them cope with climate change – was the preferred way to address the problem. As such, China joined the US in dismissing some developing countries' agendas that were designed to channel as many resources as possible from the rich to the poor.

China is increasingly aware of its dual status as a developing country and a major contributor to global environmental challenges. In the past, partly due to national pride, China resisted linking financial and technical assistance from developed countries to climate change control. But now it has demanded the transfer of funds from the West on non-commercial and preferential terms, and promised to channel such resources to contribute to the battle against international climate change. As a result, China has become the largest recipient of environmental aid from the World Bank, and receives substantial amounts of environmental aid from other international funding agencies. Indeed, most of China's environmental budget already comes from abroad (Economy 1998: 278).

China is also receiving environmental technological assistance from overseas, such as that offered by the United Nations' CDM (Japan Environmental Council year: 106). It is therefore impossible for China, after receiving all this funding, to behave in any way differently from the expectations of the UNFCCC. China's current participation in international environmental institutions and processes has increased noticeably. China has signed a wide range of treaties and declarations, developed extensive linkages with scientific and environmental policy communities around the world, and hosted a variety of international conferences and workshops on the environment. These gestures have paved the way for China to allow the UNFCCC to play a larger role in its domestic bureaucratic and policy coordination concerning climate change.

87.4.3 The Focal Points of China's Climate Diplomacy

Recognizing the important international political significance of its climate change posture, the Chinese Government had adopted a climate change strategy that consists of three basic tenets. First, the UNFCCC and its Kyoto Protocol serve as the basis and the mandate of the Bali Roadmap plays a central role. Within this framework exists the principle of "common but differentiated responsibilities," which China adheres to strongly. Second, China subscribes to the principle of "equitable development and technology transfers," which is embedded in the fundamental notion that developed countries have certain responsibilities to provide technology and assistance (economic or oth-

45 "Statement by Jiang Weixin at the Joint High-level Segment of COP12", 7 January, 2007; at: <http://www.ccchina.gov. cn/cn/index.asp> (15 April 2007).

46 [Information Office of China's State Council]: "'Full text' of China's policies, actions for addressing climate change", in: *BBC Monitoring Asia Pacific-Political*, 30 October 2008.

erwise) to developing countries that are only beginning to enjoy the fruits of economic prosperity. Third, any long-term approach to the challenge of climate change will require appropriate strategies in terms of mitigation and adaptation.

87.4.3.1 Principle of 'Common but Differential Responsibilities'

The principle of 'Common but Differentiated Responsibilities' is the global consensus within the UNFCCC, which has evolved into an international legal norm that allows "different responsibilities among different groups of parties" (Stone 2004: 279). Essentially, under the Kyoto Protocol to the FCCC, developed countries (Annex I) must (as a group) reduce greenhouse gas emissions by 5.1 per cent or more below 1990 levels during the 2008–2012 time frame. The non-Annex I countries (i.e. developing countries) do not have any quantitative obligations (Stone 2004: 279).

China and other developing countries' adherence to this standard reflects, as many politicians and legal analysts have noted, a basic structural shortcoming within the Kyoto Protocol regime to the extent that developing countries are, in essence, excluded from universal abatement obligations. This is particularly problematic because, as one legal analyst has noted: "[D]eveloping countries will be responsible for half the world's emissions by 2020 or earlier" (Gerber 2008: 333). Nevertheless, Chinese leaders contend that each person in the US now emits more than five tons of carbon per year, while in China the figure is only one ton per year. Since the start of the industrial revolution, the US and Europe account for more than 50 per cent of the total, accumulated global emissions over two centuries, while China accounts for less than eight per cent. The 50 least developed countries have together contributed less than 0.5 per cent of global cumulative emissions over 200 years."[47]

Developed countries, in general, argue that China and other developing countries must immediately take action to reduce carbon emissions; otherwise, international environmental cooperation, particularly regarding climate change, will be unsuccessful. For example, by 2006, carbon emissions in developing countries were 44 per cent over 1990 levels, and 71 per cent over 1986 levels. In 1998, the EU successfully persuaded certain Latin American countries to reduce GHG emissions, which led to the creation of the 'Buenos Aires Plan of Action' which imposed greater pressures on China. At the COP8 in New Delhi in late 2002, China joined with India in reiterating its outright rejection of GHG emissions cuts for developing countries proposed by the EU, arguing instead that increased emissions would be required to eradicate poverty in their respective societies.

87.4.3.2 Equitable Development and Technology Transfers

For China, the largest developing country, global warming issues are intimately linked to efforts to modernize the economy and the associated energy strategy necessary to bring about such modernization. However, according to Professor Pan Jiahua, developed countries' resource and energy use is excessive and wasteful, particularly in comparison to the use in developing countries. China and other developing countries only struggle to satisfy their basic needs, which can be characterized as industrialization, urbanization and maintenance of a basic and reasonable physical life.

Developing countries contend that it is their inalienable right to develop their economies, to improve living standards and to enjoy the same living standards of people in developed countries. Of the world's 6.5 billion people, only one-third enjoys regular access to electricity. In addition, one third – roughly two billion people – lack access to modern energy services and live on less than $2 per day.[48] Furthermore, the global dilemma between energy and environment should be solved through international coordination, cooperation and mutual assistance in clean energy development. Developing countries are deeply dissatisfied with developed countries in this respect because the latter refuse to pay necessary regard to the constraints imposed by developing countries' lack of development.

Wealthy countries, for instance, place a low priority on technology transfers, and insist on the high price of intellectual property rights of these technologies. Since its inception, the *Global Environment Facility* (GEF) has promoted technology transfers, grants, and loans from the developed world for reduc-

47 "CO_2 emissions increasing faster than expected", in: *M2 Presswire*, 22 May 2007.

48 According to International Energy Agency data, the per capita total primary energy supply of the U.S. was more than six times higher than China's and nearly 15 times that of India's in 2004; the per capita emissions of carbon dioxide by these countries followed a similar pattern.

ing carbon emissions through a series of projects in developing countries. However, since its launch in 1991, the GEF has only allocated about $ 4 billion in grants.[49]

Through CDM mechanisms, industrialized countries could also meet part of their obligations for reducing emissions under the Kyoto Protocol by receiving credits for investing in projects that reduce carbon emissions in developing countries. However, developed countries could also adopt a more ambitious programme of transferring advanced clean energy technologies to the developing world. China has joined with other developing countries to demand that developed countries provide non- commercial technology assistance to developing countries to help them cope with climate change and cultivate low-carbon emission economies.

However, developed countries have insisted on using commercial approaches to facilitate transfer of technology. One 'middle way' alternative would be funding of joint research centres involving China and foreign countries, such as the United States. Such centres, employing scientists and engineers from both countries, could focus on breakthrough technologies (for GHG abatement purposes) that could be distributed globally on a largely non-market basis.

87.4.3.3 Adaptation and Mitigation for Climate Change

Among developed countries, the EU and its member states place more emphasis on mitigation than on adaptation in climate change negotiations. In early 2007, the EU decided to cut greenhouse gas emissions by 20 per cent by 2020 from their 1990 levels and by 30 per cent if other industrialized nations join in. The EU also agreed to back collective cuts of 60 per cent to 80 per cent by 2050 compared with 1990 levels.[50] However, a new alliance emerged between the United States, China and many developing countries, such as India and members of OPEC. According to the logic underpinning this alliance, if China decreased its GHG emissions by 10–20 per cent, the country's GDP would decrease by 2 per cent. By contrast, if the per capita income increased by 5.1 per cent, the GHG emissions would also increase by 1.29 per cent (Zhang 1996). Thus, China agreed with the United States that *adaptation* measures – defined broadly as transfers of funds and technology from developed to developing countries to help the latter cope with the consequences of climate change – were the preferred ways to address the problem.

87.4.4 From Climate Diplomacy to Chinese Policy Implementations

With regard to addressing climate change concerns and in preparation for the upcoming Copenhagen negotiations, China is facing a complicated set of negotiations, especially when considering its energy consumption patterns (and resultant GHG emissions). Moreover, emerging economies (such as China) have become the key stakeholders in Bali Roadmap and Post-Kyoto negotiations. The success (or lack thereof) of their negotiations will influence the future of global stability, particularly as the effects of climate change continue to manifest and become more severe. It has often been argued that China should clarify its climate diplomatic position in order to pursue more understanding and support from the developed world and the international community.

However, by shifting the focus of climate talks to adaptation, and away from mitigation, both the rich and poor countries can avoid doing what they have sought to avoid the most: demanding that entrenched economic interests reduce their GHG emissions. Ironically, China has been sceptical regarding the practicality of imposing a global carbon tax (a proposal supported by the EU) as a mitigation measure from which revenue could be used to finance technological transfers. As is well known, higher trade dependence would result in a sharing of the burden associated with China's energy-intensive industries and resulting carbon emissions. In 2005, China's GDP was 18,670 billion RMB, and its exports of goods and services were roughly 6,858 billion RMB. In 2006, China's GDP was 21,438 billion RMB, and its exports of goods and services at 8,396 billion RMB.[51] Thus, the global carbon tax proposed by the EU would likely damage China's economic development.

49 "GEF in China"; at: <http://www.gefchina.org.cn/> (1 September 2007).

50 "EU Plans Steep Emissions Cuts to Avert Climate Disaster"; at: <http://www.ens-newswire.com/ens/jan2007/2007-01-10-03.asp> (13 December 2007).

51 "China: 5-year forecast table", in: *Economist Intelligence Unit - ViewsWire*, 16 April 2007.

87.5 Conclusion: Chinese Initiatives Beyond 2012

China's response to global warming and climate change has a number of social, political and economic implications (Barnett 2009; Schreurs 2009; chap. 28 by Heberer/Senz; chap. 57 by Gao/Hu; chap. 36 by Shen; chap. 15 by Zhao). First, it is clear that China has proactively addressed the challenge in multiple ways, in the policy, legal and technical front. Such actions suggest that fellow Asia-Pacific countries can not only benefit from China's growth, but also the larger consequences of China's balanced development model. A number of wealthy countries, including the United States, have been unable to implement adequate measures to facilitate GHG emission reduction. Many of these countries have sought only to adopt incremental measures domestically while avoiding international obligations to substantially limit GHG emissions.

Despite this reality, China has decided to move forward using its dual status as a developing country (with rights to and needs for development) and its growing role as a major contributor to global environmental problems (such as GHG emissions) to acquire substantial influence in international environmental negotiations. To be sure, China is well-positioned to leap frog into a clean energy development path. In the longer term, however, China could show true leadership on climate change in the developing world by adopting a concerted transition to an economy that produces fewer carbon emissions. Such a choice would be greatly facilitated (and expedited) with financial and technical aid from developed countries. Nevertheless, even in the absence of such aid, it is clear that the Chinese government should integrate climate change into its development policy. Otherwise, collective action against global warming and climate change will likely fail.

Lastly, another important factor in the future of China's climate change policy is its ongoing dialogue and cooperation with the United States. Based on total quantity of GHG emissions, China and the United States are two of the world's most important countries in terms of climate change. The American Energy Secretary Steven Chu stated recently that "what the U.S. and China do in the coming decades will help shape the fate of the world."[52] For years, both countries have used the other – particularly allegations of the other's lack of progress or sincerity regarding greenhouse gas emissions abatement – as a justification for delaying or avoiding difficult policy choices.

Recently, the Obama administration has sought to obtain specific abatement guarantees from China, partially as a way of pre-empting opposition to its own abatement proposals within the U.S. Congress. However, China has resisted such specific targets, while at the same time accusing the United States of failing to adopt meaningful GHG abatement targets. Nevertheless, the U.S. and China have still agreed – under the aegis of the U.S.-China Memorandum of Understanding to Enhance Cooperation in Climate Change, Energy and the Environment – to engage in an "ongoing dialogue on what both countries are doing to reduce emissions and to advance international climate negotiations."[53]

In the longer-term, however, a sustained U.S.-China dialogue on climate change may provide the foundation for scientific advances in clean energy technology that would have global implications. In July 2009, the United States and China announced the establishment of a clean energy research centre in China, reflecting a pro-technology policy preference among many American and Chinese officials. A senior U.S. official stated that "clean energy is the solution [and] the transformation to a low carbon economy in our country [US] and China, and ultimately globally, is the only way to solve this problem."[54]

On a recent trip to China, a senior U.S. Department of Energy official, David Sandalow, expressed surprise by the speed and depth of Chinese research into clean-energy technologies. "It is clear the Chinese are investing heavily in clean energy, and intend to be world-class players in clean-energy technologies in the decades ahead."[55] Both China and the United States are slowly positioning themselves for the challenges and opportunities associated with the major energy transition period that lies ahead.

U.S. Energy Secretary Chu provided one of the more optimistic assessments when he stated that "through clean energy, we can create new jobs and

52 Transcript of remarks by U.S. Energy Secretary Steven Chu, 28 July 2009, in: *US Fed News,* 13 August 2009.

53 Transcript of remarks by David B. Shear, U.S. Department of State, Deputy Assistant Secretary, in: *Financial Markets Regulatory Wire,* 11 September 2009.

54 Transcript of senior [Obama] administration official [unnamed], "Preview of First Joint Meeting of the U.S.-China Strategic and Economic Dialogue", in: *States News Service,* 23 July 2009.

55 Derek Sands: "Chu says China could 'eat our lunch' on innovative clean-energy technologies", in: *Platts Inside Energy,* 27 June 2009, p. 14.

new industries and vitalize our economy."[56] Through mutual confidence and ongoing dialogue, China and the United States are positioned to serve as potential leaders in the field of clean energy and GHG abatement in the years and decades ahead.

56 Transcript of remarks by U.S. Energy Secretary Steven Chu, 28 July 2009, in: *US Fed News*, 13 August 2009.

88 Japanese Climate Change Policy: Moving Beyond the Kyoto Process

Hiroshi Ohta

88.1 Introduction

Despite its potential to become a leader in international negotiations on climate change, Japan has not played an assertive role in this field since the third *conference of the parties* (COP 3) of the *United Nations Framework Convention on Climate Change* (UNFCCC) held in Kyoto in 1997. Focusing on Japanese climate change mitigation policy, this study uses the process-tracing method to examine the reasons why Japan relinquished its leadership and initiative internationally. Since overcoming severe pollution problems in the 1960's and 1970's, Japan has maintained a technological lead in pollution-abatement and energy-efficient technologies. This chapter demonstrates how unfavourable marginal abatement costs in comparison with those of EU member states and the United States have dictated a regression in Japan's climate change policy discourse. A lack of strong and stable political leadership on climate change through this period has also allowed well-organized economic interests and the economy ministry to solidify an industry-oriented policy coalition. With the advent of the new Democratic Party of Japan-led administration in September 2009, however, Japan has begun to move back into its natural position as a vital force in international climate change negotiations.

Political change has finally come to Japan, and with it a new dynamic on climate change policy. Prime Minister Yukio Hatoyama, at the UN Summit on Climate Change on 22 September 2009, pledged that Japan would reduce *greenhouse gas* (GHG) emissions by 25 per cent by 2020 from the 1990 level if all major emitters also commit to ambitious reduction targets. In order to promote a broader cooperation, he proposed the 'Hatoyama Initiative', an international scheme for the provision of additional technological and financial support for developing countries while assuring developing countries' "measurable, reportable, and verifiable" emission reduction targets.[1]

As the world's second largest economy, Japan has sought a proper position in international society through its contributions to the provision of international public goods. Japan overcame severe environmental pollution problems in the 1960's and 1970's and weathered two oil crises in the 1970's. In surmounting these problems and crises, Japan has developed pollution-abatement and energy-efficient technologies. Regarding mitigation of climate change, it has maintained a technological lead, for instance, in developing and commercializing hybrid cars and solar panels. In tandem with these efforts, Japan has had a strong domestic political incentive to play a leading role in non-military issues like global climate change due to the 'no-war clause' in its constitution, which renounces war as the sovereign right of a nation and prohibits the threat or use of armed forces even in the settlement of international disputes. As expected by many observers in the world, Japan, jointly with European countries, has taken the lead during negotiations for the UNFCCC and it did host the Kyoto Conference (COP 3) in 1997 and contribute to the adoption of the *Kyoto Protocol* (KP). However, since that time it has been reluctant to grasp the initiative once more. Rather, by assigning itself the role of a mediator between the United States and the European Union, it has become increasingly allied with those countries that remain cautious on international negotiations on climate change.

Under President Barack H. Obama and his 'Green New Deal', the United States is now moving, although not yet fully joined by Congress, with the EU toward the front lines of the battle to arrest global climate change. Is Hatoyama's commitment to climate change a mere reaction to evolving changes in international

1 Minister of Foreign Affairs of Japan (MOFA), "Statement by Prime Minister Yukio Hatoyama at the United Nations Summit on Climate Change", New York, 22 September 2009; at: <http://www.mofa.go.jp/policy/un/assembly2009/pm0922.html> (23 September 2009).

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relations on climate change? Or does it reflect an undercurrent of domestic changes within Japanese society? If so, why has Japan been so reluctant to take a leadership role in climate change negotiations despite the technological lead it holds that could generate economic gain, vigorous public support, and the strong political incentive, as mentioned above? What kind of political will is necessary to overcome resistance from the forces intent on maintaining the status quo?

This chapter attempts to answer these questions by analysing the domestic process of Japanese foreign policy making on climate change, focusing on the policy discourse for achieving the Kyoto target (88.3), international cooperation toward ratification of the Kyoto Protocol (88.4), and international negotiations beyond the Kyoto process (88.6).[2] The scientific discourse in Japan on this subject is also briefly discussed (88.5). This study employs the process-tracing method, giving a detailed account of the important decision-making processes and describing the core elements of climate-change policy discourse (George/Bennett 2005).

88.2 The Analytical Framework

Numerous studies have been done on the domestic sources of foreign policy or on the interaction between international relations and domestic politics. Putnam's 'two-level games' (1988), Gourevitch's 'second image reversed' (1978), and Milner's 'domestic interest-based' explanations (1997) are just a few.

The analytical framework for this study of the interaction between international and domestic politics combines the two-level game approach with an emphasis on domestic-factor based explanations. Government negotiators work out a tentative agreement, which each country's constituents must decide to ratify or not. Thus, the domestic political discourse of international negotiation is of crucial importance. Domestic politics includes "[political] parties, social classes, interest groups (both economic and noneconomic), legislators, and even public opinion and elections, not simply executive officials and institutional arrangements" (Putnam 1988: 432). The intersection of domestic politics and international negotiation is the "win-set" which is defined "for a given Level II (domestic) constituency as the set of all possible Level I (international) agreements that would 'win' – that is, gain the necessary majority among the constituents – when simply voted up or down" (Putnam 1988: 437). In Japan, however, since the process of ratification of international agreements is more or less automatic, one can afford to be less concerned about domestic constituents during international negotiations. Instead, special attention must be given to the following factors that influence the state's behaviour during international negotiations on climate change.

From the perspective of the domestic sources of international negotiations, the degree of ecological vulnerability and the cost of climate-change mitigation are the main factors that determine state behaviour (Sprinz/Weiss 2001). The higher a state's ecological vulnerability and the lower the mitigation costs the more likely a state is to become a 'pusher' or 'lead' state in international negotiations. Contrarily, the lower its ecological vulnerability and the higher its mitigation costs, the more likely a state is to become a 'dragger' or 'veto' state. If both ecological vulnerability and mitigation costs are high, the state may become an 'intermediate' (between pusher and dragger), or what is called a 'support' state. If ecological vulnerability is low and mitigation costs are high, a state would become a 'bystander' or a 'swing' state.[3] Japan is ecologically quite vulnerable since it is surrounded by the sea, often suffers from severe seasonal floods, and is occasionally hit by damaging typhoons. The mitigation costs for Japan are very high because it has already achieved high standards of energy efficiency. This means that one unit of CO_2 emission reductions is relatively more expensive in Japan than in other OECD countries. According to this domestic interest-based explanation, thus, Japan is likely to become an 'intermediate' or 'support' state in negotiations on the climate change regime.

The explanation, however, requires elaboration of the domestic sources of Japanese international negotiation positions beyond a mere analysis of cost-benefit positions. For instance, perceptions of mitigation costs may differ between energy-intensive industries and 'green' industries, between the economy and trade ministry and the environment ministry, or between the business sector and the environmental

2 On Japan's domestic politics and diplomacy on the *UN Framework Convention on Climate Change* (UNFCCC) and on the Kyoto Protocol, please see this author's previous studies (Ohta 2009, 2005a, 2005b, 2000, 1995).

3 The terms 'pusher', 'intermediate', 'bystander' and 'dragger' are used by Sprinz and Vaahtoranta (1994) and the terms 'lead', 'support', 'swing' and 'veto' are used by Porter and Brown (2000).

NGO sector. In the absence of strong political leadership in the promotion of climate change policy, the voices of well-organized and well-funded industrial and business associations that tend to exaggerate mitigation costs can drown out those of environmental NGOs in influencing the governmental policy-making process. If, however, Japanese environmental NGOs were well organized and well financed, they would be able to balance perceptions of high mitigation costs with an awareness of the long-term benefits of precautionary measures. In this way, Japan's perception of high mitigation costs could be shifted to relatively low costs, thereby transferring Japanese behaviour from that of an 'intermediate' or 'support' state to that of a 'pusher' or 'leader' in international negotiations.

Within the purview of the hypotheses mentioned above, Japan's domestic politics of adoption and ratification of the *Kyoto Protocol* and of post-Kyoto negotiations can be explained by five variables and two parameters. The five explanatory variables include political leadership, bureaucratic politics, the business (or private) sector, environmental NGOs and public opinion polls. The relative strength of each variable determines the size of win-sets, which in turn influences Japan's negotiation positions, as pusher and leader or intermediate and supporter. Political leadership or equivalent power, including the presence or absence of policy entrepreneurs (or policy brokers) (Walker 1974, 1981; Kingdom 1984) or influential 'greenish' politicians and/or 'greened' political parties, is influential in determining the size of the win-set. It is presumed that the more influential the politicians or political party playing the role of policy broker, the more likely it is that the win-set will become larger. Bureaucratic politics, in turn, hinge on relative strength or the presence or absence of political leadership. For example, strong political leadership may make it possible for turf wars between bureaucrats in the economic and environmental agencies to be overcome and policies furthered for the sake of the environment.

The business sector and environmental NGOs are another integral element determining the size of the win-set. Neither bureaucrats from the *Ministry of Economy, Trade and Industry* (METI) and from the *Ministry of Environment* (MOE) nor politicians can ignore the pressures from business and environmental NGOs. While pressure from the business sector generally leads to the smaller size of the win-set, pressures from environmental NGOs backed by strong support from public opinion polls can support widening the win-set for international negotiations insofar as the government is active in promoting international agreements on climate change. In the former case, Japan may call for weak emission reductions, while in the latter case, for strong emission reductions.

Domestic or international political, economic, and ideational contexts act as parameters, or intervening variables, promoting or discouraging action or inaction in Japan's climate change diplomacy. For instance, Japan's bubble economy and the Asian financial crisis of 1997 activated and deactivated environmental policy-making processes, respectively. Advancements in scientific knowledge or assessment of global climate change, moreover, have great potential to further accelerate policy developments. The so-called epistemic community may again play a significant role in the promotion of international negotiations, as it normally acts as a principal agent in identifying these problems (Haas 1990; Adler/Haas 1992).

In sum, Japan's reluctance since COP 3 to take a leadership role in international negotiations stemmed from its estimation of the high mitigation costs it would have to bear resulting from the stronger clout gained by the energy-intensive industries and in the absence of a strong counterbalancing political leadership. From September 2009, with the advent of a new administration that has pledged to promote the country's role in international negotiations on climate change, Japan is now shifting gears to move from an intermediate or support state to a pusher or leader state.

88.3 How to Achieve the Kyoto Targets

After the *Kyoto Protocol* was adopted in December 1997, on 19 June 1998, the Japanese government established the *Guideline for Measures to Prevent Global Warming: Measures towards 2010 to Prevent Global Warming* (Global Warming Prevention Headquarters 1998). This policy programme counts, above all, on the role of forests in absorbing CO_2, supported through additional activities such as forest management suggested in Article 3.4 of the *Protocol*. With regard to forestry activities, the proposed 'essential measures' to prevent global warming aimed at the reduction of 3.7 per cent out of 6 per cent, or an assigned target for Japan. The policy to reduce domestic GHG emission by 2.5 per cent consists of energy conservation, introduction of new energy and more construction of nuclear power plants "with rigid nuclear safety measures." However, the *Guideline* estimated a 2 per cent GHG increase due to the emissions of

CFC-alternative gases. Therefore, Japan would have to rely on the Kyoto mechanism to the extent to which it could gain credits equivalent to 1.8 per cent of emissions reduction.

This initial policy was amended in March 2002 when accord on the detailed legal documents of the *Protocol* was reached in November 2001 at COP 7. The path to conclusion of the detailed rules for the *Kyoto Protocol* was not easy. A full agreement was not reached at COP 6, held in The Hague in November 2000, so COP 6 was reconvened in Bonn in July 2001 (IISD 2000). Three months before the second session of COP 6, the declaration of the new Bush administration that the United States would not ratify the *Kyoto Protocol* was tantamount to a sentence of death to the document. However, U.S. abandonment of international cooperation inadvertently united the rest of the world and induced the EU, during the resumed session of COP 6, to make a large concession to Japan and the Russian Federation, particularly on the role of forests for their role in sequestration of CO_2 (Hamanaka 2006). In the end, the EU succeeded in achieving political agreement on the key features of the *Kyoto Protocol* such as a flexible (or Kyoto) mechanism and on special funds for the most vulnerable developing countries. The prospect for revitalizing the *Protocol* came in sight at COP 7 in November 2001, when the detailed legal aspects of the *Protocol* were finalized in the Marrakesh accord.

Having obtained more leeway for carbon sinks,[4] the Japanese government began to prepare for ratification of the *Kyoto Protocol*. About one month after EU ratification, the Japanese government finalized its process of ratification on 4 June 2002. In March, prior to ratification, it had also adopted a new policy guideline to alleviate global warming. The special feature of the new guideline is its step-by-step method. There were to be three steps in this policy scheme. During the first period between 2002 and 2004, the government would entrust voluntary reduction efforts to industry. During the second period between 2005 and 2007, the government would review the performance of current policies and, if necessary, introduce legal institutional reforms, including the introduction of an environment tax. Finally, Japan would keep to its international commitment of a 6 per cent reduction (Global Warming Prevention Headquarters 2002). The largest emitter within Japan, which accounts for roughly 60 per cent of the entire CO_2 emissions, is the manufacturing industry. Whereas CO_2 emissions from the manufacturing sector during 1990 and 1999 increased by just 1 per cent, during the same period the household sector increased by 17 per cent and even the transportation sector by 23 per cent. As of 2002, Japan as a whole faced a 7.6 per cent increase in GHG emissions relative to the 1990 level; therefore, it has to reduce emissions by about 14 per cent during the first commitment period of 2008–2012[5]. Under these circumstances, the policy objective of the new policy guidelines, namely, "7 per cent reduction by industry, 2 per cent by households and 17 per cent by transportation,"[6] would be quite difficult, if not impossible to achieve.

To the current trend across different sectors within Japan regarding emissions must be added the new dimension of distributional justice. How to allocate emissions reductions among different industries is a vital issue for some industries, even if utilization of the Kyoto mechanism promises to generate new commercial activities. While some eco-businesses may be able to grasp the opportunity to invent energy saving technologies and use them to open up new markets, others may suffer from the emission regulations. Possible losers are the raw materials industries such as steel, chemical, paper, and cement industries.[7] In addition, some environmental NGOs have begun to stir up the policy debate regarding a carbon tax. The tax would become a legal instrument for distributing reduction costs and responsibilities among the manufacturing, transportation, and household sectors (Tansozei kenkyukai 2002).[8]

Environmental NGOs have good reasons for encouraging policy-makers to seriously discuss the introduction of a carbon tax. As a tool for relatively universal burden sharing, a consumption tax could correct excessive dependence on fossil fuels (CO_2 emissions of the transportation and household sectors are in-

4 Japan's ceiling for forest sequestration of CO_2 as a part of domestic efforts to reduce greenhouse gases was raised to 13 million carbon tons, which in turn enabled Japan to rely on carbon sinks for 3.9 per cent (up from 3.7 per cent) of its target of 6 per cent below the level of 1990 during the period between 2008 and 2012.

5 Japan's GHG emissions in 2005 increased by 7.8 per cent relative to the level of 1990 (Global Warming Prevention Headquarters 2007: 5).

6 Global Warming Prevention Headquarters (2007: 5).

7 "Shosha to haisha" ("Winners and Losers"), *Nikkei ekoloji* (*Nikkei Ecology*), July 2002: 24–37.

8 Carbon Tax Study Group, *An Institutional Design Proposal toward the Early Introduction of Carbon Tax for Promoting Measures to Arrest Global Warming*, 31 March 2002.

creasing more rapidly than for the industrial sector). As for the period between 1990 and 2002, CO_2 emissions increased for all sectors except industry: transportation by 20.4 per cent, commercial by 36.7 per cent, and residential by 28.8 per cent, respectively.

Japanese environmental NGOs are also critical of Japanese government policy, particularly its heavy reliance on nuclear power, innovative technologies, and carbon sinks. The EU and most developing countries were also hoping for more assertive Japanese leadership in mitigating climate change. Japanese leadership could be a crucial force since a country like Japan, which has already achieved the highest rate of energy efficiency among the developed countries, can become a role model for the rest of the world. Nevertheless, the short-term costs of implementing measures for alleviating climate change loom disproportionately large for Japan in comparison with other industrial countries. What, then, would be the rationale for Japan in mitigating climate change should it wish to assume such a role? What have been the major policy discourses on climate change?

88.4 Domestic Climate Change Policy Discourse: Relative Gain versus Absolute Gain

After the Sixth Conference of the Parties (COP 6) to the UNFCCC of November 2000, policy contests in Japan between the *Minister of the Environment* (MOE) and the *Minister of Economy, Trade and Industry* (METI) gradually became more noticeable, particularly over the issues of introducing an environmental tax and emissions trading. There are no clear policy guidelines for the utilization of the Kyoto mechanisms, such as for assigning specific GHG reductions targets to each industry. METI and the energy intensive industries have been unwilling to adopt a policy for a 'cap-and-trade' emissions reduction system, agreeing only to voluntary reduction efforts advocated by Nippon Keidanren (Japan Federation of Economic Organizations). Moreover, METI has not been fully supportive of the idea of imposing an environmental tax. In 2003 when the MOE made public its interim draft report and solicited public views on proposed policies including an environmental tax, the then METI vice-minister criticized the proposal. He stated that it was too early to talk about such a policy in concrete terms and opined that there were other policy options for the arrest of global warming.[9] Shun'ichi Suzuki, then environment minister, countered this argument by stating that the timing was not at all too early, for, should the 2004 policy review arrive at the conclusion that additional measures to arrest global warming were necessary, it would by then be too late to start an inquiry into the introduction of an environmental tax as an economic policy measure.[10]

The MOE policy draft on a carbon (or global warming) tax aiming at its introduction in 2005, was presented in July 2003 to the special committee of the Central Environmental Council, an MOE policy advisory body.[11] The proposed 'global warming tax' was a new category of taxation levied according to the carbon content of fossil fuels such as coal and oil. The imposition of the carbon tax sought a simplification through 'upstream imposition', where the number of taxpayers is small. Referring to the current oil tax and taxes on volatile oils such as benzene and naphtha, the global warming tax would be imposed on importers of crude oil and the manufacturers of petroleum-related products. Taking international competitiveness into consideration, tax reduction measures would be applied to the steel, cement, and other industries, which consume vast quantities of petroleum-based energy.

If a new global warming tax were introduced, even at a modest rate of taxation of 3,400 yen per ton of carbon, it could generate substantial revenue (about 950 billion yen according to the MOE's trial calculation) that could be used to subsidize the implementation of climate change policy (Chuo Kankyo Shingikai 2003: 7). Allocation of this new revenue would be a matter of great interest to all concerned ministries such as Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure and Transport and even METI.[12] In the end, a policy coalition backing the new taxation may attain a majority within policy-making circles, unless a strong drive emerges leading to the utilization of the market system to establish a 'cap and trade' emissions trading system in Japan. However, no global environmental tax has been introduced by the government until October 2009.

On the other hand, the interim report of METI's Industrial Structure Council of July 2003, entitled "Perspectives and Actions to Construct a Future Sustainable Framework on Climate Change", represents the ministry's stance on global climate change (METI

9 *Jiji tsushin sha* (Jiji Press) and *Kyodo tsushin sha* (Kyodo News Service), 17 July 2003.

10 *Jiji tsushin sha* (Jiji Press), 22 July 2003.

11 *Kyodo Tsushin Sha* (Kyodo News Service), 18 July 2003.

2003). While admitting the difficulties for Japan to achieve the emissions reduction target stipulated in the Kyoto Protocol because Japan has already achieved high energy efficiency, the METI report promises government efforts to implement various measures steadily under the new national programme to arrest global warming in a step-by-step approach. Along with recognition of the nature and value of a stable global climate as indispensable to the global public good, the METI report emphasizes the significance of technological breakthroughs in order to cope with the long-term challenge of arresting global warming. For instance, it declares that alternative energy sources (including nuclear energy) capable of replacing fossil fuels and energy-conserving technologies are keys to success even more effective than state-of-the-art technologies. In addition, the dissemination of appropriate existing technologies to developing countries is also essential for successful international efforts to tackle the long-term challenge.

The report also stresses the importance of creating a new international framework in which both the United States (the world's largest GHG emitter), and developing countries (emerging major-GHG emitters), take responsibility for reducing emissions. Accordingly, a truly meaningful climate regime beyond 2012 must take into account each country's energy supply and demand structure. This implies stress on cost effectiveness in the adoption of various policy measures. Reflecting differences in energy supply-and-demand structures, the marginal costs of GHG reductions differ greatly from country to country, from region to region, or from sector to sector. Therefore, it has been suggested that future agreement on the allocation of responsibilities among states must be made fair and just by taking into consideration the different marginal costs of reducing greenhouse gases.

In Japan, both ministries of the environment and the economy regard a stable global climate system as an international public good based on the latest scientific knowledge. For instance, on 28 April 2005, the Cabinet adopted the "Programme for Achieving the Kyoto Target" (hereafter, the 2005 Programme) (Government of Japan 2005) after reviewing the achievements of the 2002 Guideline and incorporating various existing policy measures into climate change policy. The 2005 Programme refers to scientific findings presented in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) while reporting the increase of Japan's mean temperature by one degree Celsius during the 20th century together with distinctive ecological changes that occurred in Japan (Government of Japan 2005: 1–2). Both ministries recognize Japan's responsibility to mitigate global warming and are willing to help the most vulnerable developing countries to adapt to adverse the consequences of climate change.

While agreeing on the importance of technology, another MOE policy report stresses the absolute gain of global climate change mitigation. A policy report delivered during COP 9 in Milan presented seven points for basic consideration of a climate regime beyond 2012 (Global Environment Committee 2003). This interim report calls, for instance, for continuous progress to meet the ultimate objective of achieving a stabilization of greenhouse gases in the atmosphere "at a level that would prevent dangerous anthropogenic interference with the climate system" (Article 2 of the UNFCCC), bringing the Kyoto Protocol into effect, and achieving global participation including the United States and developing countries. This report goes on to focus on the importance of ensuring equity based on the principle of *common but differentiated responsibilities* (CBDR) (Article 3.1 of the UNFCCC). In order to ensure equity between developed and developing countries based on the CBDR principle, the report calls on the leadership of developed countries to combat climate change and, at the same time, seeks special consideration for the circumstances of developing countries that lack capabilities for addressing climate change. It also calls for taking into consideration different circumstances among developed countries and among developing countries for more equitable burden sharing toward a climate regime beyond 2012.

The policy debate between the MOE and METI reflects international negotiations. Policy-makers concerned with the relative gains and losses involved in order to avoid placing their country in an unfavoura-

12 The budget for the Guideline to Prevent Global Warming in the fiscal year of 2003 was about 1.32 trillion yen in total. The largest amount of about 390 billion yen was allocated to forestry related projects such as forest environment conservation projects. The second largest share of about 320 billion yen was for measures to promote nuclear energy. The third largest amount of about 200 billion yen was allocated to the provision of waste treatment facilities, non-energy source CO_2 and methane emissions reductions through the improvement of water drainage systems in rural communities and the like. In addition, about 126 billion yen were allocated for the establishment of an environmentally friendly transportation system, and about 122 billion for the development of new energy sources (Chuo Kankyo Shingikai 2003: 11).

ble position vis-à-vis other countries (Barrett 2003; Grieco 1990). Although Japan is firmly committed to the reduction of GHG emissions, concerns with the absolute gains of global climate change mitigation are now being contested more overtly than previously by gain-and-loss-concerned industries. All in all, despite some different policy preferences between the MOE and METI, both remained in step with the Japanese government position of supporting the Kyoto Protocol based on sound climate change science.

88.5 Scientific Discourse on Climate Change in Japan

It is not an easy task to trace the scientific discourse on climate change in Japan. It is difficult to identify a clear and united Japanese epistemic community which exerts influence on the climate change policy-making process. The most influential research institutions regarding climate change are two MOE extra-departmental research bodies – the *National Institute of Environmental Studies* (NIES) and the *Institute for Global Environmental Strategies* (IGES), and two METI-affiliated bodies – the *New Energy and Industrial Technology Development Organizatio*n (NEDO) and the *Global Industrial and Social Progress Research Institute* (GISPRI). Other academic associations, including Science Council of Japan, the Japan Weather Association, the Japanese Forest Society, as well as the Society for Environmental Economics and Policy Studies, all endorse IPCC scientific research and findings and the members of these academic communities collaborate with the government in furthering the IPCC's research and peer-reviewing activities. In fact, major governmental policy papers like the 2002 Guideline and the 2005 Programme, endorse the IPCC assessment reports, referring to its major findings. In this context, rather than to attempting to trace the climate change discourse within an authoritative scientific community, it may be more meaningful to ask how IPCC assessments have been treated in Japan's mass media.

One interesting study does just that. Applying the framing analysis approach (Pan/Kosicki 1993), Asayama and Ishii analyze how three major Japanese newspapers portray the IPCC in framing the public debate – including the scientific discourse – on climate change issues (Asayama/Ishii 2009). The three major newspapers are *Asahi*, *Mainichi*, and *Yomiuri Shimbun* (newspapers), whose subscriptions together reach 22 million households, representing 42.5 per cent of all households. According to the Asayama-Ishii analysis during the period from 1988 to 2007, based on reading about 1,206 articles, the IPCC was portrayed as a 'value-free', 'apolitical', and 'rational' scientific assessment body which sounds the alarm for society about the dire consequences of anthropogenic global warming.

Asayama and Ishii emphasize that the Japanese media, including the three major newspapers, share the same information from the concerned ministries. The information from the IPCC is no exception. In Japan, the *Ministry of Education, Culture, Sports, Science and Technology* (MEXT) and the Japan Meteorological Agency are in charge of subjects dealt with under Working Group I (WG I: physical scientific assessments) of the IPCC; MOE is in charge of WG II (impacts, adaptation and vulnerability); and METI is in charge of WG III (mitigation of climate change). Since Japanese scientists and technicians are closely working with the concerned governmental departments, no serious scientific debate is being carried out among scientists and policy-makers in Japan. Thus, Asayama and Ishii suggest, on the contrary, the danger of the 'scientific monopoly' of the IPCC. The physical, social and economic assessments of the IPCC reports and the impact of climate change are in fact not necessarily 'purely' scientific and 'absolutely' free from political bias. The mass media tends to accept the IPCC assessments uncritically and its projection of the IPCC images as an 'impeccably' scientific and 'apolitical' authority could even be harmful to a sound public debate on the issues of climate change, lacking a more broad-based view of the social and political aspects of the IPCC assessments.

In sum, it is fair to conclude that, at least before the recent regime change in Japan, the scientific debate on climate change exerted little influence on the Japanese climate change policy-making processes.

88.6 Japan's Domestic Politics and Diplomacy Beyond the Kyoto Process

Recent Japanese climate change policy has been reactive and lacklustre, as the domestic political climate has been stormy and changeable since the 65-month coalition government led by Prime Minister Junichiro Koizumi ended. The successive administrations led by Shintaro Abe, Yasuo Fukuda, and Taro Aso were all short-lived and unstable, plagued by political scandals, parliamentary impasses, and internal party political

turmoil. These administrations, which came to power without general elections, also suffered from low approval ratings.

After formation of the Abe Cabinet on 26 September 2006, the government pursued a conservative political agenda, inheriting from the previous Koizumi Cabinet a more than two thirds majority in the House of Representatives (the Lower House) and the majority at the House of Councillors (the Upper House). The conservative agenda included the National Referendum Law (enacted on 14 May 2007), which established for the first time procedures for initiating revisions to the Japanese Constitution promulgated in 1946 (known as the 'Peace Constitution').

The Abe administration also showed interest in the issues of global climate change. Abe was eager to create a new framework beyond the Kyoto process in which the entire world would participate in emissions reductions. In May 2007, he announced the new climate change initiative 'Cool Earth 50'. The proposal has three pillars.

- The first pillar sets forth a long-term strategy for reduction of GHG emissions globally. It proposes a long-term target for reducing global GHG emissions to half from the current level by 2050 as a common global goal. The proposed solutions include the establishment of innovative technologies, the creation of a 'low carbon society', and a national campaign for energy conservation.[13]
- The second pillar is composed of three principles for establishing an international framework to address global warming beyond the Kyoto process. The first principle calls on all major emitters' participation in an international framework beyond 2012. The second principle stresses the importance of the flexibility and diversity of a new framework, taking different circumstances of each country into consideration. Thirdly, such a framework should be able to cope with both environmental protection and economic growth by fully utilizing energy conservation technologies and other best-available technologies. Concrete measures to realize these three principles include the creation of a new financial mechanism for developing countries, the dissemination of energy conservation technology throughout the world, and promotion of the safe and peaceful use of nuclear power with the provision of assistance such as infrastructure development for developing countries.[14]
- The third pillar of 'Cool Earth 50' is a national campaign for achieving the Kyoto Protocol target. This policy proposal expresses the Japanese government's determination to achieve its Kyoto commitment to reducing GHG emissions by 6 per cent. The government planned to promote its initiatives and urge municipalities and major business entities to accelerate their actions for emissions reduction. A national campaign called for efforts and creative ideas for reducing GHG emissions by one kilogramme per person per day while making 'Cool Biz' (casual dress, without tie and jacket, for men) the standard practice in summer.[15]

Despite the role that Abe played in getting the statement of "considering seriously . . . at least a halving of global emissions by 2050" into the communiqué of the Heiligendamm G8 summit, his sudden resignation left that policy line to drift without a leader. Various cases of political corruption by Abe's Cabinet appointees including the involvement of three ministers of *Agriculture, Forestry and Fisheries* (MAFF) in political funding scandals took a heavy toll on the Cabinet and substantially lowered its approval ratings. The heaviest blow to his Cabinet, however, was the crushing defeat to the LDP, Abe's party, in the election of the Upper House on 29 July 2007. As the result of this election the ruling coalition parties of the LDP and the Clean Government Party (New Komeito) lost substantially, whereas the DPJ significantly increased its seats so as to make it the leading party in the Upper House.[16] Although Abe did not immediately resign, taking responsibility for this historic electoral defeat, he later gave up his post after reshuffling his Cabinet. After a brief political vacuum, the LDP chose Yasuo Fukuda as its new party leader (and prime minister), who was not such a strong political leader as Koizumi. Without a strong leadership Japan could hardly be expected to play a significant role in the negotiations at COP 13 in 2007 in Bali. Japan took sides with the United States and developing countries in opposing

13 More details at: <http://www.kantei.go.jp/foreign/policy/ondanka/2007/0524inv/siryo1.pdf> (19 September 2007).

14 Abe's policy statement on 'Cool Earth 50' is available at: <http://www.kantei.go.jp/foreign/abespeech/2007/05/24speech_e.html> (19 September 2007).

15 See: Abe's policy statement on 'Cool Earth 50'; at: <http://www.kantei.go.jp/foreign/abespeech/2007/05/24speech_e.html>.

16 *Kyodo Tsushin News*; at: <http://topics.kyodo.co.jp/feature38/> (16 December 2007).

the introduction of mid-term numerical targets in the so-called 'Bali roadmap' [*Bali Action Plan* (UNFCCC 2007d)]. Germany, on the other hand, proposed a reduction of greenhouse gas emissions by 40 per cent compared to the 1990 levels by 2020 (Gabriel 2007). This was a more ambitious target than the EU's proposal of 20 per cent reduction by 2020.[17] The final text of the *Bali Action Plan*, however, lacks any binding commitments; instead the delegates from 187 countries agreed to conclude a new accord in 2009 that will require "deep cuts in global emissions" (UNFCCC 2007d).

During the Bali Conference (COP 13), one of the Japanese governmental side events demonstrated the clear influence of established and energy-intensive Japanese industries such as steel, cement, transportation, and electric power.[18] These industries constitute the core of Nippon Keidanren, the umbrella organization for major Japanese industries and businesses. The preponderance of the METI and energy-intensive industries policy alliance permeated the process of the G8 Toyako Summit in July 2008. The Japanese government did not press the G8 leaders to negotiate numerical targets for a mid-term scheme with persuasive arguments for the sectoral approach to emission reductions as a viable policy option. Critics and environmental NGOs consider the G8 Toyako Summit a failure since it did not result in agreement on the establishment of mid- and long-term numerical targets. The government sought to give a good account of itself by declaring that all major GHG emitters, including the United States, China, India, Brazil and Mexico, recognized the need for substantial emissions reductions by 2050. But this is like saying 'a miss is as good as a mile'. The outcome of the G8 Toyako Summit did not generate the desired tailwind for the international community, especially, for COP 15 in December 2009 in Copenhagen, where an international framework beyond the Kyoto process will be decided on.

Within a year, Prime Minister Fukuda, who suffered from low approval ratings, gridlock in the Diet, and economic recession, abruptly resigned his position on 1 September 2008, again creating a power vacuum. Taro Aso defeated four candidates to become LDP President in the party's election. He was elected prime minister on 24 September 2008 thanks to the Koizumi-era legacy of a ruling coalition of a two thirds majority in the Lower House. Aso's main mission was to win the next general election expected held a few months later. However, soon after taking office, mainly because of various political gaffes, inconsistency, as well as halting and incoherent responses to the global economic recession, Aso suffered from chronically low approval ratings. He has also lacked leadership qualities. He did not manage to dissolve the Diet while the LDP had the upper hand over the DPJ before his term as prime minister expired in September 2009. He was forced instead to plunge into the 'suicidal' general elections of 30 August 2009 in the wake of major LDP defeats in the 12 July 2009 Tokyo Metropolitan Assembly elections, which is often taken as a barometer of the outcome of general elections.

Against the backdrop of Japan's unstable domestic political atmosphere, on 10 June 2009 Aso announced Japan's climate change policy for the mid-term target. According to this new policy, by 2020 Japan will reduce GHG emissions by 15 per cent from the 2005 level. This target is one per cent more 'ambitious' than the 14 per cent reduction, a strong candidate as a mid-term target among the six reduction targets deliberated in government decision-making procedures. The final governmental decision of a 15 per cent reduction target from the 2005 level fell far short of the IPCC reference point for a mid-term target: that is, between 25 and 40 per cent in GHG reductions from the 1990's levels referred to in the Bali Action Plan. Aso defended the figure, emphasizing that the Japanese plan excludes purchase of emissions credits from abroad and forest sequestration of carbon dioxide, both of which are included in the EU plans calling for a 20 per cent reduction below the 1990 levels.[19] The Japanese government also considered it crucial to ensure the United States participa-

17 Communication from the Commission, "Limiting Global Climate Change to 2 degree Celsius: The way ahead for 2020 and beyond" [COM (2007) 2 final]; at: <http://europa.eu/cgi-bin/etal.pl> (5 December 2007).

18 A Japanese governmental side event entitled "Road to Hokkaido Toyako Summit: Message from Japan as a G8 Host Country in 2008," held on 10 December 2007 at COP 13, was composed of panelists representing all energy-intensive industries endorsed by MOFA's Ambassador for Global Environmental Problems and MOE's Vice Minister of Global Environmental Affairs. The proposed policy outlined a bottom-up approach under a voluntary reduction scheme differing according to each industrial sector.

19 "Greenhouse Gas Reduction," in: *The Japan Times Weekly Online*, 20 June 2009; at: <http://www.japantimes.co. jp/weekly/ed/ed20090620a2.htm> (18 July 2009).

Table 88.1: Six options for Japan's mid-term target. **Source:** Naikaku kanbo (Cabinet Secretariat, 17 April 2009).

	Main Features	Reduction in 2020	
		Above/below 1990 (per cent)	Above/below 2005 (per cent)
Case 1	Spontaneous renewal of machinery/equipment based on existing technologies according to *Long-term Energy Demand and Supply Outlook* – Japan's reduction goal comparable to U.S. and EU goals (in terms of marginal abatement cost)	+4	-4
Case 2	Equivalent of Japan's share of 25 per cent reduction (below 1990) of developed countries' total average reduction rate allocated on a basis of equal marginal abatement cost	-5 ~ +1	-12 ~ -6
Case 3	Revision of *Long-term Energy Demand and Supply Outlook* (with voluntary maximum possible introduction of optimally energy-efficient new machinery and equipment)	-7	-14
Case 4	Equivalent of Japan's share of 25 per cent reduction (below 1990) of developed countries' total average reduction rate allocated on the basis of equal cost as a percentage of the GDP	-17 ~ -8	-23 ~-13
Case 5	Stepped-up or mandatory introduction of new machinery and equipment (with all new machinery and equipment introduced being optimally energy-efficient, and mandatory partial replacement of existing machinery and equipment)	-15	-22 ~ -21
Case 6	A single common reduction rate (25 per cent reduction below 1990 levels) for all developed countries with a mandatory replacement of all machinery and equipment with optimally energy-efficient new machinery and equipment	-25	-30

tion in mid- and long-term commitments to GHG emission reductions. The US government now refers to a 14 per cent reduction below the 2005 level, so, as maintained by environment minister Tetsuo Saito, the Japanese government coordinated with the U.S. in setting its own mid-term target.[20] In any case, if the Kyoto Protocol's 1990 benchmark is applied to Japan's 15 per cent mid-term reduction target from the 2005 level, it is equivalent to only 8 per cent reduction below the 1990 level.[21] Environmental NGOs, such as the *World Wildlife Fund* (WWF), immediately criticized the Japanese mid-term target, arguing that it "completely lacks ambition," declaring that Japan will stand in the way of global climate change negotiations in Copenhagen in December 2009.[22]

The domestic policy discourse has to be taken into account to understand the Japanese policy options, particularly the debates over the six options for Japan's mid-term targets. In February 2008 the "Informal Gathering for the Discussion on Issues of Global Warming" (Chikyu Ondanka Mondai Kondankai: hereafter Kondankai), which deals with various issues regarding a low-carbon society, was established under the aegis of the Cabinet Secretariat. The Kondankai established the Mid-term Target Committee in October 2008 to scrutinize various mid-term reduction targets and generate policy proposals for the government. The Mid-term Target Committee conducted scientific studies and analysis of policy options and proposed six options for Japan's mid-term targets on 14 April 2009 and the Kondankai collected public comments about these targets as of 16 May 2009. The six mid-term targets are: -4 per cent (case 1), -12 to -6 per cent (case 2), -14 per cent (case 3), -23~ -13 per cent (case 4), -22~-21 per cent (case 5) and -30 per cent (case 6) below the 2005 level (table 88.1).

As represented in the position announced by Nippon Keidanren (2009), the energy-intensive industries and their labour unions responded to the invitation to public comments by selecting option one (case 1), the

20 Eric Johnston, "Saito Defends Midterm Plan for Greenhouse Gas Reduction", in: *The Japan Times*, 25 June 2009.

21 "Greenhouse Gas Reduction", in: *The Japan Times Weekly*, 20 June 2009.

22 WWF, "Japan's Emission Reduction Target Makes Global Agreement Harder", 11 June 2009; at: <http://www.ecoseed.org/index.php/general-news/features/in-depth/2715> (18 July 2009).

option that was chosen by 74.4 per cent of about 10,000 public comments. The main reasons for this choice include the maintenance of international competitiveness, setting up fair and equitable mid-term targets comparable to those of the EU, the U.S., and others, and the need to scrutinize the feasibility of the mid-term targets so as not to place a heavy burden on the Japanese economy (Naikaku kanbo 24 May 2009a: 2–3). Needless to say, environmental NGOs, representing about 13 per cent of the respondents, favoured option six (case 6). These respondents considered substantial reductions as a scientific imperative. They also pointed out that ambitious targets are necessary for Japan to take a leadership role in the promotion of developing countries' participation in GHG emissions reductions so as not to leave an excessive burden to future generations (Naikaku kanbo 24 May 2009a: 2–3).

Besides soliciting public comments, the Kondankai also conducted a public opinion poll on mid-term targets.[23] 15.3 per cent of the respondents favoured -4 per cent below the 2005 level (case 1), and 4.9 per cent chose -30 per cent (case 6). The most appealing option was the 14 per cent reduction option (case 3) chosen by 45.4 per cent of the respondents. It should be mentioned that 13.5 per cent opted for -21 per cent. The government decision on the mid-term target mentioned above thus reflected the result of this public opinion poll.

88.7 Conclusion

Recent international negotiations over mid- and long-term reduction targets have been bogged down over the distribution of burden sharing – over who's use is to be reduced by how much. Individual country concerns for cost-benefit calculations began to dominate the domestic and international policy discourses. In Japan the argument that marginal abatement costs would be relatively high compared with those in the EU and the United States has dictated the climate change policy discourse. The lack of strong and stable political leadership has allowed the relatively well-organized economic interests and the economy ministry to solidify their policy coalition. Thus, despite its natural position as a vital force in climate change negotiations, Japan has relinquished both its leadership and its initiative. Instead, it has withdrawn into the role of an 'intermediate' and 'supportive' state.

Japan's political landscape changed dramatically with the landslide victory of the DPJ in the general elections of 30 August 2009, resulting in forming the ruling coalition government with the *Socialist Democratic Party of Japan* (SDPJ) and Kokumin Shinto (People's New Party).[24] As is argued in this chapter, strong political leadership is the key for Japan to advocate an ambitious mid-term GHG emission reduction target. Prime Minister Hatoyama refers to "the introduction of a domestic emission trading mechanism, a feed-in tariff as well as a consideration of a global warming tax" in Japan's statement at the UN Climate Change Summit in September 2009.[25] However, there are already strong voices of dissent rising within Japan against Hatoyama's DPJ 25 per cent reduction target. One such voice attacks the premise of Japan's DPJ leadership in promoting international cooperation by proclaiming an ambitious mid-term target since developing countries are demanding that developed countries assume a 40 per cent mid-term reduction and that the prospect of the passage of a similar bill to the Waxman-Markey bill at the US Senate on climate change is not bright.[26]

The Hatoyama administration policy discourse may introduce different domestic and international policy priorities. What kinds of policy networks will emerge with a new administration among the various bureaucratic branches and business and industry associations? How open will the new government be to the general public? How attentive will it be to the scientific community and environmental NGOs? These questions are beyond the scope of this chapter, but it should at least be noted that the main slogan of the DPJ is to break down the entrenched structures of vested interests that plague Japanese politics.

23 This survey was conducted from 5 May to 17 May and obtained 1,222 valid answers out of 4,000 people above 20 years old selected according to simple random sampling.

24 Although the DPJ obtained 308 electoral seats out of 480 at the Lower House, it has not held the majority at the Upper House, where the DPJ needs to maintain a policy alliance relationship with the SDPJ and Kokumin Shinto.

25 Minister of Foreign Affairs of Japan (MOFA), "Statement by Prime Minister Yukio Hatoyama at the United Nations Summit on Climate Change", New York, 22 September 2009; at: <http://www.mofa.go.jp/policy/un/assembly2009/pm0922.html> (23 September 2009).

26 Akihiro Sawa, "The Fragility of Hatoyama's 25% Reduction Initiative," circulated through the "Climate Change Info Mailing List"; at: <http://www.21ppi.org/english/proposals.html> (24 September 2009).

89 Implications of Equity Considerations and Emission Reduction Targets: Lessons from the Case of Japan's Mid-Term Target

Norichika Kanie, Hiromi Nishimoto, Yasuaki Hijioka and Yasuko Kameyama

89.1 Introduction[1]

Unlike in the Kyoto Protocol, emission reduction targets for individual countries in the 'Copenhagen Accord' contain a list of pledges without international negotiation. As a result, whether or not international negotiations on QERLOs (*Quantified emission reduction and limitation objectives*) can actually be adopted in a post-2012 climate change governance architecture remains uncertain. However, after the COP15 of the *United Nations Framework Convention on Climate Change* (UNFCCC) in Copenhagen, it is clear that several countries are concerned about a situation where only they would have to take on the 'extra burden' of reducing GHG emissions, implying additional costs compared with their economic competitors. The business and industrial sectors are particularly concerned about an agreement with unbalanced QERLOs between and among developed countries and emerging economies. Thus, many pledges on emission reduction targets under the 'Copenhagen Accord' were made under the condition that they are only bound to their commitment if others adopt comparable (or equal) emission reduction obligations.

A key question is what a comparable effort means? In other words, what could be the criteria for measuring equal emission reduction targets? Given the current economical, social, and political inequity in the world as well as different interests of nation states, such an issue may never result in a consensus as a result of international negotiations. But it would still be useful to learn that there are different ways of defining 'equity', and that implications of the difference may sometimes lead to a larger difference in concrete target numbers than existing studies have argued. Therefore, policy analyses should pay more careful attention to the concepts and processes of numerical calculation of equity and fairness, as spaces for value judgements exist in there but tend to be overlooked in the science policy interface.

This chapter addresses the Japanese case of mid-term target setting to show how the calculation results differ if alternative equity criteria and formula are used (89.2, 89.3). It then identifies problems associated with the allocation issue and draws some lessons for international negotiations on QERLOs for the post-Copenhagen period (89.4).

89.2 Approaches to Allocate GHG Emission Reductions

Before reviewing the Japanese case an overview on approaches to allocate GHG emission reductions is appropriate. The allocation of GHG emission reductions among countries was discussed in the negotiations prior to and after the Kyoto conference (1997). It is also referred to as the emission (reduction) differentiation or the 'burden-sharing' issue. The reference to "common but differentiated responsibility" has served as the principle for the differentiation in the *United Nations Framework Convention on Climate Change* (UNFCCC), but translating this principle into concrete national emission reduction targets by numbers has been a challenge, both methodologically and politically.

Conceptual allocation principles for GHG emission reductions could be categorized using three

1 The authors are grateful for the funding provided by the Environment Research and Technology Development Fund (S-6) of the Ministry of Environment, Japan, and the Mitsui & Co., Ltd. Environmental Fund. Norichika Kanie is also grateful to Grant-in-Aid for Scientific Research (B) for the support of his research. An earlier version of this chapter is published in *International Environmental Agreements: Politics, Law and Economics* (Springer). Key ideas and concepts could be developed further in this chapter taking the specific recommendations of three anonymous reviewers into account.

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broad criteria: a) the combination approach; b) responsibility, capability, or ability; and c) efficiency or the potential to mitigate.[2] The responsibility criteria focus on the extent to which each country is responsible for climate change. The Brazilian proposal, or the historical responsibility approach, allocates national emission limitation objectives by focusing on each country's historical responsibility for the global temperature increase (La Rovere/de Macedo/ Baumert 2002).[3] It is also based on the 'polluter-pays principle'.

Although the original proposal was first presented during the Kyoto negotiations – but was not adopted to decide the final allocation formula due to its complex methodology for determining the responsibility for each developed country – the main element survived, and its scientific investigation continued within the *Subsidiary Body for Scientific and Technological Advice* (SBSTA).[4]

Under this calculation, countries that industrialized earlier, such as the United Kingdom, would face higher emission reduction allocation targets than others, such as rival developed countries that developed later, e.g. the United States and Japan. But there has always been a methodological question when to start the calculation, how to mirror the carbon cycle in the model, including land-use changes, the reliability of data for the past 100 years, as well as the question of whether the emitters may be accused when they were unconscious about the consequences of their actions. In the negotiation process, Brazil and China still consider the historical responsibility as the criteria for emission reduction allocation targets after the year 2012.

Another approach focuses on the per capita emissions. Although currently the figures on emissions per capita differ between developed and developing countries, this approach dictates that they should be equalized eventually. This approach stems from the idea that the Earth's atmosphere is a global commons, and all humans are equally entitled to use it. An approach called 'contraction and convergence' (C&C) represents this approach, although some variations exist (Aslam 2002; WBGU 2003; den Elzen/Meinshausen 2006). In this approach, countries commit to converge their per capita emissions in a certain year, such as 2050 or 2100, towards which the global emission profile contracts. Future projections of population and emissions depend on the path drawn, and therefore any calculation inevitably contains uncertainty, but these data are rather popularly used and well developed compared to other data. In the negotiations, the majority of countries from the 'G77+China', but e.g. also Switzerland, support C&C as an allocation criterion. There are still other examples of allocation approaches focusing on responsibility, such as absolute emissions or their trends.[5]

The capability, or ability, to pay is an allocation approach focusing on the economic aspect of climate change. The absolute amount of the *gross domestic product* (GDP) could be a criterion under this approach. Some others focus on per capita GDP. Although positions are not yet finalized, New Zealand and Canada argue that costs relative to GDP could possibly be an allocation criterion, while Canada also points to loss of effectiveness (income decline). Still another calculation focuses on the *human development index* (HDI) as a source of presenting the ability to pay, or using a combination of these criteria. Jacoby, Schmalensee and Wing (1999) applied the ability approach to argue that the parties to the UNFCC only enter the emission reduction phase once they have exceeded a certain level of per capita welfare, called the welfare 'trigger'. Otherwise, they would follow their reference emissions (unconstrained no-policy emissions).

The third criterion focuses on the efficiency of actions to reduce emissions in terms of economic activity. This can also be called the potential to mitigate.[6] Approaches that stem from this criterion focus on the emission reduction potential. A typical example of this approach is a Japanese proposal to equalize the *marginal abatement costs* (MAC) of emissions among industrialized countries, thereby keeping the allocation fair in terms of economic competitiveness across countries (Hanaoka/Hibino/Miyashita/Akashi/ Mat-

2 See Ott, Winkler, Brouns, Kartha, Mace, Huq, Kameyama, Sari, Pan, Sokona, Bhandari, Kassenberg, La Rovere and Rahman (2004); den Elzen, Höhne, Brouns, Winkler and Ott (2007).

3 The original Brazilian Proposal during the Kyoto negotiations included other elements such as the Clean Development Fund (CDF), but we focus here on the element of the differentiation aspect of the proposal. For more detailed account of the Brazilian Proposal, see La Rovere, de Macedo and Baumert (2002).

4 See at: <http://www.match-info.net/>.

5 Ott, Winkler, Brouns, Kartha, Mace, Huq, Kameyama, Sari, Pan, Sokona, Bhandari, Kassenberg, La Rovere and Rahman (2004).

6 Ott, Winkler, Brouns, Kartha, Mace, Huq, Kameyama, Sari, Pan, Sokona, Bhandari, Kassenberg, La Rovere and Rahman (2004).

suoka/Fujino/Kainuma 2006; Akimoto/Sano 2008). The calculation of MAC requires careful modelling, and currently it is difficult to calculate the domestic emissions of all countries for the long term, such as up to 2050. Therefore, this approach can only be used for medium-term emission allocations, and not for long-term target-setting for individual countries. Another way of translating the efficiency of emission reductions into a calculation formula uses the emissions per GDP. Although this does not guarantee to limit GHG emissions, it secures economic activity while paying attention to GHG emissions. The same could be applied to emissions per unit of production.

As these three criteria do not represent a comprehensive translation of the concept into a quantified calculation, and a conceptual principle such as 'common but differentiated responsibility' would entail a few different aspects, combinations of approaches have also been proposed, such as the 'Triptych approach'. It was first presented in early 1997 at a workshop held in Zeist, The Netherlands, prior to the Kyoto Conference, and was used for internal European Union emission reduction allocations for the Kyoto target. It was a combination of an EU-wide abatement target and a proposal for an internal emission allocation mechanism.

Its main characteristic was its sectoral approach, but it used different criteria for each sector. Each member state was divided into three sectors: the domestic sector, the energy-intensive export sector, and the electricity generation sector. An emission reduction target for each country was then set by adding up the potential for emission reduction in each sector. For example, a per capita convergence approach was applied to the domestic sector, while an efficiency criterion was applied to the energy-intensive sector, and a tailor-made approach considering national circumstances was applied to the electricity sector (Gupta/Jepma/Blok 1998; Phylipsen/Bode/Blok/Merkus/Metz 1997). It was further developed after Kyoto, and version seven of this approach now expands to a global scope and more than three sectors (den Elzen/Höhne/Moltmann 2008).

A similar combination approach includes multi-sector convergence. This multi-stage approach is another kind, whereby countries are divided into four or five categories depending on their level of economic development, and any emission reduction commitment would be enhanced once across the threshold. The commitments vary from business-as-usual, to emissions per GDP, to per capita emissions convergence.[7]

An interesting attempt was made by den Elzen, Höhne, Brouns, Winkler and Ott (2007), in which explicit attempts were made to translate the qualitative approach of beyond-Kyoto architecture into a quantitative multi-stage approach. The three criteria described earlier were used here. Cumulative per capita emissions of fossil carbon dioxide (CO_2) over the period from 1990 to 2000 were used as a proxy for responsibility criteria in the original approach, which is then translated into cumulative energy CO_2 emissions per capita from 1990 onwards divided by the number of years summed up. In order to secure an equal weighting potential to mitigate emissions, a weighting of one third was used. The *human development index* (HDI) and the GDP were used as capacity indicators, which were then translated for calculations into GDP in purchase-power parities per capita with a weighting of one-third. Finally, the potential to mitigate was expressed in the original proposal as the intensity of emissions and emissions per capita, which was translated into energy GHG emissions per GDP and all GHG emissions per capita, both with a weighting of one-sixth (den Elzen/Höhne/ Brouns/Winkler/Ott 2007).

On the practical side, the *European Community* (EC) communication addressed to the Copenhagen negotiations of 28 January 2009, also applies a multi-criteria combination approach. It includes per capita GDP as an ability criterion, per GDP emissions as an efficiency criterion, the emission trend between 1990 and 2005 as a responsibility criterion, and the population trend between 1990 and 2005.

Using different criteria results in different emission reduction allocations for individual countries. The commonly cited figure of a 25 to 40 per cent GHG emission reduction for developed countries to meet the 450 *parts per million* (ppm) CO_2-equivalent atmospheric GHG concentration stabilization level, which was presented in box 13.7 of the report of Working Group Three in the IPCC's Fourth Assessment Report, is also based on a review of the results of calculations made by allocation schemes applying these different criteria (Metz/Davidson/Bosch/Dave/Meyer 2007; den Elzen/Höhne 2008). The range of a 25 to

7 See Ott, Winkler, Brouns, Kartha, Mace, Huq, Kameyama, Sari, Pan, Sokona, Bhandari, Kassenberg, La Rovere and Rahman (2004); Höhne, Galleguillos, Blok, Harnisch and Phylipsen (2003); Höhne, Phylipsen, Ullrich and Blok (2005); Höhne (2006); Michaelowa, Butzengeiger and Jung 2005; den Elzen and Meinshausen (2006).

Table 89.1: Climate change targets for an international agreement and for Japan as of March 2010. **Source:** Compiled by the authors.

	International agreement	Japan
Ultimate goal	2 Copenhagen Accord (2009) and G8 (2009)	
Long-term global	Global 50% reduction by 2050 (G8:2007/2008)	2007 May: PM Abe (LDP) – 50% by 2050
Long-term national (AI)		2008 January: PM Fukuda (LDP) 60-80% reduction – 80% by 2050
Mid-term global (AI)	[25-40% AI / Substantial deviation from BAU NAI mentioned in LCA-KP]	
Mid-term National	Copenhagen Accord Pledge	2009 Sep: PM Hatoyama (DP) – 25% in 2020 from 1990 level (2009 June PM Aso (LDP): -15% from 2005 level (-8% from 1990)
Short-term global	KP 5.2% for AI	KP 5.2% for AI
Short-term national	KP binding	KP -6% from 1990 level

40 per cent reduction relies partly on the use of different allocation formulas. Those used for its background papers that produced this figure are a) C&C, *common-but-differentiated convergence* (CDC),[8] b) the multi-stage Triptych approach, c) equal improvement of emissions per GDP, and d) minor variations of these. However, they also argue that the allocation formula, which comes from different conceptual assumptions, is less important than are model assumptions and emissions stabilization levels and paths in determining QERLOs for a particular year. These authors challenge this argument by introducing the case of Japan, and they argue that allocation concepts and forms also matter to a great deal.

89.3 Allocating GHG Emissions: The Case of Setting Japan's Mid-Term Targets

Different allocation principles produce different consequences for each country's emission allocations; sometimes the large differences also have political and economic consequences. Therefore, a careful and discreet consideration is necessary when a principle is translated into a calculation formula, because they do not necessarily correspond one by one, and there remains room for different interpretations. Although an existing study argues that what matters more is the global emissions reduction path rather than allocation schemes (Criqui/Kitous/Berk/den Elzen/Eickhout/Lucas/van Vuuren/Kouvaritakis/Vanregemorter 2003), allocation schemes do matter for some cases, and such a difference is more than marginal in the contest of the international negotiation process, because countries make equity arguments in international negotiations based on the allocation criteria on which their arguments rely. In this section the introduction of Japan's mid-term target-setting process in spring of 2009 is discussed.[9]

In autumn 2008 the Cabinet Office of the Japanese government launched a process to review mid-term targets for Japan for 2020. In this process approaches to equitable GHG emission reduction allocations among countries were referred to, as part of preparations for the upcoming Copenhagen negotiations. As is shown in table 89.1, long-term, mid-term, and short-term targets for GHG emission reduction had gradually been set at various levels, but Japan was missing a mid-term target, which had been considered as one of the key issues to be discussed in Copenhagen.

The mid-term target committee meetings were held seven times between 25 November 2009 and 14 April 2009, and detailed calculation was tasked out in a sub-committee.[10] The then-ruling government led by the *Liberal Democratic Party* (LDP) put the efficiency

8 CDC is an application of C&C in which developing countries can increase emissions up to the level of average global emissions, and then reduce emissions to the convergence level taking the same period as the developed countries.

9 In August 2009 there was a change in Japanese government. Consequently, the medium-term target was changed to a 25 per cent reduction of GHGs in 2020 from 1990 levels. Note that this case study deals mainly with the target-setting of the former administration that set a target of an 8 per cent reduction in 2020 from 1990 levels (15 per cent from 2005 levels).

criterion at the heart of the allocation principle. The equal mitigation potential was evaluated by means of *marginal abatement cost* (MAC), but equal per GDP abatement cost was also calculated in addition as a 'side story' to the main calculation. Calculations were made by a few research institutes that are usually working with the ministry of economy, trade and industry (METI), and the ministry of environment. As the meetings carried on, it was clarified that differences in data and assumptions set by different institutes led to different results. They tried to consolidate them, where relevant. However, some of the gaps were originated from different requirements and supports made by different ministries and some of the gaps remained in existence, although they were made clear as much as possible. The result of the calculation is shown in table 89.2. These are calculated by emulating the domestic emission reduction potential, provided that the same amount of money would be spent on mitigation actions in each country. In other words, they disregard the global GHG emission reduction path for the longer term, and just look at a point in time, in this case, for 2020. In this sense, this approach is not one of resource allocation, but a bottom-up calculation of an economically feasible action by each country. The resulting numbers were slightly different from a research institution to the other, but it looked pretty much the same as is shown in table 89.2.

Table 89.2: GHG emission reductions by countries and regions by 2020. **Source:** The result of the analysis was made based on the AIM/Enduse [Global] Model; at: <http:// www.kantei.go.jp/jp/singi/tikyuu/kaisai/dai07tyuuki/07gijisidai.html> (14 April 2009).

	Japan	USA	EU25	Russia	Annex I
Equalize MAC	−5%	−24%	−27%	−32%	−25%
Equalize cost per GDP	−17%	−18%	−31%	−31%	−25%

The authors believe that taking such an approach alone is problematic taking into consideration the objective of UNFCCC as set out in its Article 2, because the Earth's climate is considered a global commons and, the allocation of benefits, responsibilities, and involuntary risks between countries and actors is required for proper management. The more general, interdisciplinary notion of allocation advanced here refers to the allocation of resources and rights among individuals and groups within and between societies, and such a concept is often opposed to conventional economic theory, where allocation is broadly understood as an allocation of input factors for production processes.

We therefore re-evaluate the allocation used for the Japanese government's calculation, using other criteria on the basis of the different idea of allocation. The assumption for the Japanese government study was a 25 per cent emission reduction for Annex I (developed) countries, so our calculation also used this condition. Three allocation formulas were employed, which were also applied in some of the background papers used to create the information in box 13.7 in the IPCC's Fourth Assessment Report. For the responsibility criterion, the authors used the C&C formula as a proxy to this principle, with converging years of 2050, 2075, and 2100.[11]

In addition, the authors employed another formula on efficiency criteria. As opposed to MAC, we used an equal improvement of the emissions per GDP throughout the world. In other words, an equal emission intensity improvement rate is applied in this calculation. In all cases, they estimated a condition of halving global GHG emissions by 2050 from the 1990 level, as this is Japan's and the G8 target, which also includes Japan, and the Kyoto Protocol's reference year emissions were applied for these calculations. All calculation results are shown relative to emission reductions against the 1990 levels.[12] The result of the calculation is shown in table 89.2.

10 See at: <http://www.env.go.jp/earth/ondanka/mid-target/exam_prog.html>.

11 *Contraction and Convergence* (C&C) is explained as follows. "Contraction refers to the 'full-term event' in which the future global total of *greenhouse gas* [GHG] emissions from human sources is shrunk over time in a measured way to near zero-emissions within a specified time-frame. The example shows 90 per cent by 2100. Calculating future emissions contraction on the basis of concentrations and sink evidence is a non-random way of responding to the objective of the UNFCCC. Convergence refers to the full international sharing of the emissions contraction-event, where the 'emissions-entitlements' for all countries result from them converging on the declining global per capita average of emissions arising under the contraction rate chosen. Converging at a rate to be agreed – the example shows 2030 – is a non-random way of responding to the principle of 'equity' in the UNFCCC, whilst still meeting its objective." Source at: <http://www.gci.org.uk/>.

Table 89.3: Emission allocations by 2020 based on different formulas. **Source:** The authors.

		Japan	USA	EU25	Russia	AnnexI	Non AnnexI	World
C&C (year of convergence)	2050	–16%	–13%	–26%	–46%	–25%	74%	14%
	2075	–20%	–9%	–28%	–48%	–25%	74%	14%
	2100	–21%	–8%	–28%	–49%	–25%	74%	14%
Equal emissions improvement per GDP		–30%	–19%	–33%	–21%	–25%	74%	14%

89.4 Discussion

The above exercise shows that even if the emission reduction rate for developed countries (Annex I) as a group is the same 25 per cent from the 1990 level, the allocation principle and formula change the required amount of emission reductions for individual countries within Annex I countries. For example, Japan's reduction by efficiency criteria, using MAC calculation, is –5 per cent, whereas C&C with converging year 2010 shows –16 per cent in the same year. Similarly, the reduction for the US is –24 per cent in the former case, but it is –13 per cent in the latter.

The cause of such a rather large difference has three levels. One level is a difference in the allocation principle, whether it takes responsibility, capability, or efficiency. The second level is a difference in the allocation formula under the same allocation principle, and the other is a different calculation criteria used under the same allocation formula, such as the difference in the year of convergence.

The gap between the conceptual principle and the quantified allocation formula used to materialize the principle, in terms of the numbers, exists partly because most if not all of the principles employed in the international regimes are established as a result of international negotiations in the form of a consensus document. In a sense, this blurred nature of the overarching principle is the very reason why such principles were agreed upon by a consensus of more than 190 countries, but it leaves space for different interpretations, and triggers the use of different allocation formulas, as well. This is also a space where value judgments may intervene, and thus a space where political and policy interpretations may come into place.

In the calculation used to produce Japan's mid-term target, there are differences in the reduction targets derived from calculating *marginal abatement cost* (MAC) and calculating *equal emissions improvement* (EEI) per GDP, even though both are considered to represent the efficiency criterion, or the potential to mitigate. In particular, Japan's target for MAC is -5 per cent, while it is –30 per cent for EEI. For the USA and EU, –24 per cent and –27 per cent for MAC respectively, whereas –19 per cent and –33 per cent for EEI. This means that the allocation formula, or the way the allocation principle is translated into a formula, matters greatly, as does the allocation principle.

In the case of Japan's mid-term target setting process, the government commissioned the Committee to apply specific calculation methods that would represent the most favourable results for Japan compared to its economic rivals. The cabinet, then, led by LDP, chose the MAC calculation formula as the main method of allocation calculation without a wide and deep discussion prior to its adoption. When the LDP was defeated in August 2009 in the general elections the *Democratic Party of Japan* (DPJ) took over. Soon after taking office, in September 2009 the new Prime Minister Hatoyama announced as the new mid-term target for Japan a 25 per cent reduction in 2020 based on the 1990 level, as the DPJ had promised during the election campaign, which is far more ambitious than the prior one. Since the announcement of the new target, it seems that the new government has not followed the same calculation formula as the former cabinet to legitimate the new target. Even when verifying the domestic feasibility of the target, they asked to recalculate the former ones under their guidance.

This process shows that there is a space for political interpretation of the equity and fairness calculation. Without a political interpretation, there is space

12 As total global emissions in 2020 are estimated to be 14% above 1990 levels, this falls into the range of scenarios below 450 ppm of CO_2-equivalent in Box 13.7 of the IPCC AR4. This allocation can also be considered as being relevant for the same scenario category (see den Elzen, Höhne and Moltmann 2008).

for an exercise requiring other scientific disciplines, such as ethics and qualitative research. The calculation itself could be a rigorous and science-based one, but it is also a task of science to reveal the extent to which science can deal with, and to which it can not. This exercise in Japan contributed to clarify this point.

In addition, MAC deals only with allocation among Annex I countries, partly due to limited data availability. In contrast, although total Annex I reductions are the same 25 per cent as with the MAC case, EEI allows calculations to be done for non-Annex I countries. The implication of using this allocation calculation scheme is that it requires more emission reductions for many developing countries whose emission intensity is currently very low. At this point, one may wonder about the feasibility of applying solely efficiency criteria in allocation of global common goods which principle is set under the norm of "common but differentiated responsibility" (Art 2,x of the UNFCCC). This is the point where a shift is needed from quantitative work to qualitative considerations.

Another difference exists within the same allocation formula, but it is still possible to use different criteria in calculating things such as benchmarks or baselines that may end up with varying results. Our calculation for C&C shows that, due to different future predictions, the converging year to realize equal per capita emissions between 2050, 2075, or 2100 resulted in different targets for Annex I countries in 2020, as presented in table 89.3. Different converging years imply a different reduction path for each country. This difference also has implications for the allocation principle. The question is, which year should we realize equalized rights to use the Earth's atmosphere, given the current unequal allocation? Should it be 2050, 2075, or 2100? As environmental governance is also a matter of equity between the current and future generations, allocations in the current and near-term has also implications for the burdens of future generations. Such a notion may not be considered if only the efficiency criterion was used.

89.5 Conclusion

The case study of allocation schemes focusing on Japanese mid-term targets has shown that different equity criteria and different calculation formula would lead to largely different QERLOs for individual countries. This is true if different principles are employed for calculations, but is also true even if they are calculated with the same principle, but different formula for calculation were used. Thus, the model assumptions and emissions stabilization levels and paths are important factors in determining QERLOs, as existing studies argue, but the authors would like to raise more attention to implications of different allocation principles and formulas.

Importantly, this is a space for political intervention. In the end it is up to policy-makers, and not to scientists, to determine which allocation formula would be useful for deciding on the political target. However, more attention should be paid to a space where value judgements can intervene even though it looks like rigorous science at a first glance. Such a problem can be solved by employing other study discipline(s), but often collaboration at this level is neglected. Sometimes differences in resulting numbers are large enough to make different perceptions regarding implications of what consists of equal and comparable efforts. The issue is particularly important in the context of post-Copenhagen international negotiations, as Copenhagen did not deal with the allocation of emissions. Should there be any step forward to go beyond pledges of targets as set out in the Copenhagen Accord, the allocation issue may reappear. Then, national interests will enter into this issue, and therefore a careful calculation, or a simpler calculation formula, would be required.

Even if it is impossible to reach the consensus on equity criteria for QERLOs calculations by international negotiations, it is still important for science to present comparability in terms of various criteria. In the end it is the role of politics that determines national emission reduction targets either at international or national levels, but presenting a menu to politics is included in roles of policy-oriented science. The allocation of emission rights in climate change governance cannot be fully appraised without employing integrated interdisciplinary approaches. In order to identify a long-term global emissions path to reach certain stabilization levels, such as 450 or 500 parts per million of CO_2 equivalent, or placing an upper limit on temperature increase, such as a two-degrees Celsius above pre-industrial levels, a dynamic optimization model may be required.[13] Only then can global differentiation schemes be calculated. Such schemes involve the consideration of both a long-term and short-term institutional framework on climate change, as well as social and political feasibility, data availabil-

13 See e.g., Eickhout, den Elzen and van Vuuren (2003); Höhne (2006); Hijioka, Masui, Takahashi, Matsuoka and Harasawa (2006).

ity, and considerations of ethical aspects (Kanie 2008). One of the most important and difficult challenges here is the way to translate equity considerations into numerical calculations. Gaps exist between institutional architectures, allocation principles, and allocation formulas. A challenge for future research is to fill in these gaps.

Because of the solid interaction between science and policy in contemporary environmental governance research, limits to data availability and manoeuvrability constrain the governance architecture in return. As den Elzen stated, "the current methodology does not quantify the effect of qualitative commitments such as obligatory *sustainable development policies and measures* (SD-PAMs), sectoral CDMs, and non-binding targets of the proposal, as this requires more detailed, disaggregated, sectoral energy modelling" (Den Elzen/Michel/Höhne/Brouns/Winkler/Ott 2007: 188). The same is applied to more diffused governance architectures. A combination of national targets and private agreements remains an option for a possible future climate governance architecture.[14]

In fact, it is argued that the best institutional design for managing complex problems such as climate change is a loose, decentralized, and dense network of institutions and actors that are able to relay information and provide sufficient redundancies in the performance of functions, so that the inactivity of one institution does not jeopardize the entire system. Emerging environmental governance agencies beyond the state seem to confirm this observation. The experience of the Copenhagen conference has also indicated that an institutional arrangement beyond nation states may be an option for the post-2012 period. Sector-based cross national arrangements, possibly with partnerships with the multilateral process, appear to be an option in this regard.

Should these be effectively dealt with in an allocation methodology, then the numerical impact of the institutional architecture, including those qualitative mechanisms, can be presented to negotiators and policy-makers, who tend to prefer a strong numerical backbone before introducing new mechanisms. The final deal may be made politically, but numbers interacting with norms, principles, and narratives make up the foundations of the architectural design.

14 Aggarwal (1998); Ostrom (2001); Ansell and Weber (1999): Haas, Kanie and Murphy (2004); Kanie (2008).

Part VIII A Technical Tool: Remote Sensing, Vulnerability Mapping and Indicators of Environmental Security Challenges and Risks

Chapter 90 **Land-use and Flood Risk Changes in Coastal Areas of South-eastern Spain**
Juan M. Quiñonero-Rubio, Francisco López-Bermúdez, Francisco Alonso-Sarría and Francisco J. Gomariz-Castillo

Chapter 91 **Monitoring Conflict Risk: The Contribution of Globally Used Indicator Systems**
Jochen Jesinghaus

90 Land-use and Flood Risk Changes in Coastal Areas of South-eastern Spain

Juan M. Quiñonero-Rubio, Francisco López-Bermúdez, Francisco Alonso-Sarría and Francisco J. Gomariz-Castillo

90.1 Introduction

Flash floods are a major natural hazard in the south-east of Spain. A semi-arid climate along with severe droughts with extreme rainfall events are the cause for a scarce vegetation cover. For geological reasons, the steep slopes near the sea have generated this situation (Romero Díaz/Maurandi Guirado 2000; Camarasa Belmonte 2002). Human occupation in this area was scarce and the land use limited to some dry land cultivations. But during the last 25 years, two new trends have increased the human risk from natural flood hazards.

- *Firstly* the availability of groundwater for irrigation initiated an explosive increase of newly cultivated and irrigated areas, thus reducing the soil infiltration capacity;
- *Secondly* the tourist and property boom have increased the residential occupation near the sea in many '*ramblas*' (ephemeral channels in Spanish) (Torres Alfonsea 2002).

Land use describes the activities carried out by humans in the landscape (Koomen/ Stillwell/Bakema/ Scholten 2007). The changes of land use have an impact on economic, social and cultural activities, as well as those related to the safety of the population, since natural processes govern any human activity, although it is well known that current generations are the first that can degrade the environment and ecosystems where humankind has survived since its origin.

These anthropogenic changes affect various fields of the Earth and social sciences, such as climate change, desertification, alteration of the hydrological cycle, diversion of sea currents in areas close to the shore by the construction of ports, change and degradation of plant cover, degradation of soil fertility by overexploitation, change of the generation of runoff flows, soil erosion (López Bermúdez 1996), and so on.

The response of the water flow to the geomorphologic characteristics of a basin is obvious, but land-use may represent an important factor in the dynamics of surface water, since discharge flow varies between land-use types. In addition, some uses are associated with an increased risk to the public.

Population growth contributes to a process of intensification and expansion of human activities and therefore of land occupation. This process has produced changes in the Earth's surface that have in many cases profoundly changed land use (Barbera/ López Bermúdez/Romero Díaz 1997; Goldewijk/Ramankutty 2004). This chapter studies these changes in the dynamics of surface runoff due to changes in land use in recent decades.

Two documents on management of flood risks must be taken into account at the national and European level:

- The Basic Guidelines for Planning of Civil Defence against Flood Risk (1995);
- Directive of the European Commission and the Council on the assessment and management of flood risks (2007).

Both documents, which entered into force in 1995 and 2007, aim at the prevention and management of flood risks, for which they offer procedures for action. They also refer to the division of responsibilities among different territorial entities to safeguard the health and welfare of the population and prevent damage to property. Territorial studies are a common tool and in Spain they are assigned to the autonomous regions, including weather forecasting, hydrological studies, land use, and geological and geomorphologic features of each territorial entity.

Since these tasks aim at the management of flooding events, one of their premises has been the crea-

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Figure 90.1: Rambla of La Azohía. Example of the geomorphology of streams. **Source:** photo by Juan M. Quiñonero-Rubio

Figure 90.2: Rambla de las Moreras. Water outlet and land-use changes between 1956 (left) and 2003 (right). **Source:** Regional Ministry of Spatial Planning.

tion of a database identifying where the problem spots are and providing a classification of areas in terms of levels of risk related to different return periods of flows, as well as mapping the geological and associated geomorphologic risks at varying scales, but always adapted to the magnitude of the phenomenon and as accurately as possible (Alonso 2002). In this study land use is taken into account, but land-use change and its effects on hydrological processes are not addressed. These studies are also related to the directives and guidelines for spatial planning with a purely legal management, to obtain economic returns, and often they are not very concerned about the environment and are inefficient regarding population safety (CARM 2007).

This chapter goes a step further and establishes a timescale for hydrological studies, determining how changes in land use during several decades may have impacts on the flow of several non-gauged streams *(ramblas)* located near the southern littoral of the Region of Murcia in the south-east of Spain. It is necessary to use hydrological models that adapt well to

the area. New information technologies are indispensable to obtain high quality precise results, thus *Geographic Information Systems* (GIS) as well as satellite and aerial images were used.

90.2 Spain and Flood Risk in the Region of Murcia

The database created by the CRED (*Centre for Research on Epidemiology Disasters*) EMDAT (*International Emergency Disaster Database*) shows that among the ten major natural disasters in Spain, seven were floods. The economic damages and people affected from floods are behind droughts. There were 21 floods from 1953 to 2007 with 742,300 affected people where 1,279 people died; followed by wind storms with 15 events with 60,412 affected people and 132 dead people.

Research by the CCS (*Consortium of Insurance Compensation*) and the IGME (*Geological and Mining Institute of Spain*) (2004) analysed the consequences of the risks and losses associated with disasters derived from earthquakes and floods in Spain. This research offers much information on the value of the loss, amounting to 0.1 per cent of the national GDP for the period 1987–2001 (with 2002 as the year of reference), whereof floods represent 98 per cent. The most affected provinces were Valencia, Málaga, Barcelona, Guipúzcoa, Alicante, and Huelva. Estimates for the next 30 years project a reduction of losses from floods by 7 per cent.

In the Region of Murcia historical records (figures 90.3, 90.4) exist on large and persistent river floods that affected different spots and were caused either by the Segura River or one of its tributaries (e.g. the River Guadalentín, currently regulated) or were caused by *ramblas* that pose complex challenges for risk management and prevention. Thus, the annual distribution of these phenomena can be assessed, most of which occurred in September and October (figure 90.5; Romero Díaz/Maurandi Guirado 2000).

The shock caused by natural disasters led to initiatives for action against river floods. The local bodies opted for the principle of prevention relying almost exclusively on the massive execution of civil works (river bed course rectification, retaining of dams and channels). These works are carried out in the main river beds and require on some occasions monumental works to regulate the river beds to reduce the risk

Figure 90.3: Historical floods of the Segura Basin. **Source:** Regional Atlas of Murcia (2008).

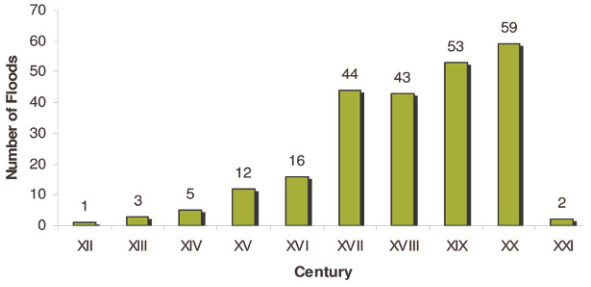


Figure 90.4: Floods of the Segura River in the XX Century **Source:** Regional Atlas of Murcia (2008).

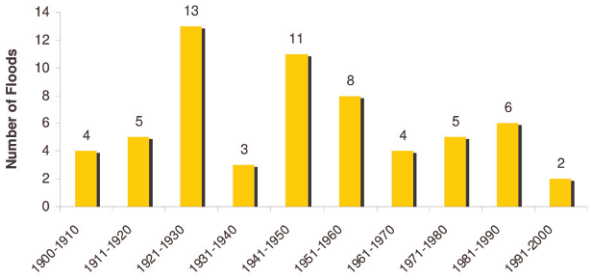
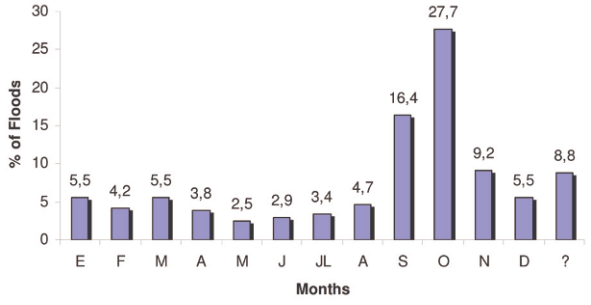


Figure 90.5: Flood annual destruction in the basin of the Segura River. **Source:** Regional Atlas of Murcia (2008).



of floods. A second aim addresses problems of water resource management.

The population is highly vulnerable. On numerous occasions, these works are not the solution to avoid events like the Santa Teresa flood in Murcia. On 15 October 1879 the flow of the Segura River reached 2000 m^3/s in the city of Murcia devastating everything also in the neighbouring town of Orihuela. The entire country mobilized to help the flood victims. Another example is the severe flood suffered by the town of Cartagena on 29 September 1919 with the overflow of the *Rambla de Benipila*. Water in the town centre peaked at three metres. The consequences of both events were catastrophic in terms of

Figure 90.6: he centre of Cartagena city during the flood of 29 September 1919. **Source:** <http://www.cartagenaantigua.es>. The photo is in the public domain.

casualties, home loss, socio-economic consequences, and the number of people affected.

90.3 Study Area

The study area is the southern part of the Region of Murcia (figure 90.7) and is located in the south-south-east of the Guadalentín River basin along the Mediterranean Sea. In this territory are the southern foothills of the Cordilleras Béticas mountain ranges (Sierra de las Moreras, 431 m; Mayorales, 689 m; Lomo de Bas, 641 m; Carrasquilla, 785 m; and Almenara, 881 m) that are of Tertiary origin and derived from the Alpine orogeny and arranged in concentric arcs that open to the sea and subdivide the coastal strip. Among the elevations of this rugged landscape, there are several Neogene-quaternary basins where wadis develop. This hydro-geomorphologic system in the Mediterranean was selected for this study (Rosselló 1986; López Bermúdez/Conesa/ Alonso Sarría 1998).

The region has a semi-arid Mediterranean climate, with a marked dry season during the summer months, and two rainfall maxima in spring and autumn, which represent more than 70 per cent of the annual rainfall. In general, these are concentrated in a few hours due to their intensity and torrential character. Minimum rainfall occurs in winter. Only some meteorological observatories throughout the study area have records of annual precipitation above 250 mm. The area is warm with an annual average of 19 °C, with peaks above 40 °C in the summer and a minimum of 9–11 °C depending on altitude and exposure. The climate is the driest in Europe and extends to the Cabo de Gata in the province of Almería (Vilá 1971; Geiger 1973; Font Tullot 1989; López Bermúdez 1999).

This combination of topographic, geographic, and climatic factors leads to a unique variety of vegetation species. This diversity spans from an open scrubland dominated by esparto, thyme and lentisc, becoming denser with altitude, to pine forests in the higher elevations, often due to reforestation, but also tamarisk, oleander, palms and carob on the beds of numerous wadis, some of them coming from an ancient human use.

The most populated areas are near the city of Cartagena in the eastern sector, Mazarrón and Puerto de Mazarrón in the central sector and Águilas, the main urban community in the western sector. In addi-

Figure 90.7: Study area in Murcia. **Source**: This map was designed by the authors.

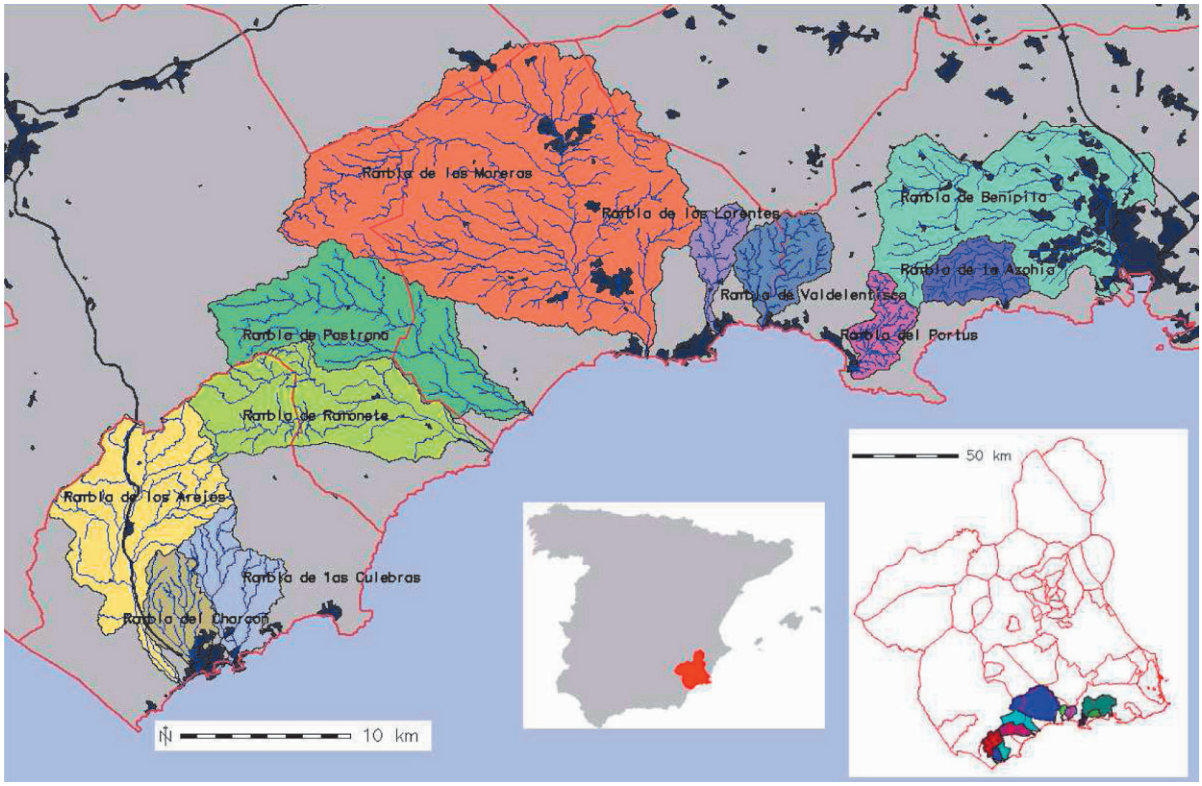


Figure 90.8: Typical vegetation environment of the area. **Source**: Photo by Juan M. Quiñonero-Rubio.

tion, there are several small villages along the coast. These communities are affected by the hydrological dynamics of wadis due to the overflows and floods they cause.

90.3.1 Risks linked to Land-Use Changes

The first settlers in this zone lived close to the river beds, as they offered suitable areas for agriculture and cattle, which directly exposed the population and their principal activities to hydrologic risks. Stone walls and terrace farming in river beds were usual measures that alleviated the harmful effects of floods, but their effectiveness was low in major events.

The population has increasingly been exposed to flood risk as demographic developments required a territorial expansion of economic activities and also favoured building of new homes due to great technological advances, especially during the last decades. Thus, losses are more substantial and disasters more frequent. Great transformations occurred in this region during the last decades that match these processes:

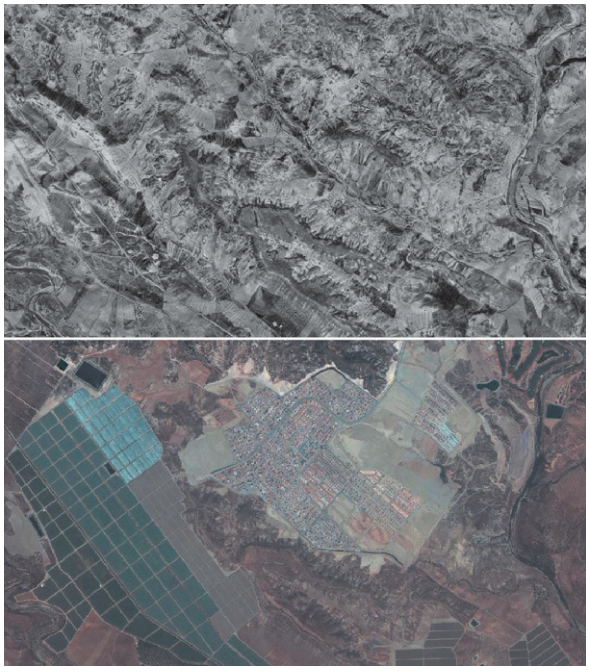
- Increase of the artificial presence of new constructions on the surface;
- Transformation of agriculture with the spread of new irrigation techniques;
- Changes in forest ecosystems with hydrologic consequences, not only for increasing flood risks but also for the loss of the ecosystem itself;
- Decline of wet areas and endorreic zones due to the first two developments.

The growth in housing and intensive farming in this region constitute the main risk factors for the people.

The increase in the number of houses since 1996 has been spectacular, especially the growth that occurred during the last three decades. But the number of people remained practically constant; it also declined in small clusters or it suffered a slow evolution which does not match the vast construction of houses. Many houses located in this part of Murcia are secondary dwellings (not permanently occupied), resorts, and apartments destined for tourists that are used especially during summer, what affects the vulnerability of the population from flood risks, since the non-permanency throughout the year implies that a major part of the damages will affect goods and not people. This differs for *camping areas* that are usually next to riverbeds.

A clear example are the resorts – e.g. in the Saladillo area where housing increased by about 2,500 per cent – that changed from an almost uninhabited area to a population of 800 inhabitants within a short time (Pérez Morales 2008). This implies environmental changes, exposition of houses in areas of water convergence and modification of the surfaces and of the direction of the runoffs. The city of Águilas experienced a moderate change with an urban growth rate of 361.4 per cent and 117.8 per cent for the population (data from National Statistics Institute; at: <http://www.ine.es>).

Figure 90.9: New urban area close to Mazarrón city (images from 1956 [top] and 2005 [below])
Source: Regional Ministry of Spatial Planning.



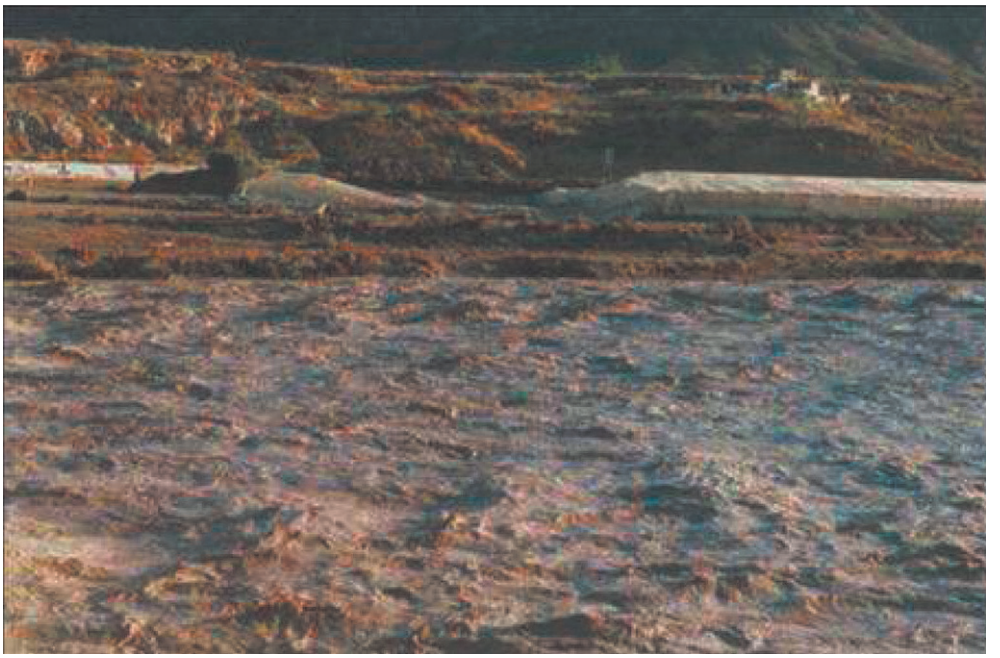
The new urban expansion along the coastline is associated with an intense real state speculation, which resulted in a progressive decline of agricultural areas. Thus, these areas are not available any longer for farming, which poses additional risks besides the growth of economic activity and population.

90.3.2 Consequences of Flood Risk for Spatial Planning

The western sector of Águilas is a clear example. It was previously a terraced area which used the water coming from the ramblas Majadas and Peñaranda-Labradorcico. Now it is part of the urban setting and is highly vulnerable when it rains heavily. An event in October 1989 showed the limited awareness for the risks of imminent floods in urban planning. The river burst its banks and a flood wave grew rapidly and further increased due to the narrowing of the drainage system. This provoked an increase of the height of the water of up to one metre in some parts of the city (*La Verdad*, 17 October 1989). Estimates by the Regional

Figure 90.10: Old salt flats (1956, left) and new urban expansion. (2007, right) **Source:** Regional Ministry of Spatial Planning.

Figure 90.11: Rambla de las Moreras Flood in September 1989. **Source:** High School of Mazarrón "Felipe II".



Agricultural Ministry referred to 567 houses affected and total losses of 7.5 million Euros.

All actions to avoid such events were inadequate. In May 2006 the city was affected by a new flood. Marina de Cope, an agricultural area close to Águilas, was chosen for a housing project for tourists which was classified as an *Action of Regional Interest* with an extension of 2,116 hectares for 9,000 houses and 20,000 hotel beds. An analysis of 2004 on the flood risks generated by this project was only a mere artificial drainage systems when heavy rainfall in the description which did not include all possible risks that may occur in the future (Pérez Morales 2008).

In the municipality of Mazarrón, urban growth occurred in areas of natural drainage or in endorheic areas. The most extreme example of an area affected by frequent floods is the so-called *Urbanización Bahía de Puerto de Mazarrón*. This cluster of houses was built on an area used by the Romans as *salt works* (figure 90.10). The orographic situation of these houses makes it difficult to evacuate all water through area leads to floods.

Figure 90.12: Flood of Rambla de las Moreras in September 1989 during the flood close to Bolnuevo village (left) after the flood in the campsite (right). **Source:** High School of Mazarrón "Felipe II".

The most significant event was the flood of 7 September 1989 in the *Rambla de las Moreras* (Mazarrón), whose disastrous effects were caused by poor land-use planning. There was more than 100 mm of rainfall in just over an hour that resulted in a runoff with an estimated flow peak of 500 m^3/s. The narrowing of the stream bed due to an artificial channelling in the village of Bolnuevo generated a flood wave of several metres that destroyed the urban infrastructure, greenhouses, and a campsite that were located in the ephemeral channel flood-plain and in its delta (figures 90.11; 90.12) at the Mediterranean Sea. Two persons died and economic damages amounted to several million Euros (Rodríguez Estrella/López Bermúdez/Navarro Hervás/Albacete 1992; López Bermúdez/Gomariz 2006). This was another example of bad land use or territorial management. But today the campsite remains in the same place.

The major activities carried out focus on this basin shown above. However, the urban expansion resulted in new risks since the clusters invaded the mouths of the main riverbeds of adjacent basins such as Lorentes, Valdelentisco, Ramonete, etc. In the future, heavy rainfalls may produce new risky situations for the people in this area.

90.4 A Simulation of the Study Area

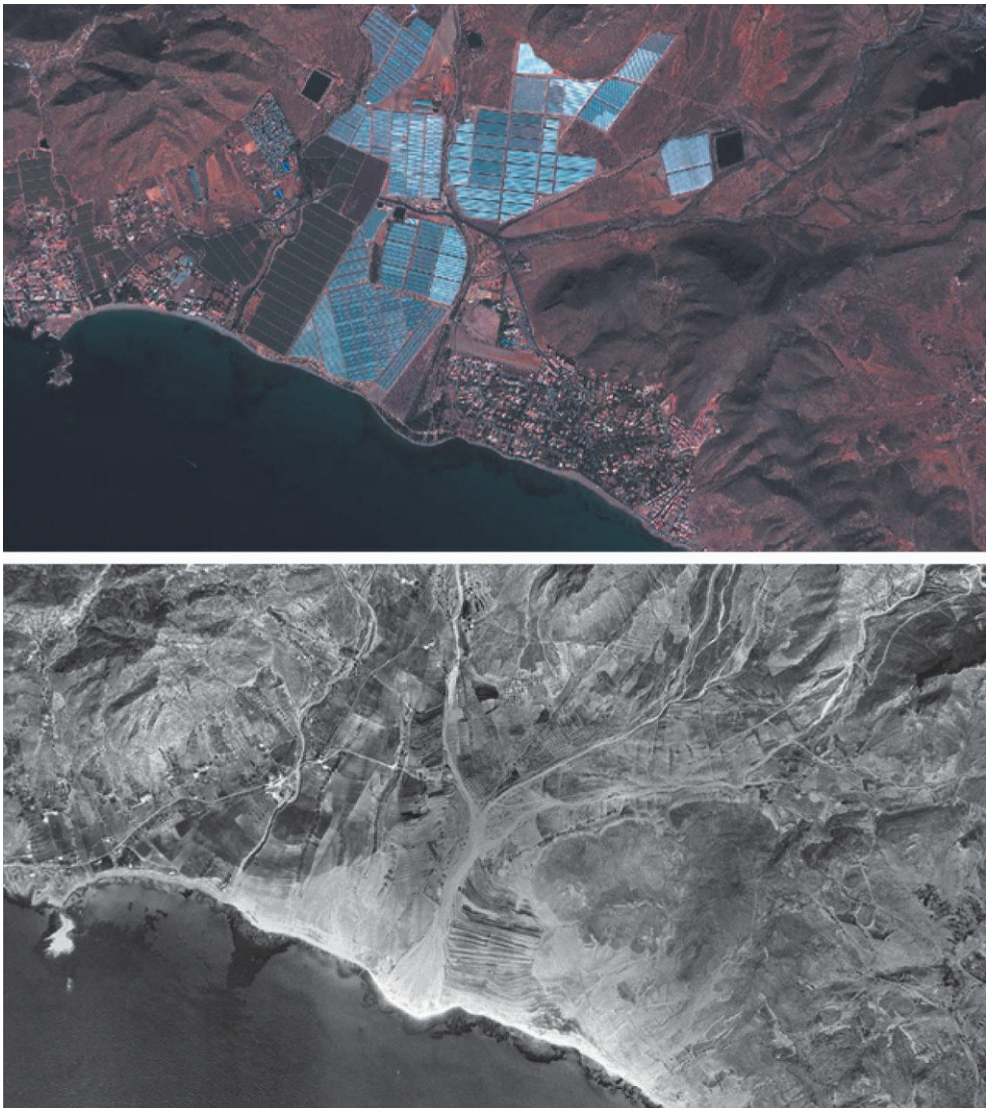
This study used a *Geomorphologic Unit Hydrograph* (GUH) (Iturbe 1993) to analyse the increase in risks that has taken place during the past 25 years by modelling three different stages using land-use maps that were generated with remote sensing images. Drainage networks are extracted from a Digital Elevation Model by GIS (Burrough/McDonnell 1998) techniques using GRASS software and HEC-RAS, developed by the *US Army Corps of Engineers* (USACE 2000; 2008; McCuen/Richard 1982) to predict for different scenarios the depth flow generated on inhabited zones.

A simple aggregated hydrological model was used to analyse how land-use changes can alter the potential flood hazard for high return periods. This specific model is based on well known models recommended and used by the Spanish hydrological and weather authorities (Ferrer Polo 2000; Santamaría Arias/Parrilla Alcaide 1999). For this chapter a simple and robust modelling approach is used instead of more sophisticated ones, assuming that the trends discovered with such a model will be consistent with those estimated with other models and with reality (Chow/Maidment/Mays 1999; Olivera/ Maidment 1999). GRASS GIS (Neteller/Mitasova 2002) has been used for the spatial side of the implementation (Crawley 2005).

Dangerous spots covered in the study rely on the work of INUAMA (2001), and were selected based on these criteria: a) they are located (or not) in the streams and its mouth or close to it; and b) they were selected based on population and the main land-use types.

For the generation of flood risk maps the assessment of risk of the DIHMA methodology (1997) was applied, which takes into account both the probability of occurrence of flooding at the levels reached, assuming for this study the proposed interval for storm return periods of 500 years (low frequency of flooding) and low depths, resulting in the so-called 'low risk' of flooding. Table 90.1 shows the evolution of the runoff parameters; *Qp* stands for runoff peak and *Qt* for total runoff. The general trend is towards a slight decrease in those parameters, except for *Ram-*

Figure 90.13: Land-use changes in a water outlet area of the coast of Mazarrón (2005 (top) and 1956 (bottom)). **Source:** Regional Ministry of Spatial Planning.



bla del Charcón and *Rambla de los Arejos* where an increase in total runoff and peak can be assumed.

After an analysis of the selected spots for the return period of 500 years, minimal differences in the flows were observed that were calculated in the hydrological modelling stages for land-use changes, what is apparent in the area for the resulting water table.

Different performances of the modelled problem spots were distinguished on the basis of the measures taken to prevent floods:

- *Channels regulated* by containment measures, usually an artificial canalization with stone walls and clean and hardened river beds. In most cases the sizing was correct, showing the mouth of the Rambla del Portús where it can be seen that neither in 1977 nor in 2000, the characteristic water level for a return period of 500 years overflows the channelling, with the exception of a point located on the left wall, where water was overflowing and affected the camping.
- *Unregulated channels*. In this case, as in the previous ones, differences of land use in the basin barely affect the water sheets resulting from a return period of 500 years. However, contrary to what happens in the above-mentioned spots, in this case overflows seriously affect human uses in each of the periods in question.

Figure 90.14: Hydrology and Hydraulic processes for simulation. **Source:** created by the authors.

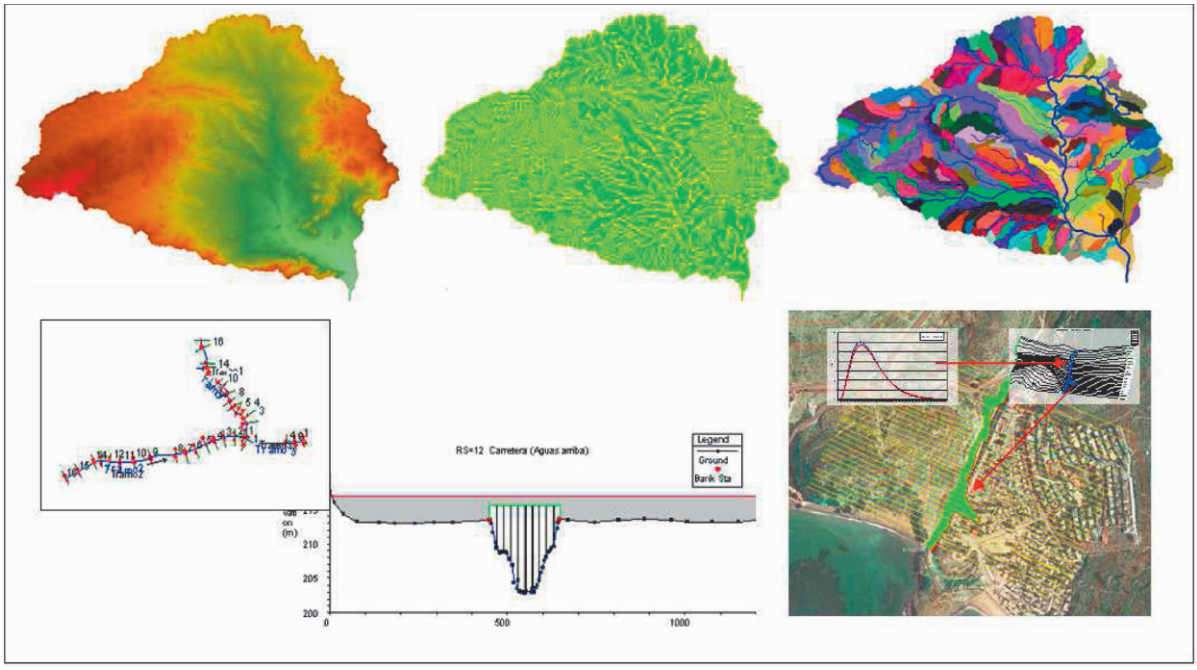


Table 90.1: Evolution of hydrologic results. **Source:** Compiled by the authors.

	Basin	Qp 1977	Qp 1990	Qp 2000	Qt 1977	Qt 1990	Qt 2000
1	Lorentes	347.90	329.28	329.28	1.10	1.06	1.06
2	Azohia	613.33	581.09	550.20	1.19	1.16	1.12
3	Pastrana	956.82	956.82	956.82	6.67	6.67	6.67
4	Ramonete	1008.45	899.37	899.37	5.95	5.58	5.58
5	Moreras	1543.78	1543.78	1543.78	19.15	19.15	19.15
6	Benipila	667.15	591.05	591.05	7.88	7.33	7.33
7	Charcón	671.33	789.81	789.81	1.81	1.97	1.97
8	Arejos	964.42	1146.24	1146.24	5.69	6.27	6.27
9	Portús	423.27	399.75	399.75	1.41	1.36	1.36
10	Culebras	927.50	927.50	927.50	2.47	2.47	2.47
11	Valdelentisco	724.93	686.13	686.13	2.15	2.08	2.08

90.5 Conclusions

- The land-use changes did not affect the flow of the wadi studied and if there is any change it has been of limited hydrological significance.
- The simulated peak flows do not pose a high risk for the current population in the area, although in the past they have occurred when human activities have triggered major disasters. The construction of new barriers to defend against floods is more effective than those in previous decades but is no solution.
- Based on these results, the geomorphology of the ephemeral channels has set an effective drainage system. It is recommended not to change these channels so as to permit the water to flow freely without creating problems for the safety of the population.
- Spatial planning in the flood areas is presently producing good results, although it is always possible

to observe in situ some spots that should be studied in the future.

- The new spatial planning based on massive tourism and intensive agriculture is a real economic fact but the surfaces for these activities must be located in the correct areas. The vulnerability of the population is growing if this situation remains.
- Past floods are the best examples of possible future situations.

91 Monitoring Conflict Risk: The Contribution of Globally Used Indicator Systems

Jochen Jesinghaus

91.1 Introduction: Indicators Are No Toys for Statisticians[1]

No Prime Minister in the World will sleep well when the rate of GDP growth is below zero. The risk to lose the next elections is just too high. In richer countries, this holds also true for bad unemployment and inflation rates. Another example how indicators drive politics: There would be no Kyoto Protocol if our statistical offices had not the indicator 'CO_2 emissions per capita' in their pockets. At the right place, in the right moment, and under certain conditions, indicators play an overwhelmingly powerful role in politics, and may indeed decide the fate of governments. Could indicators play a role in preventing conflicts?

In the following, the author will try to formulate how an indicator system intended to help reducing the risk of violent conflicts should look like. The goal formulation, an indicator system intended to help reducing the risk of violent conflicts, is certainly ambitious – is it credible to picture a warlord in the heart of Africa who looks at these indicators and then says, "ok, you convinced me, from now on I will settle my disputes peacefully?"

A more desirable and realistic scenario would be a political environment in which warlords simply do not thrive, thanks to efforts by all actors involved to exploit resources in a fair and sustainable way, and to seek dialogue instead of confrontation. This implies understanding the root causes of non-sustainable behaviour, and it implies creating a situation where options to reduce or eliminate such causes are being discussed by those who have the power to negotiate solutions. To name some of these actors (in the heart of Africa, or in the mountains of Central Asia, etc.): The government, opposition parties, civil society, warlords, UN troops, the donor community.

While the media do not appear in this list as 'direct' actors, they do have a crucial role, as *media*tors, in enforcing dialogue among the political actors. For example, in April 2008, a Chinese ship loaded with weapons had trouble with the media. A headline from a Pakistani online service:

'Zimbabwe silence may be Mbeki's demise': South African President Thabo Mbeki's failure to criticize neighbouring Zimbabwe leader Robert Mugabe has weakened his international stature, analysts said. ... human rights groups have reported an upsurge in violence by pro-Mugabe militias and the military. ... Mbeki rival Jacob Zuma ... denounced Zimbabwe's 'police state' during a European tour in which he met Britain's Prime Minister Gordon Brown.[2]

The same day, the *Financial Times* comments:

> 'No guns for Mugabe': Beijing had no need of more bad publicity ahead of the Olympic Games and on Thursday said the ship [the An Yue Jiang], which was carrying enough bullets to start a civil war, was heading home. ... Human rights activists, church groups and unions across southern Africa have shown solidarity with long-suffering Zimbabweans by campaigning to bar the An Yue Jiang from African shores.[3]

World-wide, in the UK and in Pakistan, people with access to newspapers and/or the internet learnt something about the role of the following actors: R. Mugabe, T. Mbeki, human rights and church groups, J. Zuma, the Trade Unions, G. Brown, and the Chinese government. At the time of writing this article, Mr. Mugabe is still President – but the whole world is watching the news from Zimbabwe, and is debating

1 The views expressed here are strictly personal and do not represent official positions of the European Commission

2 See at: <http://www.thenews.com.pk/daily_detail.asp?id=109528>.

3 See at: <http://www.ft.com/cms/s/0/94281fee-1483-11dd-a741-0000779fd2ac.html?nclick_check=1>.

H.G. Brauch et al. (eds.), *Coping with Global Environmental Change, Disasters and Security*, Hexagon Series on Human and Environmental Security and Peace 5, DOI 10.1007/978-3-642-17776-7_91, © Springer-Verlag Berlin Heidelberg 2011

how to cure the African disease, i.e. greed and corruption of governments.

While there might be situations where secrecy helps to advance a good cause, as a general rule transparency enforced by the media helps to push the actors towards the negotiation table. Of course, a ship full of weapons for a government that just rigged the elections is a simple case, so one would not need any indicators for explaining what are the stakes here. But most conflict situations are far more complex, and require a thorough analysis.

In the following, the author will present a practical example of an indicator system created from existing data sets, discuss its messages, and draw lessons for a more elaborate system aimed at enhancing a societal debate on policy priorities, inter alia with regard to resolve tensions through dialogue rather than armed conflict.

91.2 An Indicator System for Communicating Conflict Risk

Indicator systems can help to provide political actors and stakeholders with a good analytical basis for negotiations – and the media are the vehicle to transport such indicators, and thus their underlying issues, into the debate. To illustrate how such a system could be designed, a 'strawman' framework will be presented here, focusing on three dimensions/elements related to conflict risk in developing countries: a) the quality of institutions; b) socio-economic development; and c) the natural environment.

As a working title for the strawman, the author chose "*Sustainable Development Index*" (SDI) – a name that is far from being innovative but certainly rings a bell for the audience; the 'bell' is, by the way, a required feature for any indicator system that is supposed to be used by the media: An indicator system should *not* be innovative; it should rather reflect and present, using simple and easy-to-understand means, facts and figures that relate to the already existing mental setups, 'world views', of a majority of potential users. There is currently no other world view as broadly accepted as 'sustainable development', and it should not be too difficult to convince the citizen that *sustainable development* (SD) requires a functioning government, money in the wallet, and a thorough look at the mid- and long-term risks of overstretching nature's patience.

For each of the three dimensions (quality of institutions, socio-economic development, and the natural environment), a database is required – more precisely, a set of figures that have the necessary *properties* for being fed into difficult and complex political negotiations, for example: being scientifically sound, robust and politically relevant official statistics. Given that a lot of detail will be needed, such figures should lend themselves to *aggregation*, so that the actors at the negotiation table will not get lost in piles of spreadsheets containing data cemeteries. Several 'indicator sets' exist already. UNDP's Office for Development Studies has found 178 aggregated indicator sets, among them are: [4]

- 31: *Disaster Risk Index* (DRI)
- 91. Human Rights Commitment Index
- 97. Index of Human Insecurity
- 105: *International Country Risk Guide* (ICRG) Ratings - Composite Risk Rating
- 113: Least Secure Countries
- 162: The Observer Human Rights Index
- 177: World Military Expenditures and Arms Transfers rankings

And then there is No. 89, the *Human Development Index* (HDI), one of a handful in the list that are well-known to the media – although in a "Google contest", even the HDI would have no chance against GDP and unemployment. For the purpose of the 'strawman', these three indicator sets are used:

91.2.1 Quality of Institutions

The *Failed States Index* (FSI by Foreign Policy and Fund for Peace[5]) is a comprehensive dataset examining the ability of states to manage their own business:

> Because it is crucial to closely monitor weak states – their progress, their deterioration, and their ability to withstand challenges – the Fund for Peace ... and Foreign Policy ... ranked 177 states in order of their vulnerability to violent internal conflict and societal deterioration. To do so, we examined more than 30,000 publicly available sources, collected from May to

4 Romina Bandura, UNDP Office of Development Studies: "A Survey of Composite Indices Measuring Country Performance: 2008 update" (personal communication from Ms Bandura, June 2008).

5 See: Foreign Policy: "The Failed States Index 2009"; at: <http://www.foreignpolicy.com/articles/2009/06/22/the_2009_failed_states_index> (21 September 2009); Fund for Peace: "Failed States Index 2009", at: <http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=391&Itemid=549 (21 September 2009).

December 2007, to form the basis of the index's scores." [6]

The indicators used are:

- *Social Indicators*: I-1. Mounting demographic pressures, I-2. Massive movement of refugees or internally displaced persons creating complex humanitarian emergencies, I-3. legacy of vengeance-seeking group, grievance or group paranoia, I-4. Chronic and sustained human flight;
- *Economic Indicators*: I-5. Uneven economic development along group lines, I-6 sharp and/or severe economic decline;
- *Political Indicators:* I-7. Criminalization and/or delegitimization of the state, I-8. Progressive deterioration of public services, I-9. Suspension or arbitrary application of the rule of law and widespread violation of human rights, I-10. Security apparatus operates as a 'state within a state', I-11. Rise of factionalized elites, I-12. Intervention of other states or external political actors.

91.2.2 Socio-economic Development

The *Millennium Development Goals* (MDG) dashboard uses over 60 MDG indicators elaborated by the UN system in the wake of the 2000 Millennium Summit to calculate overall scores of 'MDG performance' for all countries of the world. Its structure reflects the eight MD Goals agreed in 2000 by 189 Heads of State and Government [7]:

- Goal 1: Eradicate extreme poverty and hunger
- Goal 2: Achieve universal primary education
- Goal 3: Promote gender equality and empower women
- Goal 4: Reduce child mortality
- Goal 5: Improve maternal health
- Goal 6: Combat HIV/AIDS, malaria and other diseases
- Goal 7: Ensure environmental sustainability
- Goal 8: Develop a Global Partnership for Development [8]

91.2.3 Natural Environment

The 'Environmental Performance Index' [9] is the latest of a series of environmental indices, elaborated by Yale and Columbia university that was presented in 2006 (as a 'pilot') and 2008 at the Davos World Economic Forum. It contains a total of 25 indicators, structured by six major themes:

- Environmental health (with sub-themes burden of disease, water, and air pollution)
- Air pollution (ecosystems)
- Water resources (ecosystems)
- Biodiversity and habitat
- Productive natural resources
- Climate change.

91.3 A First Look at the 'Strawman'

To make the 'strawman' look more realistic, real data for real countries will be used from now on. To avoid showing boring spreadsheets, a simple code of shades will be used in the following: darker means better, lighter means worse than others in the same group. For the current context, Africa was chosen as the peer group to compare with. For the current context, Africa was chosen as the peer group.

Here are the results for Tanzania (figure 91.1):

- First, the *FSI* portrays Tanzania as a country with a medium risk of state failure. Refugees and IDP (internally displaced persons) require specific attention, though.
- Second, the socio-economic performance measured through the MDG lens highlights Tanzania's good education system by assigning a dark green. Hunger and poverty seem to be more serious than in the rest of Africa; a closer look at the data reveals that the World Bank's headcount, per cent of people living with one US$ per day, pulls down the score, together with a high share (44 per cent) of malnourished adults – the latter contrasted by a better-than-average child malnutrition score of 22 per cent, as compared to over 40 per cent in Sudan and Madagascar. Tanzania's red spot, however, is the Maternal Mortality Ratio (MMR): 1500

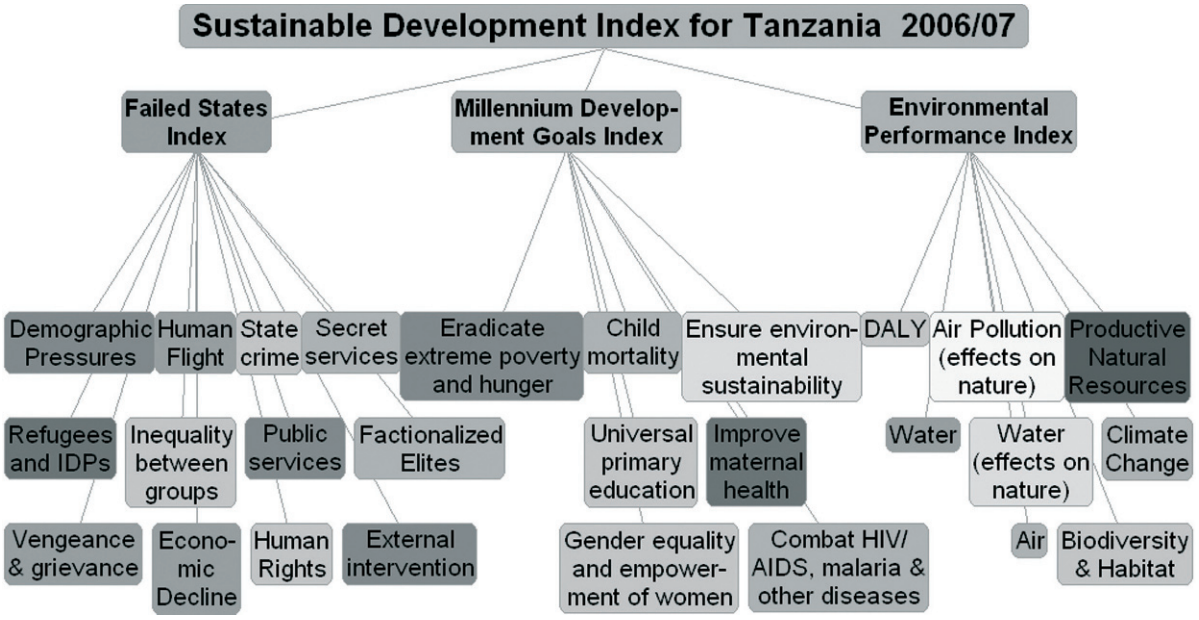
6 Foreign Policy, "The Failed States Index 2008"; at: <http://www.foreignpolicy.com/story/cms.php?story_id=4350> (12 September 2009).

7 See "Road Map towards the Implementation of the United Nations Millennium Declaration (A/56/326)", Annex, point 5: "The proposed formulation of the eight goals, 18 targets and more than 40 indicators". In 2007, the indicator set was revised, following UN Resolution GA 60/1, "2005 World Summit Outcome".

8 The MDG dashboard; at: <http://esl.jrc.it/dc/>, holds data for Goal 8, "Global Partnership", but for the purpose of this paper, we will concentrate on the first seven dimensions designed to measure development progress.

9 Environmental Performance Index 2008, at: <http://epi.yale.edu/Home> (21 September 2009).

Figure 91.1: Sustainable Development Index for Tanzania (2006/2007). **Source:** The author.



deaths per 100,000 live births, almost twice as high as in the neighbouring countries Uganda (880) and Zambia (750)[10]

- Third and finally, the *Environmental Performance Index* (EPI) shows a rather mixed picture – excellent for air pollution, even for Sub-Saharan Africa standards, a yellow for water quality, and a red spot for 'productive natural resources'. Further investigation identifies two culprits for this low score: the *Marine Trophic Index* (MTI) promoted by the *Convention on Biological Diversity* (CBD), which

  > is used to measure the degree to which countries are 'fishing down the food chain', i.e., catching smaller and smaller fish ... It is considered to be a measure of overall ecosystem health and stability, but also serves as a proxy measure for overfishing;[11]

  and *pesticides*:

  > The Pesticide Regulation indicator is based on national participation in the Rotterdam Convention, which controls trade restriction and regulations for toxic chemicals, and the Stockholm convention, which bans the use of Persistent Organic Pollutants.[12]

The need for pesticide regulations in Sub-Saharan Africa might be worth a debate, but to move on, here the respective results for Senegal (figure 91.2):

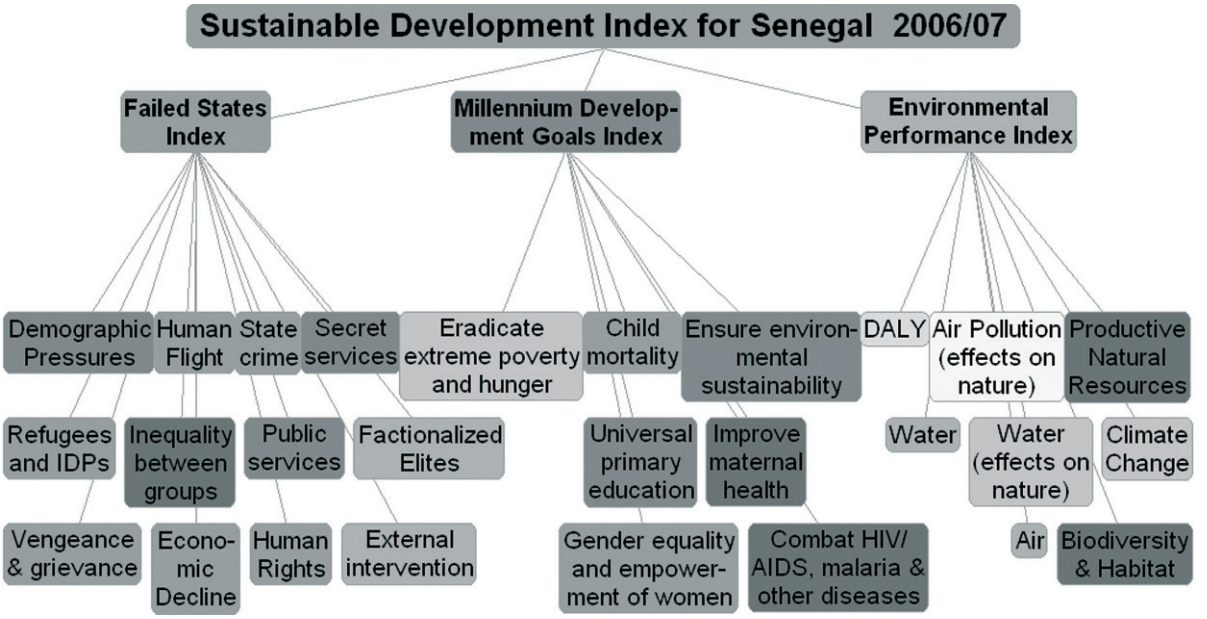
- First, the *FSI* shows Senegal as a low risk country. Observers should keep an eye on demographic pressures, in particular on refugees and IDP's, and should not overlook the activities of the secret services – but overall, on risk of state failure Senegal scores a lot better than Tanzania.
- Second, Senegal's *MDG* indicators look better on poverty but only marginally better on maternal health – the *Maternal Mortality Ratio* (MMR) is under 700. However, contraceptive use (a component of the maternal health index) is half as high as in Tanzania, and this low level of protection against sexually transmitted diseases might contribute to Senegal's HIV/AIDS problem.
- Finally, Senegal's *Environmental Performance Index* (EPI) looks pretty similar to the Tanzanian one, with a slightly lower score on biodiversity but better water quality. Again, the 'natural resources' indicator is strongly pulled down by the *Marine Trophic Index* (MTI) and pesticides. As mentioned earlier, these valuations are calculated against the peer group 'Africa', and there are quite a number of countries in this group with excellent

10 "Data derived from the direct sisterhood method adjusted estimates: The direct sisterhood method is a variant of the sisterhood method- a survey-based technique that obtains information by interviewing respondents on the survival of all their adult sisters"; MDG Dashboard, based on; at: <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=553>.

11 Full source; at: <http://epi.yale.edu/MarineTrophicIndex> (6 August 2008).

12 Full source; at: <http://epi.yale.edu/PesticideRegulation>

Figure 91.2: Sustainable Development Index for Senegal (2006/2007). **Source:** The author.



scores for MTI (Tunisia, Cameroon) and pesticides (Burundi, Rep. of Congo, Sudan, Benin, Egypt and Morocco), so the question may be allowed why the governments of Senegal and Tanzania have another pesticide strategy than the rest of Africa.

91.4 Observations on the 'Strawman'

As a philosophical concept, sustainable development is great for election campaign speeches and late night talk shows, but for decision-making it needs quantification – they need to know what are the priorities for action, at a given point in time and space. Do the twenty-seven indicators shown above offer enough substance for informed debates on policy priorities?–

91.4.1 Function of the Goal Sustainable Development

The focus of this chapter shifted slowly from 'monitoring conflict risk' to the seemingly banal alternative 'sustainable development'. There are good reasons for this shift, but they need some elaboration. While it is desirable and important to know the truth about conflict risk, it would be even more desirable if governments acted to avoid tensions and prevent violent conflicts. The challenge is to find a good compromise between the academic desire to *measure* things correctly, and the need to exert (media) pressure on those who can *change* things[13]. There is no lack academic initiatives to *measure* conflict risk; to quote one initiative claiming comprehensiveness,

> *Facts on International Relations and Security Trends:* The FIRST system offers researchers, politicians and the media an authoritative and structured factual reference system on international relations and security trends. It contains high-quality, up-to-date and clearly documented information in areas such as: conflicts, arms transfers and military expenditure, hard facts on states and international organizations, economic and social statistics, chronologies ... data in FIRST is provided by the following [16] organizations. [14]

For a post doc working on conflict risk, FIRST is as valuable as Eurostat for the general statistician. Another example: The European Commission's *Joint Research Centre* features a specialized Support to External Security unit [15] that claimed in a paper on conflict risk assessment:

> we hypothetized that a number of widely used structural indicators might be strongly correlated with the risk of armed conflict in a country. Our study findings were that despite widespread discussion in academic papers, the most commonly used academic indicators [GDP growth, ODA, FDI etc]... did not unequivocally emerge

13 See Figure 5.2., "Policy cycle in a media society using an SDI", in: Hak, Moldan and Dahl (2007: 86).
14 See at: <http://first.sipri.org/ (7.12.2009).
15 See for the full source; at: <http://ipsc.jrc.ec.europa.eu/research.php?unit=2>.

after regression analysis as causal factors (Burnley/Buda/Kayitakire 2007).

There is considerable man- and institutional power behind this paper, but it is *research*, and as such very different from publications that hit, for example, the BBC headlines because Italy finds herself three ranks below Botswana in the *Transparency International's Corruption Perception Index*:[16] "An independent organization which produced an annual 'corruption index' reckons that Italy is more corrupt than the African state of Botswana, and Greece is more corrupt than Namibia." [17]

It is necessary to distinguish clearly between the kind of information that flows into research papers and into the secret 'crisis rooms', and public information that is able to influence ordinary citizens to the extent that they threaten to send the government onto the opposition benches.

To spur a political debate, messages must be simple and straightforward, to the taste of journalists. However, to launch a good political debate, TI's Corruption Perception Index is not the ideal tool. Certainly, it points to an important phenomenon, but if it were to become a really powerful indicator such as GDP growth, it would detract attention from other, equally important issues. Pushing a society on a sustainable path to prosperity requires complex information served in a simple format. The FIRST integrated database system mentioned above, for example, is public, and contains rich information from many respected international organizations specialized in conflict research, but selling it as "a free-of-charge service for politicians, journalists, *researchers* and the interested public" is wishful thinking. Besides researchers all other users want something more digestable, something simpler.

Simple messages are not possible without research. Even a seemingly primitive indicator like 'CO_2 emissions per capita' builds on a huge body of scientific literature on climate change. How many tonnes of paper on climate change would a researcher find in a medium-sized specialized library? And yet, climate change politics, i.e. the Kyoto process, is largely driven by one single figure, CO_2 emissions,[18] thus acknowledging that many years of research have led to the 'simple' conclusion that reducing greenhouse gases is *the* top priority.

Likewise, intensive research on the roots of conflict will come to the 'simple' conclusion that we should work on a number of variables that can be influenced by politics. Above, a total of twenty-seven indicators were presented in a sustainable development framework; and it would be easy for any conflict researcher to dismantle this framework in a few minutes, by demonstrating that many of the variables have nothing to do with conflict risk. And yet, there is a precise reason why the author chose SD to analyse conflict risk: because sustainable development is *mainstream*, i.e. it is a policy framework that is accepted by, and familiar to, a broad range of stakeholders, from Greenpeace to industry associations, and from trade unions to religions.

But conflict risk also seems to be mainstream, at first sight: A Google phrase search for 'conflict risk' yields an impressive 49,400 hits,[19] demonstrating that many authors write about, and are familiar with, the notion of conflict risk. However, 'Gross Domestic Product' yields 5 Million hits, and the abbreviation GDP arrives at over 57 Millions – this is 'real' mainstream...! Given that the Bretton Woods' 'GDP is good for you' ideology is not so helpful in this context, [20] the author chose 'Sustainable Development' (with 'only' 25 million hits) as the mainstream vehicle to transport conflict risk messages.

One might argue that being mainstream is not a goal in itself, and certainly not a guarantee for quality. For example, the *Failed States Index* (FSI) shown above is a high quality effort to present crucial vari-

16 Full source; at: <http://www.transparency.org/news_room/in_focus/2007/cpi2007/cpi_2007_table> (1 September 2008).

17 "Analysis: How corrupt is Europe?", in: *BBC News Europe*, 15 January 2002; at: <http://news.bbc.co.uk/1/hi/world/europe/1762447.stm> (August 2008).

18 Only recently governments have recognized the need to use a more comprehensive measure, the so-called "Kyoto basket" of several greenhouse gases, condensed to a greenhouse gas index by weighting individual gases (CO_2, CH_4, N_2O, CFCs and others) with their respective greenhouse warming potentials.

19 All Google searches done on 29 September 2009.

20 The European Parliament organized in November 2007 the "Beyond GDP" conference in order to demonstrate that societal progress should not measured as GDP growth; at: <http://www.beyond-gdp.eu/>. OECD promotes the same line through the "Measuring Societal Progress" initiative; at: <http://www.oecd.org/dataoecd/52/19/42536811.pdf>; and most recently, the *Commission on the Measurement of Economic Performance and Social Progress* established by President Sarkozy comes to the same conclusion: that GDP is inadequate to measure progress; see at: <http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf> (28 September 2009).

ables in a carefully constructed framework; however, it is too specialized to attract the attention of researchers and NGOs, and therefore could never exert the political pressure that is necessary to change Ms. or Mr. Prime Minister's behaviour. It requires a mainstream index à la GDP, strong enough to hit the headlines, in order to feed messages into a public political debate. Including the FSI as one of three components into a *sustainable development index* (SDI) is a smart way to promote it from a specialists' tool to a mainstream indicator.

91.4.2 Dimensions of Sustainable Development

Sustainable development is vague enough to accommodate a range of operationalizations. Again, there is a mainstream interpretation: 'SD equals economy plus social plus environmental issues'. Industry, for example, has adopted this three pillar model as the 'triple bottom line',[21] i.e. an extension of traditional economic measures of corporate performance taking account of social and environmental values.

Many claim that *culture* should be added as an essential fourth pillar of SD; [22] however, the United Nations SD indicator list, drafted in the wake of the 1992 UNCED, featured already a fourth dimension called 'institutional indicators',[23] which might well include cultural aspects. In recent years, the term 'institutions' has been replaced by 'good governance'. While it is difficult to find evidence for any formalized consensus, there seems to be a widespread feeling that SD is a 3+1 model, with economic, social, environmental plus governance elements.

The 'strawman' takes account of this line of argument but clusters economic and social aspects under 'MDG performance'. This may seem an arbitrary decision, but it is pretty obvious that, in the non-OECD World, policy has adopted the MDG framework for measuring *poverty* and *development* – synonyms for *economic* and *social* performance. Again, we need to balance the quest for analytical clarity with the need to talk the customer's language. The only alternative to the MDG set would have been the UN CSD Sustainable Development indicators set, which is nicely split into economic and social SD indicators but almost unknown outside environmental expert circles.[24]

Taking account of these choices and arguments, the author opted for a three-pillar sustainable development framework composed of governance, socio-economic development, and environmental elements.

91.4.3 The Right Indicators

The choice of the indicator sets was driven by pragmatic compromises between the need to be analytically and scientifically sound, and politically acceptable.

- The *Failed States Index* (FSI) covers important governance issues but has, in contrast to broad general governance indicator sets,[25] a specific focus on conflict-related aspects; furthermore, it is one of a several databases that are available for a sufficient number of countries and for more than one year.
- There is no real alternative to the *Millennium Development Goals* (MDG) indicator set when dealing with socio-economic issues in developing countries. Legitimated by the Millennium Declaration, a document endorsed by almost every Head of State in the World, this indicator set has become a de-facto standard for measuring 'development' in a broad sense – but not by

21 The term was coined in 1998 by John Elkington (1999).

22 See, e.g. on 'culture': "The Fourth Pillar of Sustainable Development" by the Creative City Network of Canada; at: <http://www.creativecity.ca/news/special-edition-3/culture-fourth-pillar.html> (August 2008). According to Council of Europe: "Sustainable developent requires ... also protecting the diversity and vitality of the worlds' many cultures"; at: <http://www.coe.int/t/dg4/culture-heritage/Topics/dev_en.asp> (August 2008). See also Keith Nurse (June 2006) for the Commonwealth Secretariat on "Culture as the Fourth Pillar of Sustainable Development"; at: <http://www.fao.org/sard/common/ecg/2700/en/Cultureas4thPillarSD.pdf> (August 2008). "Culture, politics, governance" as fourth pillar of a "fairly traditional four-pillar model of Sustainable Development", was discussed at the OECD-JRC conference on "Measuring Wellbeing and Societal Progress", Milano, 19–21 June 2006: The Follow-Up; at: <http://crell.jrc.ec.europa.eu/Well-being/WB_Summary_JRC.pdf> (August 2008).

23 The 1997 Eurostat publication "Indicators of Sustainable Development" contained 9 economic, 14 social, 21 environmental and 2 institutional indicators taken from the then official UN DESA list.

24 There is also no regular data collection for the UN CSD set. The last database was built in 2000 by John O'Connor, the former Head of the World Bank's environmental indicator programme, for the "From Rio to Jo'burg Dashboard"; at: <http://esl.jrc.it/envind/dashbrds.htm>.

25 The World Bank Institute's detailed indicator set falls into this category.

accident it excludes governance aspects, which gives the opportunity to highlight them in their own 'pillar' through the FSI.

- The *Environmental Performance Index* (EPI) is by far the best-known environmental index, due to the promotion by the World Economic Forum, and its solid academic background provided by the universities of Yale and Columbia. There is no real alternative to this set.[26]

All three sets have in common that the data are *really* available and not buried in badly maintained databases in not-so-accessible formats, but rather ready for download in handy spreadsheets, and part of an institutional setting that ensures regular updating of the data.

It is debatable whether one should take these indicators 'as is', i.e. as provided by the owners of the datasets, or whether omissions and/or additions are meaningful. The author believes that unless there is a compelling reason, the sets should *not* be modified. First, because it would be arrogant to think that the authors personal modifications would lead to a better result than many man-years of teamwork performed by specialists; second, even if the result was better, it would trigger a loss of ownership. Imagine that a future Sustainable Development Index became widely accepted by the media, and journalists would interview the makers of FSI, EPI and the MDG indicators set. If the SDI used their original sets, their reaction would be a sensation of proudness and ownership, and a renewed commitment to make it even better. If the SDI picked the cherries only, thus dismissing the conceptual efforts the teams put into these sets, the reaction might well be to call the lawyers and see how this abuse of data could be stopped.

And yet, the 'strawman' features one significant modification: MD Goal 8, "Global Partnership", has been deliberately left out. It is unlikely, though, that this omission would trigger harsh reactions, because it is generally felt that Goal 8 is less relevant for developing countries, since it focuses on donor countries' commitment to development, in particular regarding ODA and trade policies.[27] The author did not eliminate MD Goal 7, "Ensure environmental sustainability". Although one might argue that the environment is already present through the EPI, there are two good reasons *not* to exclude Goal 7:

1. One should maintain the consistency of the MDG set (and there is *no* general feeling that Goal 7 is less relevant to DCs – on the contrary);
2. Several of the Goal 7 indicators are social indicators in disguise, such as access to clean water and sanitation, and the percentage of slum dwellers; they are important but not yet covered in the EPI.

Considering these arguments, the question whether the 'right' indicators are chosen can be answered that a good compromise was reached between having perfect indicators and those that are available at a sufficient level of consistency and coherence, and provided by reliable initiatives.

91.4.4 Right Weights

Many indicator experts will claim that the question is irrelevant because one should not weight at all: Aggregation is misleading, obfuscates the facts, makes us lose valuable detailed information, is scientifically unsound, etc.; this debate cannot be solved here, but a few words are necessary to avoid the impression that the author is unaware of this debate.[28]

An example may illustrate the complexity: On behalf of the 27 heads of government of the European Union, a group of a dozen really senior researchers had been asked to write a report on the current situation, future trends and priorities of developing countries; and that they had been required to base their analysis on the available facts and figures, i.e. the roughly 100 variables underlying the 27 indicators of our strawman, for each of the 140+ countries. At one page per indicator and country, the report will have 100 x 140 = 14,000 pages – no problem for a powerful printer.

26 The EPI has been criticized for its idiosyncratic way of calculating the climate change score – which sees the United States in the green range, well ahead of, for example, Swaziland, Botswana, Djibouti and Guyana. While the EPI disqualifies therefore for judging EU environmental policies (having a strong stance on climate change issues), the choice of indicators such as 'CO_2 per electricity generation' and 'industrial carbon intensity' gives roughly the right message to poor nations' governments: 'Don't let your economies depend on oil imports'.

27 Unfortunately, Goal 8 also contains a handful of indicators that do not fit into this logic, such as 'telephone lines per 100 population', 'cellular subscribers' and 'internet users'. Besides this political argument, a much more explicit and elaborated the Commitment to Development Index is available at the Center for Global Development, Washington.

28 For the mathematically literate: see Nardo, Saisana, Saltelli and Tarantola (9 August 2005).

The trouble starts when the heads of government ask for an executive summary. Even if we assume that they are willing to read a dozen pages, we are still stuck with a substantial problem: How to condense 14,000 pages into only twelve? There is a pragmatic solution: Each of the twelve experts picks the three indicators and the three countries s/he knows something about, and writes one page highlighting the winners and losers. The problem of this 'solution' is that it insults the institutions that developed the other 64 indicators, and the people of the 104 countries that could not be covered by the analysis.

To avoid such political trouble, the group of senior researchers will be given a reasonable budget, so that they can put at work twelve groups of junior researchers to produce a thousand pages each. Of course, the seniors will ask for twelve 'sub-executive summaries'. Then, the final executive summary will *seem* to cover everything, will use plenty of phrases such as 'the economic situation in the Sahel zone is characterized by...' or 'the education system in Eastern Africa continues to be more efficient than elsewhere', and manage to arrive at the conclusions at page 11. What the authors definitely will *not* include is a description of the indicators used for assessing the overall 'economic situation' and the performance of 'the education system', let alone explain how they weighted different aspects of *economy* and *education* ...

The SDI strawman *mimics* the production of an executive summary, but it makes all choices and assumptions explicit. Of course, the same people who would silently accept the black box of a traditional executive summary are often the first to attack the explicit and transparent weightings used in a *Sustainable Development Index* (SDI). The ideological dispute on aggregation will continue, so at this point the author limits himself to one statement: Saying 'Thou shalt not aggregate my indicator batteries' is equivalent to telling a head of government 'There is no executive summary, you have to read all 14,000 pages'. Which leaves the reader with the rather trivial but unanswered question at the top, 'Are these the *right* weights?'

For both levels, equal weights were chosen; this means the scores of the 12 FSI indicators are multiplied by 8.33 per cent to arrive at the FSI score, to which MDG (7 x 14.3 per cent) and EPI (8 x 12.5 per cent) scores are added. Finally, the sum of the three sub-index scores is divided by three. Admittedly, choosing equal weights is a straightforward but arbitrary decision. Here are some alternatives:

- *Reduce the complexity* of reality: Instead of arguing about the relative weight of climate change vs. biodiversity, of child vs. maternal mortality, etc., just take GDP per capita. The problem is that many experts dislike this alternative, precisely because it assigns *very* unequal weights: 100 per cent to GDP, 0 per cent to all other aspects of development and conflict risk.
- Find some *magic formula*: Run the data through a statistical package, and pick a method that calculates the weights for the user. Here, the problem is that only statisticians will understand what has been done, and several of them will claim they know a much better formula that produces, unfortunately, completely different results.
- Let *experts decide:* Pick one-hundred conflict risk and sustainable development experts, give them the list of indicators and run a simple *budget allocation process* (BAP):

  > You are an expert for state failure and conflict risk. Here are 12 indicators related to your field of expertise. You have a budget of 100 points. How would you distribute these 100 points on the 12 indicators, in view of calculating an index that truly reflects the importance of each indicator in reducing the risk of violent conflicts?

That looks complicated, but this system works surprisingly well: The weights obtained are usually very near to one's plausible expectations, and in addition the survey creates a group of 100 experts who have participated in defining the weights. They develop a sense of ownership and are thus often willing to promote 'their preference' in conferences. However, the problem of the BAP is to find the panel experts: There are 140+ developing countries, so in order to be politically correct and to guarantee world-wide acceptance, one should at least find one expert per country. To ensure qualified replies to the survey, this person should be specialized in all 27 issues covered by the strawman.

While the latter alternative works in principle, it is evident that considerable manpower and a lot of time would be needed to set up such an expert survey. This is an alternative beyond the scope of a strawman. To conclude: equal weights are not the 'right' weights, but they are probably a lot more 'right' than those obtained by the first two alternatives outlined above. Furthermore, they give one clear message:

"Here are 27 measurable issues that may play a role in reducing the risk of conflicts, and in heading towards Sustainable Development. In the absence of clearly defined political priorities, we consider each of them *equally* important." This does not dissolve us

from the obligation to perform some statistical checks: A global *sensitivity analysis* (Saltelli/Ratto/Andres/Campolongo/Cariboni/Gatelli/Saisana/Tarantola 2008) identifies which indicators and which other elements of the calculation have the strongest influence on the final results, i.e. on those rankings that journalist *like* and politicians with low scores *hate*; sensitivity analysis helps to identify indicators that must be improved or replaced. It should be coupled with *robustness analysis*, i.e. the question whether weaknesses in the data can make the preferred index so volatile that it becomes unusable for judging conflict risk and SD performance? As a rule of thumb, indices with many components are more robust than those with a handful of indicators – little errors tend to compensate each other. Since the 27 indicators of the strawman are all indices themselves (for example, over 50 indicators are needed to calculate the seven MDG scores), they are probably robust enough to stand a political blow by somebody who dislikes the outcome.

91.4.5 Correct Data

With rare exceptions, neither official statistical services nor private institutions provide error margins for their data; getting reliable information on the quality and correctness of data used is almost impossible. It is an open secret that poor developing countries do not have the resources to provide reliable data, but partners in development cooperation have learned to live with this problem, and are trying to improve the consistency and reliability with various means, such as modelling, statistical plausibility checks, and coordination with partner countries, e.g. through the Paris 21 *Statistical Capacity Building Initiative*.[29]

Instead of asking for correct and precise data here and now, one should approach this question processwise: If incorrect data are being publicly used, and if experts openly criticize such data, then chances are high that the owners of such data will improve them. The internet is full of databases that nobody seriously uses, and a closer look at them usually reveals plenty of fairly obvious errors. Those databases instead that are used by a large number of experts and scientists tend to be well maintained, with footnotes flagging those problems that could not yet be eliminated, such as breaks in time series and similar methodological changes. In particular, those limited sets of indicators that are being used for calculating indices, such as the FSI and EPI, undergo thorough checking, and face strong criticism from the expert community if something goes wrong. The same applies to the United Nations MDG database: although not flagged for aggregation, it is used by a broad range of development experts, and therefore enjoys the kind of feedback that helps eliminating the errors.

The three datasets FSI, MDG and EPI have deliberately been chosen because of their public availability, and the commitment of the institutions behind to keep them public. There is no better mechanism than public access and user feedback to ensure that databases are being improved and maintained for many years to come.

Finally, the strawman, or a more elaborated 'SDI pilot', should not be seen as 'the' best available measure for describing conflict risk and SD, but rather as an invitation to discuss:

- whether the weights are correctly assigned,
- whether the right indicators have been chosen,
- whether the data are correct,
- what is missing in the picture.

91.4.6 The SD Index as a Conflict Prevention Tool

The *Sustainable Development Index* (SDI) seems to work, in the sense that the rankings obtained reflect well-known patterns; as in most country rankings, the Scandinavians are on top, Afghanistan, Somalia and Sub-Saharan Africa are at the bottom. So there are no big surprises. It is very important to recall that the objective of publishing such an index is not to *describe* 'reality' in all its facets. Finding the true level of conflict risk, and its key determinants, is a task that will keep a number of research disciplines, including economics, game theory, sociology and psychology, busy forever.

The goal of the SD index is rather to *change* reality, by using figures that are as 'true' as possible, and by exploiting the mechanisms of a media society: The hunger of journalists to get the headlines, the habit of voters to believe their messages, the fear of ministers to lose their posts. Scoring rank 99 among 200 countries is not particularly exciting; but losing three positions on a close neighbouring country does trigger debates, especially if the 'culprits' can be named and shamed.

This mechanism works best in a democracy with a free press; but even in more closed societies, opinion leaders have access to such information, and will use it. The availability of a detailed country profile for public debate is healthy for *any* society. However,

29 See at: <http://www.paris21.org/betterworld/goals.htm>.

apart from journalists, and ordinary citizens, there is another group of actors that deserves attention: investors.

Imagine you would have a Million Euros on your bank account, and were looking for a more profitable location to invest this money. You have two alternatives: First, a bank in Switzerland, offering an interest rate of 5 per cent; second, a bank in Somalia, offering 10 per cent. As *homo economicus*, you would of course take the higher offer – provided your friends and family would allow you to do so...

In real life, people invest in high risk countries only if they can expect, *on average*, a hefty profit. Risk aversion plays a strong role: The fear to lose is much higher than the joy to gain. Therefore, even if the expected profit (corrected for the probability of losing all our property) is twice as high as in Switzerland, we would rather not invest in Somalia. We might change our mind at 50 per cent, though – but this implies that poor Somalis have to work for much lower salaries than they deserve. To illustrate the argument with a simplified example: When producing a pair of shoes with a market value of 50€ in Switzerland, 5€ would go to the investor, 45€ to the worker; when producing an identical pair in Somalia, 45€ would go to the 'greedy' foreign investor, only 5€ to the Somali. There is surprisingly little research on this mechanism[30], but it is evident that insecure countries pay a high price.[31]

Would investors consult the SDI, or would they rather rely on Moody's?[32] Big investors have to justify their decisions in front of shareholders and the general public. While they may be inclined to trust a private specialized reliable black box more than a public not-so-specialized SDI, public opinion might force them to look also at a transparent SDI that takes into account human rights, democracy and other Western values, as well as country performance on education and health. The debate on economic ethics in the context of the Beijing Olympic Games shows that pure economic performance considerations should be balanced against the risk to lose a reputation. Overall, an investor finds in the SDI many relevant aspects: Confidence in the institutions, respect for human rights and democracy, education and health, respect for the environment, they all complete the picture and are able to give hints how sustainable an investment in country X would be.

91.5 Conclusions

Conflict risk needs monitoring. Researchers try to identify, by studying present and historic data and their correlations, what are the key variables promoting conflicts. Such information is certainly valuable for political decision-making, but it tends to be most useful for *understanding* conflicts, i.e. for their ex-post analysis.

The *Sustainable Development Index* (SDI) presented here is radically different from the researcher's approach. It starts from the assumption that conflicts will not thrive in a political climate that is driven by a transparent societal dialogue on a country's strengths, weaknesses, opportunities and threats. The SDI takes therefore a broad inclusive approach aimed at triggering informed debates between a country's government, opposition and civil society about the political priorities that have to be addressed in order to achieve sustainable development. The key idea is that societies which openly debate their tensions and conflicts can eventually resolve them before they escalate to violence. A detailed SD Index would be a good vehicle to promote such debate, but in order to succeed, it must be *more* attractive to the media and their audience than the current main policy guidance indicator, the rate of GDP growth. Acceptance of any new

30 The literature focuses on the 'risk premium' defined as the difference between returns from government bonds and 'risky'stocks, *for a given country*; see e.g. Mehra and Prescott (1985: 145–161). Comparisons *between countries* are difficult to find (but there are some, see next footnote), although analysts are aware of the phenomenon; see Ambrose Evans-Pritchard: "Georgia a reminder of 'Russia risk' premium ... This geostrategic earthquake comes at a moment when global funds are already starting to have serious doubts about the wisdom of sinking any more money into Vladimir Putin's Russia", in: *The Telegraph*, 12 August 2008.

31 In addition, the presence of big money tends to directly decrease the risk of violent conflict: "There is no evidence that the Russians intended to hit the [Baku-Tbilisi-Ceyhan pipeline], which is 30 per cent-owned by BP .. The BTC pipeline cost $3bn (£1.5bn) to build"; see at: <http://www.telegraph.co.uk/money/main.jhtml?xml=/money/2008/08/17/ccgeorg117.xml> (1 September 2008). It would be naïve to believe that British Petrol invests a billion dollars without political guarantees from the most relevant actors in the region.

32 Both Aswath Damodaran; at: <http://www1.worldbank.org/finance/assets/images/Equity_Risk_Premiums.pdf > (1 September 2008) and Allan Huang; at: <http://www.sjsu.edu/faculty/watkins/econ202/risk.htm> (1 September 2008) base their per-country risk premiums on Moody's information.

indicators is difficult to achieve, given that economic growth is still an overwhelmingly dominant political goal, and that GDP has been its yardstick for so many years. However, a carefully designed Sustainable Development Index that is not only technically sound but also resonates with the political interests of citizens might have a chance to make GDP history, and to enable a societal debate on real priorities, including the need to manage conflicts peacefully.

Part IX Towards an Improved Early Warning of Conflicts and Hazards

Chapter 92 **Networking Disaster and Conflict Early Warning in Response to Climate Change**
Patrick Meier

Chapter 93 **Vulnerability Assessment in Sri Lanka in the Context of Tsunami Early Warning**
Juan Carlos Villagrán de León

92 Networking Disaster and Conflict Early Warning in Response to Climate Change

Patrick Meier

92.1 Introduction

Can *Disaster and Conflict Early Warning* (D/CEW) systems be networked to untangle the multiple but interdependent crises that characterize complex emergencies, particularly in response to climate change? In other words, can continuous information gathering identify the socio-ecological ingredients of complex crises before they escalate into widespread violence? And if so, can early warning methodologies based on events-data analysis provide the common platform to network D/CEW for early response?

The purpose of this chapter is to explore these questions from the perspective of a scholar-practitioner engaged in the development of field-based conflict reduction systems. The questions posed will be addressed using the case-study method. To this end, the *Conflict Early Warning and Response Network* (CEWARN) in the Horn of Africa serves as the primary case study.

After highlighting the confluence of climate change and complex emergencies (92.2), I briefly review the perennial conflicts between nomads and resident farmers in the Sahel Zone, both in West and in East Africa (92.3). This is followed by a presentation of CEWARN as an operational methodology being adapted to network D/CEW (92.4). The next section outlines how networked warning systems can remain effective in response to climate change (92.5), while the final section ties the above analysis to people-centered early response (92.6).

92.2 Climate Crises and Isolated Responses

The occurrence of 'natural' disasters amid complex political crises is increasingly widespread: over 140 natural disasters have occurred alongside complex political crises between 2001 and 2006 alone (UN 2006). "The dramatic increase in major disasters witnessed in the last 50 years [also] provides worrying evidence of this trend, [and] if climate change produces more flooding, heat waves, droughts and storms, this pace may accelerate" (UN 2004a: 27). In fact, average worldwide losses from natural disasters have been increasing exponentially since 1960 (Munich Re 2005). To make matters worse, where conflicts already exist, "the threat of climate change is likely to exacerbate, rather than ameliorate matters because of uncertainty about the amount of future resources that it engenders" (IPCC 2001a: 225; IPCC 2007: 14). At the same time, political crises and armed conflicts indirectly exacerbate the impact of natural disasters by exhausting coping mechanisms and response capacities (Brauch 2002). Indeed, human-driven "environmental degradation has enhanced the destructive potential of natural disasters and in some cases hastened their occurrence" (UN 2004a: 27).

In this rush of feedback loops, "the catastrophic risks are magnified by the fact that some risks are positively correlated" (Posner 2004: 89), which implies that "regional climate change, as with other causes of environmental degradation, could make armed conflict more likely" (Purvis/Busby 2004: 68), with "more people on the move, internally and across borders, [seeking] livelihoods away from stressed areas" (Walker 2006: 2). During the last decade, for example, an estimated 188 million people per year worldwide were affected by natural disasters, more than 6 times the 31 million annually affected by armed conflict (Purvis/Busby 2004). The *International Panel on Climate Change* (IPCC) warns that "migration of populations affected by extreme events or average changes in the distribution of resources might increase the risks of political instabilities and conflicts" (IPCC 2001: 85; IPCC 2007a: 12). At present, an estimated 25 million people per year are fleeing temporarily from weather-related disasters and global warming is projected to increase this number at least eight-fold

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to some 200 million before 2050 (Myers 2002: 609). Ethnic compositions usually in flux may solidify around local resource- and identity-based conflicts as a result. The most recent drought and famine in the Horn of Africa in year is unfortunately yet another data point on this grim scatter plot since it had an immediate impact on the fluid relationships between pastoral groups. To be sure, "the ethnic composition of countries can be altered [or sharpened] by migration. This is one of the most widely cited conflict-generating effects of climate change in the literature" (Nordås/Gleditsch 2005: 18).

There is little doubt that climate change will spawn new ecological crises across Africa (Bättig/Wild/Imboden 2007) but these needn't become complex political emergencies unless perilously managed – perhaps deliberately so – by outdated strategies of war and diplomacy (Sachs 2006). Clearly then, "study[ing] the linkages between human insecurity and conflict and between humanitarian crises and conflict is vital," but these linkages "have not been as widely studied as the political and military factors that lie behind [them]" (Lacina/Gleditsch 2005: 149–150). More effective cross-disciplinary research is desperately needed to bridge the archipelago of disaster studies (Hewitt 1983a). To be sure, partitioning the general study of disasters from other fields, and partitioning specialties within disaster studies from other specialties, "creates a patchwork of isolated approaches rather than what we need: a coherent, comprehensive, and connected view" (Email by Ilan Kelman, 18 January 2007).

These isolated approaches may explain why the disaster management and conflict prevention communities hardly collaborate. Indeed, they opine that disaster and conflict early warning systems "are logically different" (Schmeidl/Jenkins 1999: 474) even though "both types of disasters have commonly led to massive internal and external displacements of people" (Ryan 1992: 166), and many such disasters, "whether man-made or natural, are interlinked, and disaster-prone regions, countries or groups are vulnerable to any kind of disasters" (Kuroda 1992: 217). In other words, "despite the different origins of disasters, they share many common elements" (Helbing/Ammoser/Kühnert 2006: 332). Moreover, there are obvious functional parallels in risk assessments, monitoring and warning, dissemination and communication, response capability and impact evaluation. These analogous functions have real operational consequences for implementing organizations and stakeholders (Brauch 2003f; Brauch/Oswald 2006).

Still, the two communities are not engaged in either joint dialogue or scientific research. This is ironic given repeated concerns that *disaster early warning* (DEW) systems are too narrowly focused on meteorological and agricultural information at the expense of socio-political indicators (Maxwell/Watkins 2003; UN 2006; Dynes 1998), while *conflict early warning* (CEW) systems are being urged to integrate environmental change indicators into their analyses (Brauch/Oswald 2006; Meier 2006). These converging trends suggest that D/CEW do share the same functional logic: early detection and early response.

92.3 Pastoral Conflict

In Genesis: "Cain said to his brother Abel; And when they were in the field, Cain rose up against his brother Able and killed him (...)." The reader will notice that what Cain actually said to Abel is omitted in the passage. One respected interpretation gives a plausible explanation: Cain and Abel had divided the world between them and Cain owned all the land and "became a tiller of soil," while Abel took possession of the livestock and "became the keeper of sheep." According to this religious commentary, Cain told Abel to get his livestock off his brother's land and this triggered the first violent conflict over resources. Pastoral conflict is certainly as old as civilization itself but is it merely a coincidence that "many of today's major conflicts are fought in pastoral regions – places such as Somalia, Afghanistan, Sudan and Palestine?" (Nori/Switzer/Crawford 2005: 3). To be sure, pastoralists are often dubbed the "climate change canaries" – the people most likely to become the first victims of world climate change according to a recently commissioned report (Christian Aid 2006: 3).

The relationship between violent conflict and pastoral groups is by no means a new one. Krati and Swift (1999) argue that a certain level of conflict is endemic to many pastoral areas. Resource-related conflicts are widespread in pastoral ecosystems and may fuel conflict as more people compete for fewer resources (Blench 1996; Klare 2001, Homer-Dixon 2001, 1995; Suhrke 1996). This necessarily presents tensions between nomadic peoples and more sedentary farmers. However, Turner (2004) argues that the source of farmer-herder conflicts in the Sahel goes beyond resource related competition. He asserts that "the complex relationships between political interests, moralities and resource access" are what "underlie these conflicts (Turner 2004: 863). Clearly, pastoral conflict

is part of a much larger literature that spans the world, it's history and questions the vary nature of human beings (McCabe 2004: 81). Since this chapter's focus is specifically on herder-herder conflicts, we turn our attention to the causes of such conflicts.

Pastoral conflict takes different forms. "Local-level conflicts over natural resources, of which livestock raiding is one specific form, are endemic in Africa's pastoral and agro-pastoral systems" (Hendrickson/Mearns/Armon 1998: 189). To be sure, raiding has been characteristic of the people living in East and West Africa for much of the twentieth century. Raiding is very much linked to pastoral traditions, which provide a right of passage for young men. Cattle give status and are used as dowry in marriage. To this end, raiding was based on clear principles of reciprocity. For example, elders from the attacking group would often notify their enemy of the approaching raid.

These days, cattle raiding and theft are thought to be the result of more complex cross-scale dynamics. Hendrickson, Mearns and Armon (1998) argue that raiding has been transformed "from a quasi-cultural practice with important livelihood-enhancing functions, into a more predatory activity," which "occurs on a very large scale, is extremely violent and is sponsored by actors from outside the pastoral sector with criminal motives" (Hendrickson/Mearns/Armon 1998: 186). It is abundantly clear that environmental factors are not the sole cause of pastoral conflicts. In seeking to identify the causes of environmental conflicts, "political ecologists follow a mode of explanation that evaluates the influence of variables acting at a number of scales, each nested within another, with local decisions influenced by regional policies, which are in turn directed by global politics and economics" (Robbins 2005: 11).

To be sure, a pastoral system represents a complex form of natural resource management, which Pratt et al. (1997) define as the direct interaction between three systems: 1) the ecosystem; 2) the social system and 3) the geopolitical system. This interaction occurs at multiple geographical and temporal scales with the interplay between endogenous and exogenous causal factors adding further complexity to the dynamic that episodically is punctuated by violent conflict.

Evidently, identifying all the possible causes of pastoral conflict poses a Herculean task and remains beyond the scope of this chapter. However, we would be remiss if we ignored other plausible causes of pastoral conflict altogether since a strict resource-scarcity approach to understanding pastoral conflict can undermine legitimate claims that socio-economic and political factors also influence the control, use and vulnerability that result from natural resource management. What follows is therefore a a very brief summary of the literature on pastoral conflict in the Horn of Africa's Karamoja Cluster and is not meant to serve as an exhaustive or comprehensive assessment.

The causes of conflict are often divided into two distinct categories – structural and proximate causes. The former are generally long-term social, economic, political and environmental processes that provide a permissive environment for violent conflict even though they only change slowly with time while the latter include more direct and immediate causes of violent conflict. Structural and proximate causes of conflict in the Karamoja Cluster can be further divided into those that are endogenous or internal to the cluster and those that are external the region.

Clearly, these categories are fluid and their borders porous. Causes and consequences of conflict tend to merge in certain circumstances with some indicators appearing both as causes and consequences (Oxfam 2004: 17). We therefore identify plausible indicators of conflict based on the loose definition of structural and proximate categories from the perspective of the three systems identified above by Pratt et al. (1997): the ecosystem, social system and global system.

92.4 CEWARN and Methodology

Established in 2003, the *Inter-Governmental Authority on Development's* (IGAD) *Conflict Early Warning and Response Network* (CEWARN) in the Horn of Africa uses events-data analysis to monitor and anticipate pastoral conflict (box 92.1). In 2005, the author helped to initiate CEWARN's collaboration with IGAD's *Climate Prediction and Assessment Center* (ICPAC) in order to network the D/CEW systems. The focus on pastoral conflict and climate change in the Horn's cross border regions is salient since similar ecological ingredients were present in the Sudan during the 1980's. Indeed, "is it merely a coincidence that many of today's major conflicts are fought in pastoral regions – places such as Somalia, Afghanistan, Sudan and Palestine?" (Nori/Switzer/Crawford 2005: 3).

Box 92.1: Facts on the CEWARN Project. **Sources**: Meier year; CEWARN website, AT. <add URL>.

CEWARN was initiated by IGAD and became operational in June 2003. Its participating Member States have been: Djibouti, Eritrea, Ethiopia, Kenya, Sudan and Kenya. Its mandate is to prevent cross-border pastoral conflict. Its geographical coverage: The Karamoja and Somali Clusters in the Horn of Africa. Its Methodology: Incident and situation reporting, event-data and baseline analysis. Important links are; <www.cewarn.org> and: <www.iss. co. za/af/regorg/unity_to_union/pdfs/igad/Protocol. pdf>.

Pastoral conflict is considered inherent to many pastoral ecosystems (Krati/Swift Box 1999). Indeed, "local-level conflicts over natural resources, of which livestock raiding is one specific form, are endemic in Africa's pastoral and agro-pastoral systems" (Hendrickson/ Mearns/Armon 1996: 189). Pastoral groups inhabit a mercurial ecological system, which can hardly be ignored as having a potential influence on pastoral conflict and beyond. Little wonder then that pastoralists have been dubbed the "climate change canaries" according to a recently commissioned report, which suggests that pastoralists in the Horn of Africa are likely to be the first people wiped out by climate change.[1]

Swisspeace and *Virtual Research Associates* (VRA) were invited by IGAD to develop and operationalize an appropriate methodology for CEWARN.[2] The project's specific focus on pastoral conflict necessitated a customized approach since "preventive action requires a degree of specificity which usually does not flow from global [or macro] indicators" (Ryan 1992: 170). VRA therefore proposed and developed a fully customized approach that went beyond Swisspeace's event-logging methodology (Bond/Meier 2005, 2006). In 2007, CEWARN field monitors use fully customized surveys to report from more than twenty locations along the borders of Ethiopia, Kenya, Somalia and Uganda –collectively known as the Karamoja and Somali Clusters (figure 92.1). Instead of event-logging, CEWARN integrates two types of complementary, standardized and structured surveys: 'incident reports' and 'situation reports'.

Incident Reports (IncReps) are surveys used to document specific incidents of pastoral conflict that CEWARN seeks to prevent. Local area experts from Ethiopia, Kenya and Uganda identified these incidents during a series of indicator workshops. IncReps are used to record '*who did what to who, where, when* and *how*', when these incidents occur. IncReps also document the consequences of individual incidents. In addition, each report includes measures for quality control and a short textual description or narrative of the incident, which provides the context for subsequent interpretation. Like Swisspeace's event-logging approach, Incident Reports are completed episodically, that is, when incidents occur. However, "everyone knows at least since David Hume that we have no reason to believe that the association of events provides a basis for inferring the presence of a causal relation" (Waltz 2000: 9). Furthermore, since the purpose of early warning is to anticipate these incidents *before* they occur, this retroactive approach misses the point. Early warning analysis must move beyond the event-logging approach to context-based, forward-looking methodologies that monitor precursors to peace and conflict.

Figure 92.1: The dotted area represents the Karamoja and Somali Clusters that have been monitored by CEWARN. **Source:** This map was prepared by this author.

1 Christian Aid, 2006; "Life on the Edge of Climate Change: The Plight of Pastoralists in Northern Africa"; at: <www.christian-aid.org.uk/indepth/0611climatechange 2/kenya_climatechange.pdf>.

2 The author was previously a consultant to FAST, VRA and IGAD between 2003–2006, but all information included in the chapter is publicly available.

This explains why CEWARN uses *Situation Reports* (SitReps). The purpose of SitReps is to monitor situational processes that render the likelihood of those incidents both more *and* less likely. In other words, SitReps use a weighted scale to monitor both precursors and mitigating processes associated with pastoral conflict incidents. Relevant situational processes were identified and 'unpacked' into discrete events by local area experts with extensive knowledge of pastoral livelihoods. In other words, precursors and mitigating factors were translated into physically observable indicators. It is important to note that SitReps monitor a wide range of events. These include events associated with communal relations, civil society activities, economic activity, governance and media, natural resource use and disasters, safety and security, and social services. Like IncReps, each Situation Report includes contextual descriptions of evolving situations. Unlike IncReps, they are completed on an episodic basis, currently weekly; thus ensuring that processes are monitored systematically.

By complementing these two types of surveys, CEWARN can empirically verify which precursors of pastoral conflict (documented in SitReps) are most closely correlated with subsequent pastoral conflict incidents (tracked in IncReps). Furthermore, by monitoring precursors of conflict (and not just outcomes), CEWARN may be in a position to respond to an increasing frequency of precursor events *before* these translate into irreversible incidents – such as the body counts documented in IncReps. In other words, developing SitRep baselines of precursor events is tantamount to monitoring social vulnerability and needs, while baselines of mitigating factors quantify changes in social resilience since they focus on "what is already in place: resources and adaptive capacities" (O'Brien/O'Keefe/Rose/Wisner 2006: 71).

Box 92.2: CEWARN Reports along with the aggregated data are available on-line at: <www.cewarn.org> for the time period from April 2004 to August 2006 (update).

Bond and Meier (2006) describe an early success story at CEWARN: "In July 2003 a field reporter submitted a report of a pre-raid blessing. This kind of a report is considered a signal or trigger for acute conflict in the near term, as a raid typically follows the blessing. Upon reviewing this field report, a CEWARN staff member in Addis called the country coordinator responsible for quality control in that area, and he in turn called the field monitor. Several telephone discussions later, the local police agency in the area was informed of the impending raid. The police responded by holding a previously scheduled training exercise in proximity to the two parties identified by the field reporter. The bottom line is that no raid occurred" (Bond/Meier 2006: 132). However, it should be noted that this success was not due to CEWARN's analysis of incident and situation reports (i.e., academic analysis) but rather through a process akin to signals intelligence. Also telling is the fact that only a handful of other potential success anecdotes have surfaced. This may suggest that an institutionalized, bureaucratic approach to early warning may have serious limitations.

Using a data-driven approach to humanitarian reporting means that the information collected is amenable to statistical and geospatial analyses. Indeed, the data collected using Incident and Situation Reports can be used in baseline or time-series analysis to identify trends and anticipate subtle changes in vulnerability that may lead to complex emergencies crises. Such changes or inflections in baselines may signify a deviation from the 'norm' which may indicate the need for early response. To be sure, "understanding structural causes [or processes] and recognizing the events and actions that lead to conflict should highlight potential moments and fields for intervention" (van de Goor/Verstegen 1999: 4).

Baseline analysis is thus "the fundamental building block of a rational information system" since "proper baseline data make it possible to identify the most critical information types for early warning" (Maxwell/Watkins 2003: 76, 87). Moreover, baselines analysis permits the testing of counterfactuals, which is "an essential tool because the concrete event is too complex to subsume under causal generalizations or theoretical laws" (Griffin 1993: 1101). At the same time, textual descriptions or narratives included in the Incident and Situation Reports provide the necessary context to interpret and comprehend change. "Events, then, are our points of access to structuring and narratives are how we describe, reconstitute and comprehend events" (Griffin 1993: 1098). The bottom line is that the use of both Incident and Situation Reports produces more reliable baselines.

This approach may then provide an advanced warning of impending incidents directly relevant to pastoral conflict, thus rendering systematic conflict prevention more than a hypothetical possibility. In addition, by monitoring mitigating processes, CEWARN can identify the "causes of resilience" or local knowledge and coping mechanisms employed by indigenous stakeholders when confronted with stressful situations produced by conflict and/or environmental change (Walker 1992). Information on the drivers of resilience is invaluable since recognized trends in coping mechanisms can serve to guide and inform early response and capacity building with respect to livelihoods (Meier/Zambiras 2006). The section that follows outlines how conflict systems networked with disaster systems can be adapted to inform prevention and mitigation strategies in response to climate change.

92.5 Networking Early Warning for Climate Change

Taking a multi-hazard approach by monitoring both events and the situations that lead to them is a critical component of a robust early warning and response system, particularly within the context of climate change (Reid 2006; Maxwell/Watkins 2003). This is because "disasters triggered by environmental phenomena do not cause political change, rather they act as catalysts that put into motion potentially provocative social *processes* at multiple social levels" (Pelling/Dill 2006: 4). Put differently, there is a subtle but fundamental difference between disasters [processes] and hazards [events], a distinction that Jean-Jacques Rousseau first articulated some two hundred years ago after Portugal was shaken by an earthquake in 1755.[3] In a letter to Voltaire one year later, Rousseau notes that, "nature had not built the houses which collapsed and suggested that Lisbon's high population density contributed to the toll" (Kelman 2007).

In other words, natural events are hazards and exogenous while disasters are the result of endogenous social processes (Oliver-Smith 1986; Glantz 1994; Hewitt 1995; Cardona 2004).[4] As Rousseau added in his note to Voltaire, "an earthquake occurring in wilderness would not be important to society" (Kelman 2007). That is, a hazard need not turn to disaster since the latter is strictly a product of social processes (O'Keefe/Westgate/Wisner 1976; Lewis 1988; Kelman 2007). And so, while disasters were traditionally perceived as "sudden and short lived events, there is now a tendency to look upon disasters in African countries in particular, as continuous processes of gradual deterioration and growing vulnerability," which has important "implications on the way the response to disasters ought to be made" (cited in Rupesinghe 1988: 219). But before we turn to the issue of response, what does the important distinction between events and processes mean for early warning?

In *The Poverty of Historicism* (1944), the Karl Popper distinguished between two kinds of predictions: "We may predict (*a*) the coming of a typhoon [event], a prediction which may be of the greatest practical value because it may enable people to take shelter in time; but we may also predict (*b*) that if a certain shelter is to stand up to a typhoon, it must be constructed [process] in a certain way" (Popper 2002: 38). A typhoon, like an earthquake, is certainly a hazard, but it need not lead to disaster if shelters are appropriately built since this process culminates in minimizing social vulnerability. In contemporary disaster research, "it is generally accepted among environmental geographers that there is no such thing as a natural disaster. In every phase and aspect of a disaster – causes, vulnerability, preparedness, results and response, and reconstruction – the contours of disaster and the difference between who lives and who dies is to a greater or lesser extent a social calculus" (Kelman 2007).

The vulnerability or resilience of a given system is not simply the outcome of future events since vulnerability is the complex product of past political, economic and social processes (O'Keefe/Westgate/Wisner 1976). "The role of vulnerability as a causal factor in disaster losses tends to be less well understood, however. The idea that disasters can be managed by identifying and managing specific risk factors is only recently becoming widely recognized" (Dilley/Chen/Deichman/Lerner-Lam/Arnold with Agwe/Buys/Kjekstad/Yetman 2005: 19). This explains why past "discussions with regard to early warning systems

3 This event triggered earthquake research in Europe and also served as the focus for various publications, ranging from Kant's (year) essay about the causes of earthquakes to Voltaire's "Poème sur le désastre de Lisbonne" (Jentsch/Kantz/Albeverio 2006).

4 The endogeneity argument holds for society as a whole, but not necessarily for specific communities, countries, or regions. All disasters result from social processes, but many disasters result from social processes external to the community, which experiences the disaster.

have emanated from a concern with the early prediction and reporting of events [instead of processes] which could lead to social disasters" (Rupesinghe 1988: 224).

Consider an hourglass or sand clock as an illustration of vulnerability-as-causality. Grains of sand sifting through the narrowest point of the hourglass represent individual events or natural hazards. Over time a sand pile starts to form, which represents the evolution of society or the connectedness of a social network. Occasionally, a grain of sand falls on the pile and an avalanche or disaster follows.[5] Why does the avalanche occur? One might ascribe the cause of the avalanche to one grain of sand, i.e., a single event. On the other hand, a systems approach to vulnerability analysis would associate the avalanche with the pile's increasing slope and to the connectedness (or population density) of the grains constituting the pile since these factors render the structure increasingly vulnerable to falling grains. Left on its own, the sand pile's stability, or the social network, becomes increasingly critical or vulnerable.[6]

From this perspective, "all disasters are slow onset when realistically and locally related to conditions of susceptibility" (Lewis 1988: 4). A hazard event might be rapid-onset, but the disaster, requiring much more than a hazard, is a long-term process, not a one-off event. We must therefore "reduce as much as we can the force of the underlying tectonic stresses in order to lower the risk of synchronous failure – that is, of catastrophic collapse that cascades across boundaries between technological, social and ecological systems" (Homer-Dixon 2006: 281).

Unlike the clock's lifeless grains of sand, human beings can minimize their vulnerability to exogenous shocks through disaster preparedness, mitigation and adaptation. In doing so, individuals can 'flatten' the structure of the sand pile into a less hierarchical system and thereby shift or diffuse the risk of an avalanche.[7] In conflict prevention terms, this means structural prevention, which typically focuses on local livelihoods and local capacity building. Early warning should thus seek to monitor both the falling grains *and* the vulnerability of the sand pile to determine the risk and magnitude of an avalanche. In more formalistic language, a dual approach is important because it is not always clear *a priori* whether a disaster is due to a strong exogenous, to the internal dynamics of the system or a combination of both (Sornette 2006). As the disaster management community has learned, in "support[ing] good decision-making, the issue is not one of being able to predict the unpredictable. Rather, the fundamental question is that, given that we cannot have reliable predictions of future outcomes, how can we prevent excessive hazard levels today and in the future in a cost-effective manner?" (Chadná/Motchanova/Obersteiner 2006: 296). To this end, risk is often defined as the product of hazard, exposure[8] and vulnerability (some divide this product by resilience which is a function of knowledge and capacity):

$$\text{Risk} = (\text{Hazard} \times \text{Exposure} \times \text{Vulnerability}) / \text{Resilience}$$

This explains why a simple event- or hazard-logging approach to D/CEW is sub-optimal.[9] D/CEW systems should systematically focus on both events *and* processes in order to calculate and forecast both the risk of a typhoon and the resilience of a shelter. This requires cross-disciplinary collaboration between "geologists, seismologists, meteorologists and other scientists who can monitor and predict hazards, while social scientists are brought in to explain people's behavior in response to risk and disaster and to develop early warning mechanisms and disaster preparedness schemes" (Hillhorst 2004: 52). In other words, close cross-disciplinary collaboration between the D/CEW communities from both the Global North and South is critical, as is the participation of local stakeholders.

5 Note that this analogy is more than simply conceptual; the distribution of avalanches in sand piles with respect to frequency and magnitude follows a power law, i.e., frequency and magnitude are inversely proportional. The distribution of fatalities resulting from natural disasters and armed conflict also follows a power law (see Meier/Spagat/Becerra/Restrepo 2006).

6 This is an ordinary process in complex systems called self-organized criticality.

7 The author realizes that social and physical systems are not closed, as the hourglass analogy would suggest. In addition, within the context of climate change, avalanches in the sand pile have a feedback effect on the frequency and magnitude of the falling sand. In other words, human-induced climate change "emphasizes the mutuality of hazard and vulnerability to disaster due to complex interactions between nature and society" (Hilhorst 2004: 53).

8 This parameter is particularly salient in face of climate change since exposure times are increasing while recovery times between disasters are being reduced (Walker 2006; Maxwell/Watkins 2003).

9 Earthquake physicists do not only document where and when earthquake events take place, they focus predominantly on the composition of fault processes (Stein 2005).

If event-data analysis is to be used as a platform to network D/CEW, then ecological causes of conflict need to "be concrete events specific to concrete situations" (Vayda/ Walters 1999: 171). In this respect, "if the object of explanation is truly to be environmental change," the methodology used to network early warning within the context of climate change might be characterized as an event-focused approach to ecological study, or "event ecology" (Lees/Bates 1984: 78). This method focuses first and foremost on "the environmental events or changes that we want to explain and then work[s] backward in time and outward in space so as to enable us to construct the chains of causes and effects leading to these events or change" (Vayda/Walters 1999: 169).

Event ecology is compatible with an events-data approach to CEW since the latter already uses data-driven analysis as a framework for reporting and analysis. An integrated events-data approach to disasters, conflicts and climate change may therefore provide an appropriate platform upon which to network D/CEW. However, given the importance of monitoring processes, this platform must not be limited to basic event-logging but should instead adopt the 'incident' and 'situation reporting' methodology developed by CEWARN. Furthermore, relevant ecological processes relevant to violent conflict should be identified in collaboration with local stakeholders and the climate scientists at ICPAC. These can then be networked into CEWARN's SitReps as discrete observations that serve as precursors or mitigating factors to pastoral conflict. In other words, contrary to recent recommendations that DEW should focus more on social and political indicators, the author maintains that D/CEW systems should maintain their individual comparative advantages and simply collaborate by 'trading' raw data in real-time.

With this in mind, a recent pilot study has demonstrated empirically the added value that closer collaboration between the D/CEW communities can offer.[10] Given pressing concerns over the implications of climate change for pastoral conflict in the Horn of Africa, the author drew on geo-referenced "event ecology data" from the *Livestock Early Warning System* (LEWS), the *Malaria Early Warning System* (MEWS) and IGAD's *Climate Prediction and Assessment Center* (ICPAC) to create baselines for forage, rainfall and vegetation availability respectively. By using *geographic information system* (GIS) data, these baselines or time-series were comparable to CEWARN's conflict baselines in both time and space. This study would *not* have been possible without CEWARN monitoring both events *and* processes.

Meier, Bond and Bond (2007) have demonstrated the potential added value of D/CEW by linking CEWARN with LEWS and MEWS by drawing on GIS data and analysis. Their preliminary findings, based on several multivariate regressions, suggest that the availability of vegetation is directly proportional to the social triggers of pastoral conflict with a two-to-three month lag. In other words, the correlation between high vegetation and high conflict triggers appears to be statistically significant at the 95 per cent confidence level, which may at first seem counterintuitive (Meier/Bond/Bond 2007). One of the advantages of networking disaster and conflict early warning systems is that results can be interpreted in an integrated manner. This can illuminate the influence of intervening factors. Upon further cross-disciplinary research, the key to explaining the results lay in raiding tactics. Indeed, as grasses grow tall, pastoralists seeking to raid cattle gain cover and therefore the advantage of surprise. Given that ICPAC provides high-resolution vegetation forecasts several months in advance, systematically integrating this ecological indicator (and others) into CEWARN's analysis is long overdue. An integrated approach may become even more pressing given the impact climate change is expected to have on pastoral societies worldwide. This warrants closer institutional collaboration between conflict and disaster early warning systems. However, such collaboration should not be limited to early warning only, but must also include early response.

92.6 In Response to Early Warning

The process of decision-making in the context of early warning is fraught with organizational barriers (Campbell/Meier 2007). That said, the disaster management community has made more progress in identifying and tackling these barriers than the conflict prevention community. They have also been in the business of early warning for longer than those engaged in conflict early warning. However, the two communities rarely share lessons learned and best practices (Brauch/Oswald 2006; Meier 2006), which may explain why conflict early warning systems continue to be 'wired' vertically – that is, early warning information is centralized and transmitted hierarchically (Barrs 2006).

10 For a detailed cross-disciplinary analysis of early response form a complex systems perspective, see Meier (2007).

Why are these systems vertically wired in the first place? Because first generation conflict early warning systems were designed with Western interests in mind – to control and remain abreast of escalating violence well beyond their own borders. Admittedly, "the social process of prediction, whether of physical or social events, is to secure a measure of control" (Rupesinghe 1988: 217). This explains why CEW is still largely an "exercise in understanding how what is happening over there comes be known [and controlled] by us over here" (Adelman 1998: 2). These centralized systems reflect the hierarchical power structures that already exist in international relations. They rarely recognize that "a democratic flow of information is the first condition for a democratic and open system of warning and resolution" (Rupesinghe 1988: 221). Indeed, a democratic approach to local early response for civilian networks in zones of conflict does not figure prominently since conventional systems take a hierarchical and egocentric view of early warning. In fact, local at risk communities often remain completely unaware that formal warning systems even exist (Barrs 2006), which means they exclude the real stakeholders even though "humanitarian early warning is [allegedly] based on protecting the interest of others who are at risk" (Schmeidl/Jenkins 1999: 482).

The central question is who controls or owns the information? Put differently, it is "not only timeliness and effectiveness, but also the question of whose interests are to be served," that matter in early response.[11] Furthermore, even though CEWARN is headquartered in Addis Ababa and not in Berne, the initiative still remains too hierarchical for early warning information to be customized to meet the *demands* of the end users. Some have described this using the analogy of planning food for a dinner party. "We not only need to know how many people are coming but who is coming, the time of the day, and the season. Without such knowledge, we may prepare the perfect dinner for the wrong set of people" (Krummenacher/Schmeidl 2001: 6).

However, the real stakeholders – the communities at risk – may not actually be on the guest list in the first place. As consumers of early warning information, we buy expensive alerts, flashy bulletins and colorful reports. Our early warnings are e-mailed around the world in the blink of eye but "rarely touch the ground where the killing happens. They fly through cyberspace, high over the victim's heads. People at risk on the ground might never learn that the *demarches* we write on their behalf even exist" (Barrs 2006: 2). And so, the rhetoric labels the communities at risk as "the intended beneficiaries; but, in practice they [are] not the real clients of early warning activities" (Stephen 2004: 106). From the perspective of vertically wired early warning systems, "we [the West] are the rescuers; aid does not start until we arrive" (Barrs 2006: 1). Unfortunately, we rarely arrive – Darfur being just one tragic example among dozens of "neglected crises" in addition to numerous so-called "forgotten emergencies" (World Disaster Report 2006).

The trouble with CEWARN and similar systems such as FAST is that they are designed to trigger a response from the outside. When early warning is targeted vertically, "that is from the informants to their headquarters – there must be an onus upon the headquarters to act. There is little point in investing in warning system if one then ignores the warnings!" (Walker 1992: 102). To be clear, "early warning should not be an end in itself. ... The real issue is not detecting the developing situation, but reacting to it" (Kuroda 1992: 217). Accountability and incentives to react, however, are often a function of scale. That is, communities at risk 'on the ground', are more likely to respond to conflict than a bureaucratic organization situated several thousand miles away. The limited ability to operate at the scale that generates a manageable or self-organized incentive structures for early response is another drawback of centralized early warning systems.

The field of disaster management has recognized that incentive structures are more likely to reside with the local communities themselves. The UN Global Survey of Early Warning Systems (2006: 2) defines the purpose of people-centred early warning systems for natural disasters as follows: "to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life, damage to property and the environment, and loss of livelihoods." This explains why "increasing attention is now paid to the capacity of disaster-affected communities to 'bounce back' or to recover with little or no external assistance following a disaster" (Manyena 2006: 433). To this end, people-centered early warning in the context of conflict prevention would "seek to inculcate a situational or security awareness within high-risk communities as it builds on local capacities to address and reduce their vulnerabilities in a sustainable way, which differs from the traditionally more 're-

11 Email exchange with Professor George Kent, 3 February 2007.

mote' and 'vertical' monitoring" (Bond/Meier 2006: 130).

Although the conflict prevention community has yet to embrace a new discourse let alone a people-centred approach, nonviolent social movements may be the closest parallel to people-centred warning systems for natural disasters. Indeed, lessons learned in disaster early warning systems suggest that, "the usefulness of this [people-centred] approach lies not so much in predicting ..., but in building up a strong partnership between local community and the relief agency" (Walker 1992: 103). Similarly, "prevent[ing] violent conflict requires not merely identifying causes and testing policy instruments but building a [social and] political movement" since "the framework for response is inherently political, and the task of advocacy for such response cannot be separated from the analytical tasks of warning" (Rubin 2002: 37–38, 147).

Why then are CEW and nonviolent movements erroneously assumed to be conceptually and operationally distinct in the practice of conflict prevention? Isn't communication central to both early warning and nonviolent action? Indeed, and some of the most successful nonviolent campaigns detailed in numerous case studies turned on the ability to get accurate, timely information (Ackerman/Kruegler 1994). The literature on military history also demonstrates that "success in counter-guerrilla operations almost invariably goes to the force which receives timely [local] information" (Thompson 2002: 52).

Reliable people-centred early warning is also vital when conducting manoeuvres of defensive dispersion within the context of strategic nonviolence. Tactical evasion is a central component of strategic nonviolence: people must be capable of concealment and dispersion. However, getting out of harm's way and preparing people for the worst effects of violence requires sound intelligence and timely strategic estimates (Helvey 2002). To be sure, a realistic appreciation of impending violence based on people-centred early warning makes it possible to motivate civilian groups to respond early in conceiving plans for evasive action and protection. At-risk communities can, for example, "learn what dispersed and hidden livelihoods look like. They can be shown how they might dismantle their village homes and build temporary huts near their fields as the Vietnamese sometimes did in the face of American airpower. Or use crop colors and canopies that are less noticeable from the air, as Salvadoran peasants sometimes planted" (Barrs 2006: 7). In sum, indigenous strategies have almost always been the predicate for successful resistance to oppression (Merriman/DuVall 2007).

Box 92.3: Overview of case studies on people-centred early warning systems.

There are very few case studies available that assess the implementation of a people-centered approach to conflict early warning. However, two are worth noting here. The first is the "Early Warning for Violence Project" developed by the Foundation for International Tolerance. The project started in June 2005 with participation of IFES, UNDP, OSCE, and the Swiss and US governments. From the start of the project a nation-wide network of monitors was established who reported about all cases of socio-political violence and tensions that could lead to violence. Initially, there was a special focus on conflicts related to the presidential and local elections. Analysis and recommendations were made public through a weekly bulletin and regular briefings. The project administered an emergency fund to which organizations could apply for small grants for urgent conflict intervention. Mediation activities and round tables were organized. From January 2006, only the early warning component was continued, until the end of the first phase in May 2006. In the current project phase, there is an equal focus on early warning and on early response. The project has resumed publication of its weekly bulletin and will also undertake thematic researches. It's revised early response strategy is focused on offering consultancy, training, problem-solving workshops, and mediation to individuals, organizations and state bodies. The project is closely working with a network of interveners.

The second project is more recent and based in Timor-Leste. The country's only national NGO, BELUN, is launching a new project to enhance security and community resilience in Timor-Leste through the establishment of an early warning and response system. Unlike the typical one-directional hierarchical warning systems that exist, BELUN has recognized that a two-pronged approach to conflict early warning and response is required – a national level and a community level. The vast majority of early warning projects mistakenly assume that one methodology – usually highly academic and quantitative – can address and respond to the needs of both sets of stakeholders. This is far from being the case and BELUN is therefore combining incident and situation field reporting for national-level stakeholders with preparedness and contingency planning at the community level. This very much reflects the people-centred approach taken in the

context of disaster management. Instead of preparing for possible flooding or earthquakes, local communities draw on existing capacities for conflict management with additional training by BELUN. This encourages local communities to identify threats of violence ahead of time but more importantly this approach creates a space for communities to develop action-oriented scenarios for early response. The first phase of the project was completed in February 2007. BELUN's early warning project holds great promise and may soon become a model for developing people-centred conflict early warning and response networks.

Unlike highly technical and hierarchical early warning systems, nonviolent social actions are more effective in responding to conflict since they recognize the inherently political nature of armed conflict. According to the nonviolence literature, the organizational template most useful in responding to repressive environments is a community-based network rather than a hierarchical structure since networks are more likely to innovate tactically and weather repression (Stephan 2006; Allen Nan 2006). Indeed, "networks are more flexible and effective than hierarchies in responsiveness to changing conditions: new information is more easily disseminated, interpreted, and acted on without the constraint of passing information or searching for resources up and down a hierarchy" (Ibarra 1992: 169). This explains why "nonviolent action is non-institutional; it operates *outside* the bounds of the institutionalized political channels" (Kurt 2003: 705). The operational parallels between strategic nonviolence and would-be people-centred conflict early warning systems are striking and the commonalities merit further exploration.

92.7 Conclusion

The initiative to network CEWARN and ICPAC revealed that certain environmental factors influence conflict behaviour via the role of tactics. Understanding the role of intervening factors is critical for early response, and the use of events-data – only when complemented with situation reporting – can serve to untangle the multiple but interde-pendent crises that characterize complex emergencies, especially within the context of climate change. At the same time, the fact that tactics and the environment play a role in pastoral conflicts is already well known to local stakeholders (box 92.4).

This explains the need for people-centred early warning, which in no way excludes the competent use of rigorous analysis or the parallel pursuit of more technical initiatives. Indeed, traditional coping mechanisms depend on the ability to anticipate hazard patterns, which are increasingly erratic with the advent of climate change. This means technological systems are also needed. In other words, both hierarchical and people-centered systems have distinct comparative advantages. Therein lies the added value of networking formal disaster and conflict warning systems such as CEWARN and ICPAC. To this end, a multi-track approach to early warning is perhaps the most prudent strategy to manage the conflation of conflict and climate change.

This exercise should not be an end in itself, however. Pathways for technology transfer need to be identified and community-based protocols implemented to mitigate the impact of environmental conflict and create alternative futures (Pattie 2006; Corbacioglu 2006). This means promoting traditional knowledge systems for risk reduction and blending high technology with indigenous settings (Pattie 2006; Abramovitz 2001). The added value of centralized and technological early warning systems should therefore be strictly judged on their empowerment of local people-centred systems. Put differently, formal early warning systems should seek not to supplant but instead aim to support local and informal warning systems, much akin to those operational in nonviolent movements. As the literature on strategic nonviolence clearly demonstrates, early warning works and saves lives. The most versatile and successful organizational templates in this respect are decentralized, horizontal networks. This stands in stark contrast to the typically hierarchical and centralized conflict early warning systems such as CEWARN and FAST that continue to demonstrate little to no return on investment in terms of successful early responses.

Box 92.4: Observed and projected demographic and climate change in the IGAD region. The data should be broken down for the IGAD countries. **Source**: <http://hdr.undp.org/en/statistics/data/>.

Population (millions)	1975	2005	2015	Annual Growth rate 2005-2015
Ethiopia	34.2	79	101	2.8
Kenya	13.5	35.6	46.2	3.2
Sudan	16.8	36.9	45.6	2.6
Uganda	10.9	28.9	40	3.3
Total/Average	75.4	180.4	232.8	2.975

According to the most recent global warming models produced in August 2007, there are indications for an upward trend in rainfall over much of Kenya, Uganda, and southern Somalia. Wet extremes are projected to increase during both rainy seasons. In general, the simulations project a positive shift in the whole rainfall distribution over most of east Africa during both rainy seasons. While this means more surface water for pastoralists, flash floods and flooding in general can lead to mass cross-border displacement as well as shortages in forage availability.

Source: <http://www.knmi.nl/africa_scenarios/East_Africa>.

In terms of other strategies and recommendations, further studies on local human adaptability in decentralized settings as well as self-adaptation in dynamic disaster environments may also shed light on new principles for early warning and response. To this end, a promising avenue might be the development of new protocols and principles based on self-organizing and adaptable systems. To be sure, social systems evolve and adapt, which explains why "in a world where centralized modes of risk management lose effecttiveness, we also see tendencies toward increased cross-sectional complexity, increased effective participation by people, broadening liability on international scales and a move towards a 'claim culture'" (Chadná/Motchanova/Obersteiner 2006: 317). However, responding to this claim culture with more hierarchical early warning systems is unlikely to render at-risk communities more resilient to global environmental change and security threats. Ultimately, what is required is a less egocentric approach to early warning and response – one that seeks "the proper balance between the need for external assistance and the capacity of local people to deal with the situation" (Bankoff / Hilhorst 2004: 33).

93 Vulnerability Assessment in Sri Lanka in the Context of Tsunami Early Warning

Juan Carlos Villagrán de León

93.1 Introduction

The tsunami of 26 December 2004 was a catastrophic disaster where fatalities could have been minimized if there had been an early warning system in operation and people in coastal areas would have been aware how to respond effectively to such a warning. The event caused over 250,000 fatalities, more than half of them in the Aceh province of Indonesia alone, and many others in countries as far away as Africa.[1]

In Sri Lanka, over 34,000 fatalities were reported by the *National Disaster Management Centre* (NDMC), the agency in charge of coordinating the response efforts. Material losses included the destruction of public and private infrastructure, segments of important telecommunication and energy networks, as well as train and road infrastructure. As a consequence, the country experienced a disruption in processes and services which are part of the framework of development.[2] Table 93.1 presents a summary of impacts due to a variety of natural events based on the OFDA-CRED database on Sri Lanka (1957–2007) highlighting the impacts of the tsunami.

While it is important to recognize that not all these losses could have been avoided with the use of an early warning system, the question remains whether fatalities and injuries could have been far greater should the tsunami have taken place on a weekday, when markets are extremely crowded and schools are in full operation, congregating large numbers of children in each facility.

Unfortunately for Sri Lanka and for many other countries, tsunamis were totally out of the picture in the framework of disaster preparedness prior to this event. The 2003 floods and landslides which provoked disasters in urban and rural communities of several provinces of Sri Lanka prompted the NDMC to set up a programme focusing on disaster preparedness in the five most affected districts at that time (table 93.2).

1 The *Centre of Research on the Epidemiology of Disasters* (CRED) database provides information on the impacts at the level of countries in terms of numbers of people killed, injured, affected, as well as economic losses for this and other events. Munich-Re Foundation (2004) reported data on insured and non-insured losses. Within the *United Nations Organizations* [UNO], several of its agencies published reports documenting impacts at the national level. UNDP-BCPR maintains a web page with documents related to rapid impact assessments and situation reports which emerged in the days and weeks following the tsunami for many countries affected by the tsunami. In addition, the *Asian Development Bank* (ADB) carried assessments of the impacts of the tsunami in several of the countries which were impacted by this event to define a strategy to support reconstruction and recovery efforts. For a detailed survey of impacts on infrastructure related to the tsunami see: Iwan (2006) .

2 Data on casualties and injuries within Sri Lanka, like in the case of other countries impacted by the tsunami, were initially gathered and reported by the national agency in charge of disasters. In the case of Sri Lanka, the *National Disaster Management Centre* (NDMC) took this role through an information centre established for that purpose. Impacts in terms of people killed or affected can also be found on the database maintained by CRED. A more comprehensive survey of impacts was carried out by the Department of Census and Statistics of Sri Lanka in 2005. Data are reported at the national, provincial, district, and division level on a variety of topics. In the context of the *United Nations* (UN), the *International Labour Organization* (ILO) carried out a rapid assessment of the impacts of the tsunami on livelihoods in affected regions of this country. The *United Nations Environment Programme* (UNEP) conducted an assessment of the impacts to the environment. However, there are discrepancies in the numerical data reported by some agencies due to the way in which surveys were conducted.

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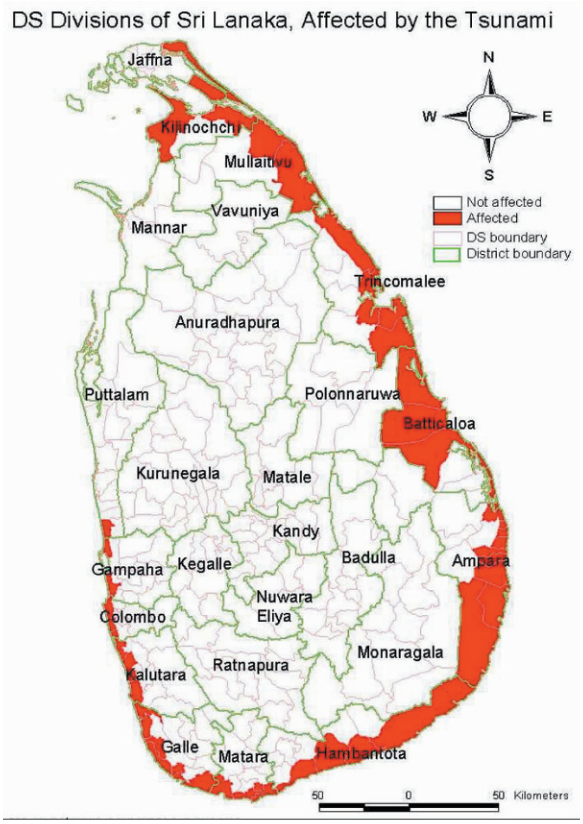


Figure 93.1: Coastal regions of Sri Lanka affected by the 26 December 2004 tsunami. **Source**: Sri Lanka, Department of Census and Statistics, public domain, permission is granted.

With the support of the *United Nations Development Programme* (UNDP), the NDMC promoted the establishment of inter-institutional Disaster Management Committees at the district level, and the subsequent elaboration of emergency and early warning plans. Unfortunately, tsunamis were not considered in such plans prior to the 26 December 2004 tsunami. In fact, in the District of Galle, one of the five districts selected by the NDMC for this programme, the *Asian Disaster Preparedness Centre* (ADRC 2005) conducted a perception survey on tsunami awareness which concluded that 94 per cent of the residents had very little knowledge regarding tsunamis. Thus, even if a warning would have reached the coastal population, people would probably not know how to react to such a warning.

A parallel survey conducted in the Nias district in Indonesia by ADRC (2006) concluded that 56.6 per cent of the residents had no prior knowledge about tsunamis, and 26 per cent had very limited knowledge about tsunamis at all. Belonging to the class of very infrequent events, tsunamis have been neglected over decades in most efforts focusing on disaster preparedness. In Latin America, a similar trend would surely take place with respect to the term 'tsunami', as the more traditional term is 'maremoto' (seaquake).

The tsunami revealed the vulnerability of people, infrastructure, processes, and services in many coastal cities along the Indian Ocean. With over a quarter of a million people killed, in particular more children and elderly than adults; the tsunami destroyed thousands of houses which were not built to stand the direct impact of such a wave, and disrupted lifelines and services provided by both the government and the private sector. As such, the tsunami displayed the physical, social, economic, and environmental dimensions vulnerability of urban and rural areas along the coastlines of those countries which were impacted. In the context of people, the event manifested gender and age-related differential aspects with respect to the social dimension of vulnerability. Such differential aspects of vulnerability need to be highlighted and linked to early warning practices.

The chapter stresses two important issues: the need to recognize differential vulnerabilities related to age and gender characteristics of the population, and the need to use such information to develop effective warning strategies which reach such vulnerable groups in order to improve the degree of preparedness of coastal communities and minimize loss of lives.

After introducing a risk model (93.2), the chapter begins with a discussion focusing on such gender and age-related aspects which depict the differential character of social vulnerability (93.3), and then assesses the exposure of vulnerable groups to the tsunami hazards using as a practical example the coastal city of Galle in Sri Lanka to deduce public warning strategies (93.4). It concludes with a discussion regarding the shift from risk assessment to early warning (93.5) and other types of vulnerabilities in early warning (93.6), and a few concluding remarks (93.7)

Table 93.1: Summarized Table of Natural Disasters in Sri Lanka from 1957 to 2007, **Source:** EM-DAT: The OFDA/CRED International Disaster Database (Brussels: Université catholique de Louvain, Data version v03.07); at: <www.em-dat.net> (12 November 2007).

†	Events	Killed	Injured	Homeless	Affected	Total Affected	Damage US$ (000's)
Drought	8	0	0	0	6,256,000	6,256,000	0
av. per event		0	0	0	782,000	782,000	0
Epidemic	5	58	0	0	206,777	206,777	0
av. per event		12	0	0	41,355	41,355	0
Flood	39	993	1,002	2,746,601	6,849,408	9,597,011	373,444
av. per event		25	26	70,426	175,626	246,077	9,575
Slides	3	119	0	0	130	130	0
av. per event		40	0	0	43	43	0
Wave / Surge	1	35,399		480,000	516,130	1,019,306	1,316,500
av. per event		35,399	23,176	480,000	516,130	1,019,306	1,316,500
Wind Storm	5	1,151	5,000	100,000	1,913,000	2,018,000	137,300
av. per event		230	1,000	20,000	382,600	403,600	27,460

Table 93.2: Top 10 national disasters in Sri Lanka with regard to people killed, affected and economic damage. **Source:** EM-DAT: *The OFDA/CRED International Disaster Database* (Brussels: UniversitÈ catholique de Louvain, Data version v03.07); at: <www.em-dat.net> (12 November 2007).

Disaster type	Date	Number Killed	Number Affected	Damage US$ (000's)
Wave / Surge	26 December 2004	35,399	1,019,306	1,316,500
Wind Storm	24 November 1978	740	1,005,000	100,000
Flood	30 May 1989	325	501,000	35,000
Flood	17 May 2003	235	695,000	29,000
Wind Storm	22 December 1964	206		37,300
Wind Storm	25 December 1957	200		
Slides	8 October 1993	65		
Flood	25 December 1969	62	1,000,000	8,500
Epidemic	November 1987	53		
Flood	24 May1984	45		
Drought	1987		2,200,000	
Drought	September 1982		2,000,000	
Flood	December 1983		1,250,000	
Drought	September 2001		1,000,000	
Drought	August 1988		806,000	
Flood	5 June 1992			250,000
Flood	2 June 1991			30,000
Flood	September 1966			5,000
Flood	18 October 1967			3,000

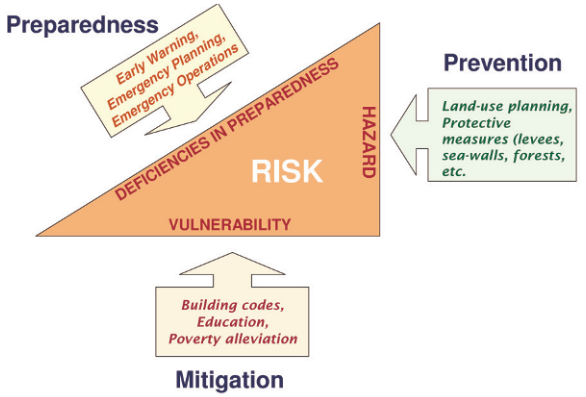
93.2 Linking the Elements: The Risk Model

As stated by the *Platform for the Promotion of Early Warning of the International Strategy for Disaster Reduction* (PPEW-ISDR 2006), an effective tsunami early warning system needs to incorporate four elements:

- Prior knowledge of risks faced by communities;
- Technical monitoring and warning service for these risks;
- Dissemination of understandable warnings to those at risk;
- Knowledge and preparedness to act.

While the second and third elements have usually been addressed in traditional early warning systems, the first and fourth components emerge when analysing gaps in such existing systems particularly after events which display their weaknesses.

Figure 93.2: Risk as the integration of Hazard, Vulnerability, and Deficiencies in Preparedness; and the elements of risk management: Prevention, Mitigation, and Preparedness. **Source**: The author.



Since 2001, the author (Villagrán 2001) has proposed a model to represent risk in terms of three components: *hazard*, *vulnerability*, and *deficiencies in preparedness* (figure 93.2). The explicit incorporation of *deficiencies in preparedness* is based on the fact that in some cases vulnerabilities cannot be reduced, but losses can be avoided or reduced if preparedness measures are in place. This is particularly essential in the case of vulnerable groups of people which could be saved, should an efficient early warning system be operational.

Risk management would comprise the set of measures which tend to reduce existing risks and those measures which should inhibit the generation or enhancement of such risks. In this context, *Prevention* focuses on a variety of measures to minimize the exposure to the hazard, or those which are aimed at modifying the dynamics of such hazards. *Mitigation* focuses on the set of measures aimed at reducing vulnerability and the factors which may enhance it. As expected, *Preparedness* encompasses the measures aimed to improve the capacity of the community to reduce the impacts related to specific events through early warning, for example.

One typical measure within the context of preparedness is an early warning system. According to the *International Strategy for Disaster Reduction of the United Nations* (UN-ISDR), early warning is defined as "the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response" (UN-ISDR 2004). Considering such a definition, an effective response to a warning should imply that governments, the private sector, and people should carry out the necessary tasks to minimize the impact and hence potential losses associated to the forecasted event, in particular, evacuation of population to safe areas prior to the event. While the destruction of infrastructure cannot be avoided through the operation of an early warning system, such a system could indeed be employed to minimize the number of fatalities and injuries, and reduce to a minimum the disruption in processes and services.

However, it is important to recognize the fact that existing early warning systems have a particular weakness: "warnings may fail to reach those who must take action and may be understood or address their concerns". As stated by ISDR in its *Global Survey of Early Warning Systems* (UNISDR 2006), existing early warning systems have been developed with a strategy to generate and issue warnings in a reliable fashion, rather than to empower those at risk who need such warnings to take evasive action.

Basher (2006) expanded the notion of 'people-centred' early warning, stating that risk assessment should focus on identifying vulnerable groups of people, determining their degree of exposure to the hazard, and identifying warning strategies to allow such groups to take evasive action should an event manifest itself. This notion of 'people-centred' early warning was brought forward during the Second International Early Warning Conference held in Bonn in 2003 and again, under the term 'last-mile' in the Third Interna-

Table 93.3: Statistics on the total number of dead or missing corresponding to nine districts in Sri Lanka. **Source:** Census of Buildings and Persons Affected by the Tsunami (2004); Department of Census and Statistics, Sri Lanka (2005).

Age Group	Total Male	Total Female	Ratio (Female to Male)	Total (both sexes)	Total /age group
0 to 4	1135	1182	1,04	2317	463,40
5 to 9	896	1138	1,27	2034	406,80
10 to 18	748	1456	1,95	2204	244,89
19 to 29	341	1242	3,64	1583	143,91
30 or more	1817	4143	2,28	5960	149,00

tional Early Warning Conference, again held in Bonn in 2006.

93.3 Vulnerable Groups

If the goal of a tsunami early warning system is to minimize the number of fatalities and injuries, then a starting point in the identification of vulnerable groups should be the assessment of the impacts of the tsunami in terms of mortality. According to Birkmann, Fernando, and Hettige (2006), children in the youngest age group (0 to 10 years old) and adults over 40 years old could be considered as highly vulnerable when looking at the mortality rates in the coastal cities of Galle and Batticaloa in Sri Lanka (see also chap. 69 by Marre/Renaud). Similarly, these authors argue that women are more vulnerable than men, based on mortality rates by gender. A similar study carried out in coastal areas of the Ampara district in Sri Lanka by Nishikiori, Abe, Costa, Dharmaratne, Kunii and Moji (2006) confirms the fact that children in the youngest age group are highly vulnerable, as well as elderly people fifty years old or more. In addition, this study confirms that women are by far more vulnerable than men (Ariyabandu/Fonseka 2009). Similar results have been published by Guha-Sapir, Parry, Degomme, Joshi and Saulina Arnold (2006) in a mortality survey in Tamil Nadu, India. Interestingly, the results from this coastal region in India point out that the ratio of fatalities to injuries is large in the case of children and small in the case of adults. These results stem from the fact that a higher number of children were killed by the tsunami than the number of children injured, whereas an opposite trend was found in the case of adults. These results were confirmed in Indonesia by Doocy, Rofi, Burnham and Robinson (2006) in a survey in Aceh where the highest mortality rate was found among the youngest children (age 0–10 years old), and elderly people over 70 years old. In addition, these researchers found that casualties among women were larger than among men, but such differences would disappear in the case of infants, and for the elderly over 70 years old.

Higher mortality in the case of children can be explained on physiological differences. In the case of children, their small mass means they can be thrown around by the tsunami rather easily and they lack the strength to hold on to objects such as trees in such a case. Table 93.3 displays data gathered by the Department of Census and Statistics of Sri Lanka (2005) regarding dead and missing persons related to nine districts which were affected by the tsunami in terms of age groups and differentiated by gender. The fifth column represents the total number of fatalities by age group regardless of sex, and the data in the last column is obtained by dividing this fifth column by the number of years which the respective age-group spans (for example, the age-group 0 to 4 spans 5 years, whereas the age-group 199329 spans 11 years. As no data is available for the last age group, a symbolic figure of 40 years was considered).

In the case of gender, column 4 (table 93.3) displays the ratio of females to males which were killed by the tsunami according to age group. As this column indicates, mortality is higher for women than for men, and in terms of age groups, the data allows for the conclusion that women in the age-group 19–29 display the highest ratio.

As stated by OXFAM (2005), and by Neumayer and Plümper (2007), higher mortality can be attributed to women than to men on the basis of physiological and social patterns. As in the case of children, these authors state that women have less strength and less inertia than men. In addition, learned skills are different for men and women, particularly in the context of swimming and climbing trees. These activities are usually taught to boys and not to girls. Finally, these authors argue that social roles play a difference as portrayed in many societies: women are expected

to look after and protect the children in the house, care for the elderly, and guard the valuables of the family within the household. This traditional division of labour would force women to spend substantial amounts of time inside houses which could collapse in case of the tsunami, due to structural vulnerability. In the particular case of Sri Lanka and India, another social aspect which could contribute to higher mortality in the case of women when compared to men is the traditional use of '*saris*', traditional clothes with long tails which could hamper running and swimming, and can even get tangled with heavy objects, leading women to death by drowning.

In addition to these results, it is likely that tsunamis may provoke fatalities in places where vast amounts of people can congregate, such as public markets, churches or cinemas, as well as in the case of those people with permanent or temporary incapacities to move, particularly patients in hospitals. Therefore, for early warning, it is imperative to find places where such vulnerable groups congregate and to tailor warnings accordingly. Thus, the most vulnerable groups are:

- *People with permanent or temporary incapacity to move*. This group comprises patients undergoing treatment in hospitals or women on maternity leave, especially those who have given birth recently, are confined to bed, and permanently handicapped people (in wheelchairs, with crutches) as well as infants.
- *Children* who because of their small size and reduced strength have difficulties to survive inside a tsunami wave.
- *Women who may have less strength than men to cope with the tsunami wave,* and may also lack the swimming skills of men in such a case or may die trying to save the children or an elderly person within their households, as well as trying to secure their valuables at home.
- *Elderly people* of both sexes in the age group above sixty years. As in the case of children the vulnerability would stem from their lack of strength to survive the impact of a wave, and their decaying state of health, which enhances their vulnerability in case of trauma.

93.4 Linking Vulnerable Groups to Hazardous Areas

Having identified the vulnerable groups, the next step is to identify places where these people meet. Schools for example are locations where children congregate, and thus they constitute a setting where there is a high amount of vulnerability during the days of the year in which the education process takes place. Children's homes or orphanages constitute another setting with a high vulnerability. In the case of homes for the elderly there exists high vulnerability. For women the identification of such places is more difficult, however, one can identify certain facilities such as schools for nurses where large numbers of female students who are enrolled in such academic programmes may congregate; hospitals where vast numbers of nurses may also congregate, as well as some commercial areas where women may congregate either to sell or purchase products of various kinds. In this context, it is important to recognize the fact that vulnerable groups of people may congregate in such places at particular times of the day and in selected months of the year, although in the case of elderly homes and hospitals one should not expect such a variation throughout the year.

The tsunami also manifested the fact that places where many people meet could constitute sources of fatalities. In Sri Lanka the tsunami overturned a train full of people killing over one thousand passengers who could not evacuate quickly from the train carriages. Other places where vast amounts of people can congregate are the main train stations and main bus stands, commercial streets and public markets, government buildings, churches and religious temples, cinemas, technical, vocational schools, universities and auditoria, as well as sports facilities including stadiums.

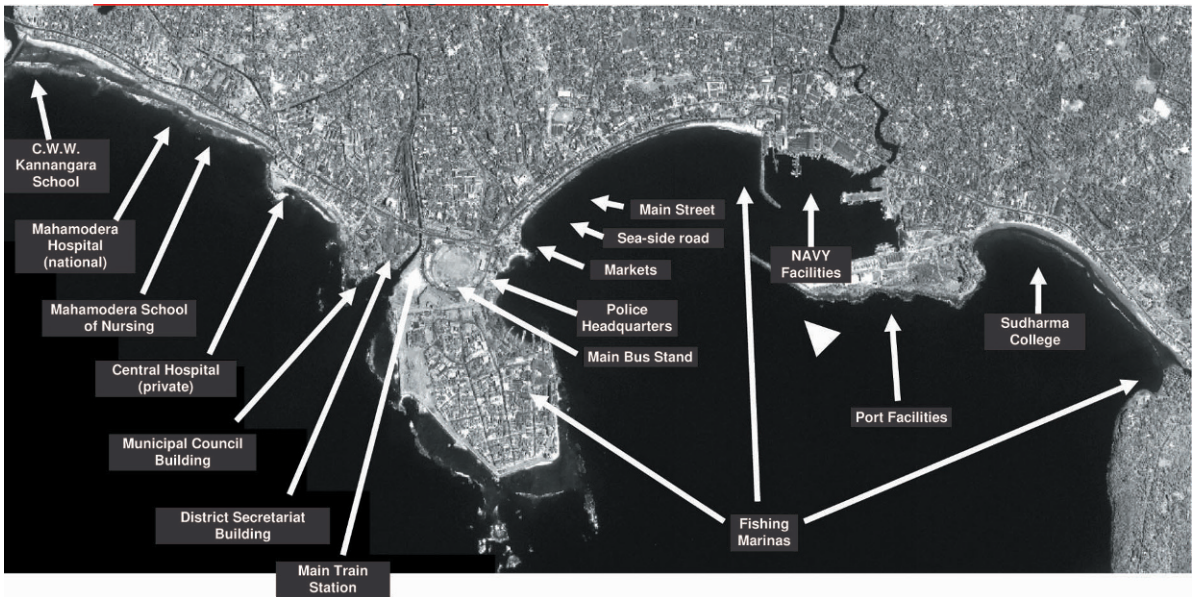
Two activities where people assemble in coastal areas are fishing and tourism. Local fishing communities usually congregate around fishing marinas and tourists prefer hotels next to the ocean shores and public beaches. Particular seasons of the year are more attractive, boosting the tourism population. This applies particularly to southern Europe that experiences a massive flux of tourists from northern Europe during the summer months.

While such vulnerable groups may be found in any part of a city, it is the combination of such vulnerable groups, places of high exposure to tsunamis, and lack of preparedness in terms of weak or non-existing early warning systems that constitute the high risk areas, which when the tsunami manifests itself turn such areas into disasters. Therefore, one should consider that high risk areas could be defined as places next to the ocean which concentrate vulnerable groups where there are no measures in place to reduce the impacts

Table 93.4: High risk areas within the city of Galle. **Source**: The author.

Hospitals	Schools	Densely concentrated areas during business hours	Government Buildings	Other
Mahamodera hospital	Mahamodera school of nursing	Public bus station Main train station	District Secretariat Municipal Council	Fish, fruit, vegetable markets
Central Hospital (private)	C.W.W. Kannagara Suddharma College	Main street Sea-side street Road to Colombo Road to Matara	Navy port facilities Police Headquarters Prison	Neighbourhoods located by the ocean shore. 3 fishing marinas

Figure 93.3: Satellite image of the central part of the City of Galle, Sri Lanka and of the coastal area indicating places where vulnerable groups may congregate. **Source:** Satellite image by GeoEye through European Space Imaging. Copyright: GeoEye, all rights reserved.



through preparedness. The identification and assessment of such areas would then be employed to design strategies regarding how to ensure that warnings reach such areas as quickly as possible so that evacuation to safe areas can be carried out prior to the arrival of a tsunami.

An exercise along these lines of identification of high risk places was carried out in the city of Galle in Sri Lanka (Villagrán 2008). The high hazard area in relation to tsunamis was defined as the buffer area spanning from the shore to one hundred metres inland. While this is an arbitrary choice, there is as yet no scientifically developed hazard map that could be used at this time for this city. Critical facilities in this high hazard area include the large Mahamodera national hospital with a capacity of 215 beds for patients in a multi-storey building and a small private hospital, the School of Nursing which hosts about one thousand female student nurses, two schools in which there are over 1,340 children registered, several streets which host large commercial areas, the main bus and train stations, as well as three fishing marinas where local fishermen congregate, and two public fish and vegetable markets (table 93.4). Figure 93.3 presents a view of the coastal area of the city of Galle, along with the location of these facilities.

The 26 December tsunami provoked considerable damages to the two hospitals; it destroyed the main bus station, damaged the nursing school and the two colleges, destroyed the fish market, severely affected the vegetable market, and damaged all government facilities listed above.

In addition, it destroyed practically all boats and fishing gear in the fishing marinas, and killed many fishermen. In terms of housing, the tsunami destroyed or damaged over 1,500 houses located next to or very close to the shore, and damaged over 100 businesses located in the coastal streets, ruining merchandize of

various kinds, as the flood level rose to the roof of such businesses. In terms of population, the tsunami killed 767 persons, and injured nearly 1,000 people as reported by a local staff member of UNDP supporting efforts on disaster preparedness at the time of the tsunami.

93.5 From Risk Assessment to Early Warning

Having identified the main risk areas, the next step in the design of an early warning system would constitute the elaboration of an early warning plan which contains the following elements:

- Strategies to ensure that warnings reach highly vulnerable groups in the identified places;
- Identification of safe areas for evacuation of people, particularly in the case of vulnerable groups, and procedures for their evacuation to such safe areas;
- Posting of signs related to evacuation routes, safe areas, and meeting points to facilitate the evacuation process in case of a real event;
- An awareness campaign so that people in high risk areas take note of the early warning system and what to do in case a warning is issued; as well as exercises and drills to identify deficiencies and gaps in early warning plans and to reinforce the awareness campaign;
- Periodic testing through drills to sustain the early warning effort.

A plan outlining such elements has been prepared by the author for the District-level Disaster Management Committee of Galle (Villagrán 2006a), as part of a project conducted by UNU-EHS in Sri Lanka within the Tsunami Flash Appeal Programme coordinated by the *Platform for the Promotion of Early Warning of the International Strategy for Disaster Reduction*.

93.6 Other Types of Vulnerabilities in Early Warning

As has been stated, an effective early warning system should include the capability of a community to minimize impacts based on an anticipated response to a warning. An impact assessment provoked by the tsunami in Galle allows identifying additional vulnerable elements and processes which could benefit from an early warning.

Lifelines: Due to its physical nature, water can be contaminated when coming into contact with the tsunami surge. Renaud (2006) referred to the short- and long-term problems which people experienced in rural areas with respect to the contamination of open wells. If such wells could be closed temporarily once a warning has been issued, contamination by debris would be minimized, event though the infiltration of salinity in the soil may generate some long-term problems. For electricity a timely warning can allow the electrical company to shut down power in transmission lines to avoid short circuits due to the high conductivity of the tsunami surge, should it come in contact with live transformers.

Transportation: For transportation, the tsunami provoked damage or destruction of motor vehicles of many types. In this context, an efficient early warning plan would include evacuation routes for people and for motor vehicles along separate roads, so that the exposure of such vehicles to the tsunami wave is reduced to a minimum.

Health processes: While there are no documented cases in the literature, surely a tsunami may disrupt many types of activities in hospitals, in particular surgeries. It is to be expected that an effective warning strategy would be for planned surgeries to be delayed temporarily until the situation after the tsunami has returned to a normal state to avoid complications during such surgeries and other medical procedures in case of a tsunami.

Critical information and paperwork: In Galle the municipality lost critical records (birth records) and other vital information stored in computers or on paper, as the information in hard disks and on paper was completely damaged when coming in contact with the tsunami surge. A similar situation was experienced at the head office of the police department since the building is located right on the coast. Commercial businesses also lost substantial amounts of money as credit vouchers were kept in a paper format. Paper is highly vulnerable when it comes in contact with the tsunami surge. When a warning is issued and effective response measures are in place, the loss of such valuable information can be reduced to a minimum without too much effort.

93.7 Conclusions

The 26 December 2004 tsunami showed the capacity of such events to trigger a major disaster with high fatalities, as well as the interruption of many processes

and services which are essential for any community. The tsunami demonstrated both the vulnerability of people, infrastructure, processes, products, information, and services; as well as the need for an early warning system to minimize the number of fatalities and injuries inflicted by such a tsunami in coastal populations. The assessment of the impacts of the tsunami in terms of mortality and in terms of vulnerability provides an insight into potential measures which can be put in place to minimize the impact of such events in the future.

Research conducted in Sri Lanka, India, and Indonesia has permitted the linkage of mortality rates to differential conditions of vulnerability in terms of age and gender by various groups, allowing for the conclusion that children and the elderly are the most vulnerable groups when it comes to tsunamis and the fact that in general, women are more vulnerable than men. The information gathered on such groups within the coastal city of Galle in Sri Lanka has allowed for the identification of high risk areas in this city, as well as a strategy to promote an efficient and timely early warning when considering as a starting point such vulnerable groups in the design of an early warning plan.

The need to go beyond just the issuing of warning in case of a tsunami through mass media such as radio and television is imperative if lives are to be saved. In the context of effective early warning as defined by PPEW, risk assessment needs to provide information on those who are at risk, so that warnings reach them with sufficient anticipation to allow for an evacuation to a safe place. In addition, it is important for the risk assessment to include the component of deficiencies in preparedness, so that capabilities to react to such warnings are enhanced. Only then will such early warning systems be able to span the proposed 'end-to-end' strategies and reach those who are located in the 'last, but most important mile'.

Part X Summary and Conclusions

Chapter 94 **Political Geoecology for the Anthropocene**
Hans Günter Brauch, Simon Dalby and Úrsula Oswald Spring

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94 Political Geoecology for the Anthropocene

Hans Günter Brauch, Simon Dalby and Úrsula Oswald Spring

94.1 Introduction: Hypothesis and Goal of this Chapter[1]

This chapter argues that a fundamental change in earth history is under way which requires a rethinking of the relationship between humankind and nature, including the political realm and international relations, that makes geopolitical approaches in the Hobbesian tradition obsolete. The Nobel laureate Paul Crutzen coined for this new period of earth history the term 'Anthropocene' (Crutzen 2002 and preface essay).[2]

During the Anthropocene our thinking on peace and security must be reconsidered. This implies a fundamental shift in the concept of security that is increasingly being influenced by human interventions into the earth system. In the Anthropocene the nature of the threat for the survival of humankind is changing from 'them' (neighbour country, coalition of states, competing military, social and ideological systems) to 'us', i.e. to our lifestyle and consumption of fossil sources of energy that has resulted in major increases of greenhouse gases since 1750 (of which 2/3 has occurred during the past five decades). However, if 'we' are the threat it is impossible to fight a war against ourselves. To cope with this threat to human well-being, survival and security a radical change in our thinking on international relations and security is needed. This new threat is global in nature and does not respect national borders or political systems, nor does it discriminate between the 'good' and the 'bad'.

The old spatializations of international political, strategic and economic relations as 'geopolitics', 'geostrategy' and 'geoeconomy' have been primarily power- and interest-based and were partially ideologically legitimated. Many of these spatializations trace at least some of their ideas back to the writings of Thomas Hobbes, famous for his theories of Leviathan and assumptions of perpetual war as the human condition in the absence of some overarching authority. While Hobbes was more concerned with civil wars than international relations, the assumption of anarchical relations between states is frequently simply called Hobbesian. These scientific and political approaches are unable to cope with the new environmental security threats, challenges, vulnerabilities and risks posed by issues of global environmental change during the Anthropocene in the 21st century.

Instead of these Hobbesian spatializations of international political, strategic and economic relations that have totally ignored the environmental dimension and issues of global environmental change, a new concept of a '*political geoecology*' is developed by introducing, scoping and contextualizing a new research paradigm and policy vision and contrasting this with the traditional Hobbesian debates on geopolitics and geo-strategy that legitimized many national strategies with political, economic and military means.

In the tradition of conceptual theory the authors argue that geopolitics, geo-strategy and geo-economics have understood space as 'territory' as a component of national sovereignty and have left the environment out. But several approaches from the natural sciences, such as Lovelock's (1979, 1988, 1992, 1998, 2006, 2009) 'Gaia hypothesis', Edward O. Wilson's (1998) 'consilience', Huggett's (1995) 'geoecology', and the approach of an 'earth systems analysis'[3] have left politics out.

The specific goal of this chapter is to conceptually merge these four approaches by bringing politics, and

1 This chapter builds on two previous joint chapters by Dalby, Brauch and Oswald Spring (2009) and Oswald Spring, Brauch and Dalby (2009) and on previous studies by Brauch (2001a, 2003, 2003a, 2008a), Dalby (2002b, 2003, 2007, 2009, 2009a) and Oswald Spring (2001, 2008, 2008b, 2008c). From the perspective of three disciplines (political science, geography, socio-environmental anthropology) and from three national vantage points (Germany, Canada, Mexico) the authors develop a joint research and policy perspective for a new security policy in the Anthropocene from a gender perspective.

2 See Paul Crutzen's webpage at: <http://www.mpch-mainz.mpg.de/~air/anthropocene/Text.html>.

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especially peace-building and widened security issues in, by developing a 'security policy for the Anthropocene' (Dalby 2009, 2009b) and outlining a policy vision for the 21st century that aims at a sustainable peace (Brauch/Oswald Spring 2009a; Oswald 2009) by combining the needed 'security policy for the Anthropocene' with proposals for a "science for global sustainability" (Clark/Crutzen/Schellnhuber 2004, 2005). This outline of a new transdisciplinary research field is highly policy relevant and may help to express the urgency of proactive political strategies with non-military means and tools (MA 2005; Leemans 2009).

This chapter, in addressing the spatial dimension of human and environmental security in the Anthropocene, calls for a shift away from the Hobbesian or power- and force-related concepts of geopolitics, geostrategy and geoeconomics, which have legitimized foreign and in some cases even military actions towards the new concept of 'political geoecology'.

The next part contextualizes the new security dangers in the Anthropocene due to anthropogenic interventions into the earth system from 1750 to the present with an outlook until 2100 (94.2). Then the spatial or 'geo' approaches with regard to geopolitics, geostrategy and geoeconomy are reviewed that are inappropriate for addressing the new security dangers and concerns of the Anthropocene era in the 21st century (94.3). Part 4 discusses the *geoecology* approach from physical geography and systems perspectives on global environmental change, the *earth systems analysis* (ESA) of the *Earth Systems Science Partnership* (ESSP) for the multiple linkages among the four global environmental change programmes: WCRP, IGBP, IHDP and Diversitas. Only IHDP addressed the political, and its GECHS programme, the security dimensions of earth systems change (94.4). Part 5 compares different approaches bringing 'ecology' into the scientific discourse on geopolitics and a 'political dimension' into geoecology given the security impacts of global environmental change in the Anthropocene. This concept leads to a broadening from state- to human-centred concerns as well as from top-down to bottom-up policy processes (94.5).

Part 6 introduces political geoecology as a new concept for research and teaching that links the approaches in physical and human geography with those of the social sciences. This requires introducing a political dimension (94.6). Part 7 moves from anticipatory knowledge to proactive action from a policy vision of a political geoecology that offers guidelines for cooperative environmental policy in the Anthropocene era (94.7). Finally, part 8 summarizes the key conceptual messages of the new features of political geoecology, bringing 'geo' approaches into the political realm (94.8).

94.2 Multiple Challenges of the Anthropocene from GEC

In the Anthropocene, global environmental change, represented by an environmental quartet (Brauch/Oswald Spring 2009; Oswald Spring/Brauch 2009) of global, regional and local climate change, land degradation and desertification, water scarcity and drought, pollution and stress of air, water and soil, and biodiversity loss, poses multiple dangers for international, national and human security (Brauch 2009a; chap vy by Bauer; yz by Scheffran). These dimensions of environmental change are all linked together in various ways and at various scales, and although they happen in specific places, the key point in thinking about matters in terms of 'geoecology' is the important point that these things are linked into the global biosphere; hence the designation 'geo'.

The anthropocene emphasizes that there are human causes to the disruptions of ecosystems, and hence these are matters that are decided by humans, although frequently decisions are made in the absence of clear understandings of the consequences of human actions. But now, as science pieces together the big puzzles of how parts of the biosphere fit together, it is clear that human actions have consequences for ecologies in numerous places. Thus 'political' geoecology adds a political dimension to 'geoecology'.

The term geoecology is a concept that has been used in Germany since 1968 (Troll) in physical geography (Müller 1983; Wein 1985; Hütter/Reinirkens 1993; Stüdemann 2008). Geoecology was also introduced as an interdisciplinary natural science by Huggett (1995) and Blumenstein, Schachtzabel, Barsch, Bork, and Küppers (2000). Huggett (1995) defined geoecology as the study of the "structure and function of geoecosystems" in different scales. In his 1995 book, he developed the framework for thinking about geoecology in three parts:

> Part I introduces geoecological systems, their nature, hierarchical structure, and ideas about their interdependence and integrity. ... Part II explores internal or 'ecological' interactions between geoecosystems and

3 See Schellnhuber and Wenzel (1998); Steffen, Sanderson, Tyson, Jäger, Matson, Moore, Oldfield, Richardson, Schellnhuber, Turner and Wasson (2004).

> their near-surface environment, ... looking at the influence of climate, altitude, topography, insularity, and substrate. Part III prospects the role of external factors, both geological and cosmic, as agencies disturbing the dynamics of the geoecosystems.

Huggett (1995: 229ff.) listed among the ecological disturbances: wind, fire and grazing, and analysed changing disturbance regimes as well as the causes of geophysical hazards (local, regional and global disturbances from volcanic activities), cosmic disturbances from meteor activities while anthropogenic interventions were ignored. Clearly there are long term effects on the earth's climate of sun spot cycles and the long cycles of fluctuation in the earth's orbit have consequences for the amount of sunlight driving natural systems, as also macro-scale changes in the arrangements of the continents, glacial periods and other long term climate fluctuations, but these are beyond the scale of Huggett's concerns.

For Blumenstein, Schachtzabel, and Bork (2000: 9) geoecology is "an environmentally-oriented, interdisciplinary natural science that defines structures, functions and modes of action within geosystems or between them and their environment". Geoecology draws both on the spatial sciences (geography, cartography, landscape and regional planning) and on the natural sciences, but it excludes the effects of environmental degradation on environmental stress and their outcomes. They called for an integration of legal, social science and economic aspects but ignored the political dimension.

A German encyclopaedia of the geosciences (Rolli 2000: 283) pointed to the linkage between bioecology (biosystem) and geoecology (geosystem), and an encyclopaedia of geography (Buttschardt 2002: 28-29) referred to its task to contribute to an ecological development in all parts of society by research, planning, advice, administration, policy and laws. From a US perspective:

> The terms 'landscape ecology' and 'geoecology' were coined by Carl Troll to describe the field of study deriving from the linkage of physical geography and ecology. ... Contemporary applications of landscape ecology in the United States typically emphasize biological concerns, but modern problems in the analysis of landscape structure and dynamics and in landscape management, especially those involving the influence of human land use patterns, require a more integrated 'geoecological' approach (should be integrated). [4]

According to Richard Huggett's definition geoecology combines geography with ecology:

> Geoecology seeks to understand how landscape mosaics are created and how they change. Three mechanisms are primarily responsible for creating landscape mosaics: substrate heterogeneity, natural disturbance, and human disturbance. Substrate heterogeneity includes the distribution of hills and valleys, of wet spots and dry spots, of different rock types, and of different soil types. Natural disturbance is caused by physical agents (wind, running water, fire) and by biological agents (burrowing animals, grazing animals, pests, and pathogens). Human disturbance arises through such activities as ploughing, forest clearance, mining, quarrying, road building, and city building. Biological and ecological processes usually modify the landscape mosaics created by these mechanisms. ... The trend is now to study a much wider range of landscape units.[5]

More recently, Stüdemann (2008: 9) defined geoecology as a holistic science whose objects are "geoecosystems and the images of all spatial and temporal structures of the geosphere. They are analysed with inventory process and structure analyses regarding systems stability and change and defined for an action maxim". But in this approach the political dimension is limited to environmental planning reflecting the requirements of sustainable development. It introduces landscape and geoecology into the development of environment policy, law and education and implementation strategies on the global level. But as other geoecological approaches, Stüdemann (2008) lacks a specific political dimension in his horizontal widening of the theoretical scope of geoecology including sustainability goals.

In Latin America political geoecology started as a scientific concept in 1979 when the State University of Moscow initiated a master's degree in Cuba, where almost all countries from the subcontinent participated. Beside human ecology a strong emphasis was given to the ecological system approach. In 1978, in Mexico a group started with an interdisciplinary research about food system, ecosystem, socio-cultural and political systems (SAS 1986; Oswald Spring/Flores 1985), analysing systematically fourteen ongoing development processes within a frame of regional and global dependency and negative repercussion in life quality and the environment. In 1998 the Latin American Centre of Social Ecology (*Centro Latino Americano de Eco-*

4 See the paper by Hugh DeForest Safford: "Geoecology: Historical Roots and Contemporary Practice," presented at the 2002 Denver Annual convention of the Geological Society of the US, at: <http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_42211.htm>.

5 See Richard Huggett: "Geoecology", in: Hancock, Paul; Skinner, Brian J., 2000: T*he Oxford Companion to the Earth* (Oxford. Oxford University Press), at: <http://www.encyclopedia.com/doc/1O112-geoecology.html>.

logía Social: CLAES 1999) integrated geoecology with policy, with a strong emphasis on economic equality. This Centre supported strongly the World Social Forum in Porto Alegre, and in 2006 they founded the *Centre for Development, Economy, Ecology and Equity* (D3E) in Latin America, where geoecology and human ecology were key themes. During the Earth Summit in Rio de Janeiro (1992) the precautionary principle was systematically introduced into the geoecological thinking in Latin America (Cafferatta 2004).

Brazil with the biggest biodiversity in the world, thanks to the Amazon, was always concerned about the foreign interests in its almost uncontrollable and wide territory, and therefore together with an approach on sustainability, the green lung of the world was always considered in the limited geopolitical interests, independently from ecological concerns (López 2009; Proença/Diniz 2008, 2009). But also the war against cocaine in Colombia, later involving Bolivia, Peru and Mexico widened the political geoecology to a military concern of the whole region, involving also the USA (Tickner/Mason 2008, 2009).

While there is no precise agreed definition of 'geoecology', the concept suggests the importance of interlinked formulations that understand dynamic ecological systems over a variety of scales while not breaking the science down into the traditional compartments of biology, chemistry, geology, etc. But the human dimension of geoecology isn't always so clear, not least because so many sciences have separated the human from the natural. Other formulations have started with the human parts of the global ecosystem and tried to work towards the ecological sciences.

In contrast, *human ecology* focuses on the interactions between human beings and the environment addressing the linkages between human activities and their impact in space as well as the anthropogenically-induced human environment by analysing societal, economic and physical environmental variables. *Social ecology* "integrates the study of human and natural ecosystems through the attempt to understand the relationships between culture and nature". Its proponents argue that "environmental problems result from social attitudes and practices, therefore the former must be solved by focusing on and changing the latter" (Pepper 2002: 484). According to the School of Social Ecology at the UC – Irvine:

> Social Ecology faculty apply scientific methods to the study of a wide array of recurring social, behavioural, and environmental problems and specialize in conducting research 'with considerations of use' in society. ... While the field of ecology focuses on the relationships between organisms and their environments, social ecology is concerned with the relationships between human populations and their environments.[6]

The original division between a geographic and a social human ecology was replaced by a holistic human ecology approach (Douglas 2002: 2–11). Sack (1980, 1996), Bennett (1985) and Orme (1985) proposed that geographers should "adopt an integrated (human-ecology) approach to spatial analysis in the human and physical environments" (Faniran 1995: 931). Douglas (2002: 3) argued that

> the extension of ecology from the study of plants and animals in specific habitats to the study of interactions between people, other organisms and their environment requires the inclusion of social processes and introduced the concept of human ecology. Early in the 21st century, several varieties of human ecology have emerged. For some, it is primarily concerned with people's interactions with the built environment, while others consider it to be about how the human being, as an organism, responds to environmental stresses and changes and thus suffers disease or retains good health. A third view examines the way society and communities can manage their surroundings to achieve a better life while not over-exploiting natural resources. Whatever the precise definition of human ecology, it is the analysis of the interplay of social life, from politics to industry ... with the biogeochemical, water and energy circulations that maintain all life on earth. Its analysis requires an integrated science that looks at the world as it really is.

This holistic approach includes an analysis of human drivers of global environmental change such as land cover and land use change, industrial metabolism and their interlinkages, as well as of the causes and consequences by addressing decision systems and cultural attitudes, the patterns and consequences of global environmental change and the feedbacks in the society. Social anthropology and psychology deepened through the theory of social representation into the cultural nature of human beings and their environment, where beside geopolitical power struggles also equity concerns within the identity processes were analysed (Flores 2001; chap. 66 by Flores/Wagner). But despite these attempts, and important formulations such as "social nature" that increasingly inform geographical scholarship (Castree/Braun 2001), the divisions between the physical and human sciences frequently remain. Interesting attempts by ecologists

6 See University of California, Irvine, School of Social Ecology; at: <http://socialecology.uci.edu/about> (9 September 2009).

to think about the transformation of systems, both natural and human, don't necessarily connect with the geoecology framework either (Gunderson/Holling 2002), even when explicitly linking globalization to ecology and security (Pirages/DeGeest 2004).

Given all these difficulties, Brauch (2003, 2003a) argued that a *political geoecology* is needed that combines the divergent approaches of 'geoecology', 'social ecology' and 'human ecology' by addressing the regional implications of global change and its potential outcomes: disasters, environmentally-induced migration, crises, and conflicts from a human security perspective on the environmental security dimension. Such a wider *political geoecology* must combine the complex causes and interactions of key factors of regional environmental change with environmental stress, natural disasters, distress migration, crises, and conflicts. Relying on the results of the natural sciences, *political geoecology* should also use methods of political science and international relations. These complex nature-human interactions have been addressed in the PEISOR model (Brauch 2005, 2005a, 2009a; Brauch/Oswald Spring 2009c).

This new approach requires an interdisciplinary discourse on global change and its regional impacts for environmental security and conflict avoidance that was suggested by Wilson (1998, 1998a) with the term 'consilience'. This term refers to the interlocking of causal explanations across disciplines. Wilson (1998: 197) correctly noted that the social sciences, in their efforts to predict alternative courses of actions, have in most cases ignored the natural sciences, and too often they relied on historical precedents. His call for a 'unity of knowledge' requires transdisciplinary cooperation among scientists.

Such thinking has precedent in the work of the French historian Braudel (1949, 1966, 1969, 1972) who has distinguished three historical times of events, conjunctures and structures.

> Historians have over the years grown accustomed to describing this contradiction in terms of structure and conjuncture, the former denoting long-term, the latter short-term realities. Clearly there are different kinds of structure just as there are different kinds of conjunctures, and the duration of either structure or conjuncture may in turn vary (Braudel 1972: 16).

For a political geoecology approach all three historical times matter, especially the structural dimension of "la longue durée" (Braudel 1969: 41–83) that addresses humankind "in its relationship to the environment, a history in which the change is slow, a history of constant repetition, ever-recurring cycles" (Braudel 1972: 20). Besides this structural history where geoecological developments and global environmental change impact, Braudel (1972: 20–21) referred to the "histoire de conjunctures" as the social history of groups and groupings with "slow but perceptible rhythms", and to "l'histoire évènementielle", the traditional history of individual men, of surface disturbances of brief, rapid, nervous fluctuations.

Inspired by Braudel's history of structures, Brauch (2001a: 53–54) applied this structural perspective to present and future environmental determinants posed by climate change, desertification and water stress that determine and constrain the range of options available for policy-makers. Clearly the Anthropocene now suggests that Braudel's assumptions about "ever-recurring cycles" in the environment are now no longer the case; historical lessons from the past may be of limited use, although the framework for analysis retains its utility. In particular this is clear in the literature in history linking the world system to environmental change (Hornborg/McNeill/Martínez-Alier 2007). Thus, the suggested approach of a *political geoecology* combines four components:

a.) a sensitivity for Braudel's three historical times or for three temporal dimensions;
b.) the three features of the notion of 'policy' (field), 'politics' (process) and 'polity' (legal structures, institutional framework):
c.) with the reference to 'geo' the specific spatialization that is delinked from the Hobbesian tradition of the notions of 'geopolitics', 'geostrategy' and 'geoeconomics';
d.) reflecting research on the environment from i) physical geography (*geoecology*), and ii) other natural sciences (e.g. physics, chemistry) on *earth systems science*, as well as iii) from a wider and holistic *social* and *human ecology* approaches.

However, the 'spatial' approaches of globalization, new regionalism and geopolitics were mostly delinked from the discourse on a reconceptualization of security (Brauch 2008a, 2008c, 2009, 2009d). So far many writers on the 'Anthropocene' in geography (Ehlers/Kraft 2006; Ehlers 2008) and in the natural sciences (Crutzen/Stoermer 2000, Crutzen 2002, 2006) have not discussed its ramifications for security; this debate is just emerging (Dalby 2007, 2007a, 2008, 2009; Brauch/Oswald Spring 2009, 2009a). Questions of the specific conditions and challenges posed during the Anthropocene require a fundamental rethinking of security.[7]

94.3 'Geo' Approaches to the Spatial Effects of GEC

Before this emerging discourse on the securitization of GEC is taken up, a brief review of the debates on the spatial approaches in international relations is appropriate. Global environmental change encompasses "a full range of globally significant issues relating to both natural and human-induced changes in Earth's environment, as well as their socio-economic drivers". According to Munn (2002: xi) "human-induced perturbations in the environment are increasingly becoming large and are potentially coming to dominate the natural workings of the complex and independent global system that sustains the Earth". Furthermore, "humans and their global environment are no longer independent. They are ever-increasingly becoming interdependent components of a single global system".

Some of these themes have appeared in earlier discussions of the environmental dimensions of global politics, and in the discussions of geopolitics in particular, but as this chapter makes clear, the sheer scale of the changes in the last half century now require a substantial update of these earlier theories and a recognition that humanity has effectively taken its fate into its own hands, even if much scholarly analysis has yet to understand matters in this way. The spatial categories of politics are especially important because, while administration is still understood in these terms, the ecological context we now live in makes many of them redundant in terms of how security now needs to be understood.

94.3.1 Spatial Approaches in International Relations

Both the old and the new approaches of geopolitics and the related issue areas of geostrategy, geoeconomics, and geo-culture have addressed issues of international politics from a perspective of political geography where spatial categories are essential. Since the end of the Cold War, geopolitical considerations within geography in particular experienced a renaissance with the emergence of new scholarly journals.[8]

Two phases of geopolitical thinking can be distinguished: the old primarily German and Swedish school of *Geopolitik*[9] and the British and American approaches to *geopolitics* and *geostrategy*,[10] and the recent revival of geopolitics in the UK and the US[11], of *géopolitique* in France[12] and its impact on the renewed thinking on *Geopolitica* in Italy[13] and Spain[14], as well as in Cuba, Brazil, Mexico, Argentina, and other countries in Latin America[15] in the 1990's, of *Geopolitik* in Germany,[16] and in Israel[17] the postmodern approaches to *critical geopolitics*[18] in the tradition of the deconstructivist schools and other *new* approaches partly provoked as a geopolitical response to the globalization challenge.[19]

After World War II, in many German political dictionaries and international relations textbooks, *geo-*

7 See the first two volumes of the Environmental Security Handbook for the Anthropocene co-edited by: Brauch/Oswald Spring/Mesjasz/Grin/Dunay/Behera/Behera Chadha/Chourou/Kameri-Mbote/Liotta (2008) and Brauch/Oswald Spring/Grin/Mesjasz/Kameri-Mbote/Behera Chadha/Chourou/Krummenacher (2009).

8 See in France: *Hérodote*, *Géopolitique*, *LiMes. Revue française de géopolitique* (1996-); in Italy: *LiMes. Rivista italiana di geopolitica* (1993-); and in the UK/US: *Geopolitics*.

9 See: Ratzel ([1]1897, [2]1903, [3]1923, 1882, [3]1909, 1898, 1969); Haushofer (1928, 1932); Kjellén (1915, 1916, 1917, 1924).

10 See the debate in the UK: Mackinder (1890, 1895, 1904, 1905, 1907, 1918); in the USA: Mahan (1890, 1897, 1900, 1907, 1957).

11 See the new debate in the UK: Dodds and Atkinson (2000); Gray (1977, 1985, 1986, 1988, 1999); Parker (1985, 1988, 1988a) and in the USA: Agnew (1993, 1998, 2000); Agnew and Corbridge (1989); Cohen (1963, 1982, 1991, 1991a, 1993).

12 See in France: Claval (1996); Chauprade (1999); Defarges (1994); Dussouy (1998, 2000); Gallois (1990); Lacoste (1976, 1980, 1984, 1987, 1993, 1994, 1996, 1997); Laïdi (1998).

13 See in Italy: Claval (1996); Defarges (1996); Ferro (1993); Jean (1995); Lorot (1997); Petersen (1993, 2000).

14 See in Spain: Vincens Vives ([3]1981); Nogue Font and Fufí (2001).

15 See in Cuba: Grupo de Geoecología (1980); in Ecuador: Castro (2001); CLAES, (1998); in Mexico: Oswald Spring and Flores (1985); in Brazil with bioenergetics after the oil crisis in 1973 see: RCCI (2007); Santos de Morais (2001); in Argentina: Segrelles (2008); Ballester (1993); Alldanegra (1996); Slater (1996).

16 See in Germany: Brill (1993, 1994, 1998); Buck (1996); Diekmann, Krüger and Schoeps (2000); Ebeling (1994); Faßler (1996); Grabowsky (1960); Laak (2000); Maull (1959); Palaschewski (1989, 1992); Schöller (1961); Schultz (1989, 2000); Sprengel (1996, 2000).

17 See on the debate in Israel: Bernstein (2000); Biger (1990); Kimmerling (1983); Kliot and Newman (2000); Newman (1999).

18 See: Dalby (1991, 1999); Ó Tuathail (1989, 1996, 2000); Ó Tuathail and Agnew (1992); Ó Tuathail, Dalby and Routledge (1998).

politics did not exist.[20] The term '*Geopolitik*' (1899) was originally coined by Rudolf Kjellén (1864–1922) while the related concepts of a political geography were fully developed by Friedrich Ratzel (1844–1904) and Karl Haushofer (1869–1945).

Geopolitik refers to a scientific approach between geography, law, history and the social sciences that analyses interdependencies between political factors and space focusing on the impact of geographical or spatial factors on political phenomena. Prior to World War II, this school of thought had some impact on Japan, Italy, Spain but also on the US, Brazil, Chile and Argentina.[21]

Ratzel's laws on the 'spatial growth of states' were highly deterministic while Haushofer's concept of 'Lebensraum' (living space and movable borders) was adopted by the Nazis to justify German expansionism. After 1945, these concepts were not used among professional geographers "because of its association with Nazi policies and ideas of environmental determinism from which geographers were in retreat" (Agnew 1993: 349).

In Great Britain in the early 20th century, *geopolitics* was popularized by Halford Mackinder (1861–1947)[22] who focused on the *heartland* as the seat of power and the *inner* (running across the Mediterranean region) and *outer crescent*. In the United States Alfred Mahan (1840–1914)[23] in his writings on naval power became an early proponent of geopolitical and geostrategic thinking while Nicholas Spykman (1893–1943) was influenced by both.[24]

These old conceptual and political debates in Germany, in the UK and in the USA influenced the political and strategic debates in the USA since World War II when realist notions gradually replaced the idealist and Wilsonian worldview that was influential after World War I.

In this early discourse, the environmental dimension and ecological considerations were lacking. However, the relevance of climatic factors on human history were already addressed by the American geographer Ellsworth Huntington (1915, 2001) who argued that the geographical-physical conditions, which are determined mainly by the climate and climate changes, decide the character of the people, as well as their history.

Since the 1930's, this determinist paradigm "was replaced by the anthropogenic model, which placed all blame for the emergence and collapse of civilizations (including the improvement and degradation of the natural systems supporting them, such as water, soil, and vegetation) on human malpractice".[25]

However, the impact of the Sahelian droughts (1968–1984) on people in Africa, and the growing influence of paleo-environmental research began to "bring an increasing number of geographers, archaeologists, and historians to start shifting the blame back from man to climate changes and other natural causes".[26] This neo-deterministic paradigm "emphasizes the dynamic interaction between the natural environment as decided by the geographical position, climate, water, soil, vegetation, etc. and the human society supported by that environment. This interaction oscillates within the endurance capacity of both systems dictated by their sustainability, as well as by the flexibility of the natural system and the agility of the human mind" (Issar/Zohar 2009: 119–120).[27] But this discourse among climate historians did not discuss se-

19 The debate on geopolitical topics and problems as well as on the use of the geopolitical approach exists also in many countries in Asia and Africa and in other parts of the world. See the bibliography compiled by the *Centre for Geopolitical Studies* in Geneva; at: <http://www.exploringgeopolitics.org/Education_Books_Bibliography_Geopolitical_Thought_Analysis_Critical_Geopolitics.html>; see also Dalby (2010).

20 Exceptions are *Brockhaus Enzyklopädie* (1989: 326); Schmidt (1995: 350); Nohlen (1998: 213).

21 For a critical review see: Ó Tuathail (1996: 43–50, 111–140); Diner (1993); Sandner (1994: 8–20); Schultz (2000: 39–84); Fahlbusch (2000: 103–146); Sprengel (2000: 147–168).

22 Mackinder (1890, 1895, 1904, 1905, 1907, 1918); for a critical review and an extensive review of literature see: Ó Tuathail (1996: 75–110).

23 Mahan (1890, 1897, 1907); for a critical review see: Ó Tuathail (1996: 38–45); van Laak (2000: 257–282).

24 Spykman (1938, 1942, 1944); for a full discussion see: Wilkinson (1985: 77–130) and for a brief critical review see: Ó Tuathail (1996: 50–53, 268).

25 Representatives of the anthropogenic school are: Woolley and Lawrence (1936); Albright (1949), Glueck (1968); Lowdermilk (1946); Worster (1982); Evenari, Shannon and Tadmor (1971).

26 The major representatives of this school are: Carpenter (1966); Braudel (1972); Le Roy Laudrie (1971); Lamb (1977, 1982, 1985); Issar (1990); Angelakis and Issar (1996); Issar and Brown (1998); Brown (2001); Yoshino, Domrös, Annick, Douguédroit, Paszyñski and Nkemdirin (2006, 1997); Issar (2003); Issar and Zohar (2004, 2007, 2009).

27 The neo-deterministic paradigm is obvious in the work of: Dalfes, Kukla and Weiss (1997); Issar (2003); Issar and Zohar (2004, 2007, 2009).

curity issues. Thus, these two approaches by geographers in the early 20th century remained unrelated.

94.3.2 The Hobbesian Obsession of Geostrategy

After World War I, with the emergence of international relations as a new sub discipline of political science, at least in the USA, idealist conceptualizations of international relations in the Wilsonian tradition prevailed, while in the UK Carr (1939) expressed realist notions. During and after World War II, realist thinkers (Morgenthau 1948; Niebuhr 1949; Hertz 1959) represented the mainstream that stressed the US national interest and US national security concerns. In the post World War II period Mackinder's heartland model fell into disrepute, and geopolitics, without an explicit continuity, acquired two new meanings:[28]

> 1) as a synonym for geostrategy in the pursuit of particular diplomatic and military goals and 2) as the equivalent of political geography, in the sense of a real variation in political phenomena at all scales, including the global. The more classical usage returned to prominence in US debates over international politics in the late 1970's and early 1980's. ... Soviet desire for warm-water ports and oil deposits in the Middle East, and the key role of the US Navy in denying the world's sea-lanes to the Soviet Union. From this perspective the United States and the Soviet Union were seen as successor states to, respectively, Britain's nineteenth century maritime empire and French and German attempts to assemble an overwhelming 'continental bloc' (Agnew 1993: 349).

Since the late 1970's, and especially during the 1980's, there was a renaissance of geostrategic and geopolitical thinking among US and UK civilian and military strategists (Gray 1977, 1986, 1988, 1992, 1994, 1999, 2005) that were influenced by Mahan, and in 1990's, there was a revival of political geography with a focus on nuclear geopolitics and on geoeconomics. Influenced by Mackinder and Spykman, Cohen (1963, 1991, 1991a, 1993) applied geopolitical categories for the analysis of world politics and zones of influence, and the basic differences between conservative *continental* and liberal trade oriented *maritime* powers. After the Cold War he introduced the term of 'gateway regions' that link up the economic and political transfer between neighbouring geopolitical and geostrategic regions. Cohen (1991: 552) argued:

> Geographers today have an unparalleled opportunity to dispel geopolitical illiteracy by focusing on the 'geo' of geopolitics. ... while the 'geo' accounts for the spatial dimension, the 'politics' in geopolitics is the exercise of power that derives from and seeks to control economic, social and cultural forces. ... The 'geo' in geopolitical analysis starts with spatial structure. ... The structure is hierarchical.

From a different perspective, O'Loughlin and Heske (1991: 37) argued: "It is time to reclaim the geopolitical theme from the hijackers in the strategic community" and – influenced by the new French school – suggested to convert "a discipline for war to a discipline for peace".[29]

However, the renewed attractiveness of geopolitical thinking in Europe and North America after the end of the Cold War has only partly been influenced by the old German and Anglo-Saxon roots, it was rather stimulated by a completely distinct school of political thinking on *geopolitique* in France influenced by *Yves Lacoste*, his centre for geopolitical research and analysis (CRAG) at Paris University VIII, and the journal *Hérodote*.[30]

94.3.3 Revival of Geopolitics in France

The work of Lacoste was a result of analysing problems of the violent process of decolonization. For him geography is a social discourse "a mode representing the world", and a strategic form of knowledge that by "the structuring of knowledge relating to space, is a strategic knowledge, a power" that is needed both for warfare but also for territorial administration and government (Ó Tuathail 1996: 162–163). For Lacoste (1984: 214) the theses of Mackinder and Mahan "rest more on historical evocations than on rigorous strategic thinking, based as they are on grandiose geographical metaphors of Land and the Sea" lacking scientific value. He called for a repoliticization of the geographic discipline and he stressed the necessity

> to exhaustively document the complex spatial relationships that is to be found in international relations. Geographers must think of space as something that is 'textured, extremely varied and very complex'. Only ... a 'sensitive analysis of the articulation between them will make geographical reasoning worthwhile and enable geographers to arm themselves better against the

28 See Agnew and Corbridge (1989: 266–288); Dalby (1990: 171–188).

29 O'Loughlin (1994); Nester (1995); Wiarda (1996); Simon and Dodds (1998); Dodds and Atkinson (2000).

30 Hérodote (1976ff.); Gallois (1990); Lacoste (1990, 1993, 1997); Raffestin (1995); Chauprade (1999); Claval (1996); Defarges (1994); Laïdi (1998).

influence of ideological assumptions' (Ó Tuathail 1996: 166).

Nevertheless, Ó Tuathail (1996: 167–168) – from the perspective of critical geopolitics – argued that Lacoste's work falls "back into the very ideological system of epistemology he wished to challenge" and that it is "a polemical argument against its (ab)use by the military", that he leaves "the epistemological infrastructure of geography/geopolitics intact", and that it "ultimately fails to specify a detailed way how geographical knowledge functions strategically as a form of power/knowledge". For Lacoste (1997), the state and nation remain the key actors and concepts of politics and international relations.

In a review of the new attractiveness of *géopolitique* in France, Dussouy (2000: 507–519) distinguished between: a) the geopolitics of the state, and b) of the international system. Lacoste (1996: 3–8) has applied a wide concept of *géopolitique* that covers everything "what refers to rivalries between different types of power on territories that may be of different dimensions", thus focusing not only on inter-state but also on intra-state conflicts. For Dussouy (2000: 515–519, 1998) the geopolitical space "is a system of material and immaterial or symbolic spaces in which each space has its own organizational logic, its own structure" (Dussouy 2000: 515–516). He argues that the analysis of different spaces and that the structuring of each space often reflects a dialectics of homogenization and fragmentation with respect to heterogeneities. For example, the geoeconomic space and the diplomatic international space produces both a global homogenization (market, production, consumption patterns) and a dual polarization between North and South and an internal polarization within multinational enterprises. He defines the international system as a configuration of spaces and actors that act in the pursuit of their interests under the influence of the socially imaginary. In conclusion, Dussouy argues that interdependencies of territories and networks in a regional framework may be best suited to permit a coexistence of the unsolvable problems of geography and history with the forces of a homogenization within macro systems.

Many French studies have analysed the German and Anglo-Saxon roots of geopolitics (Defarges 1994; Claval 1996; Raffestin 1995; Chauprade 1999) by contrasting the geopolitics of maritime and continental powers, discussing the relations between geopolitics and war and geoeconomy and the specific *géopolitique* of France (Defargues 1994), the evolution of geopolitical thought in history, especially during fascism in Germany, Italy, and Spain (Raffestin 1995), focusing on the methods, and on permanent and changing geopolitical factors (Chauprade 1999) or dealing with the relationship between geopolitics and (nuclear) geostrategy (Claval 1996).

94.3.4 Revival of Geopolitics in Italy and in Germany

In Italy, in the 1990's the renaissance of *Geopolitica*[31] (Petersen 2000: 481–505, 1993) was very much influenced by the French debate, especially by Lacoste (1993), Defargues (1996), Claval (1996a), and Lorot (1997) whose books were translated into Italian. Since 1993, the journal *Limes*, and Carlo Jean (1995)[32], a retired general, played a leading role in spreading geopolitical concepts in Italy.[33]

Until the 1990's, in Germany geopolitical approaches were ignored after efforts in the 1950's to reintroduce the pre-Nazi geopolitical thought failed.[34] In the early 1990's, a few experts called for new geopolitical considerations (Palaschewski 1989, 1992; Brill 1993, 1994) while others focused on Haushofer (Ebeling 1994). In 1994 a conference reviewed theoretical designs on the political space and the journal '*WeltTrends*' devoted an issue on '*Geopolitik*' with contributions by Lacoste and Taylor.[35] In autumn 1997 and 1998, two conferences reviewed the old thinking on *Geopolitik* from 1890–1945 and new approaches since 1945.[36]

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31 The first debate in the late 1930's was nearly exclusively influenced by the German debate by Haushofer, Ratzel, Maull et al., see Petersen (2000: 486–487). From 1939–1942 the journal *Geopolitica* was published in Milan by Roletto. From the mid 1940's until the 1980's, geopolitics had virtually disappeared.

32 Based on French and Anglo-Saxon publications, Carlo Jean analysed world politics from geopolitical, geostrategic and geoeconomic perspectives. See also the conference volume edited by Ferro (1993).

33 Among the challenges are: disintegration of Italy, the emergence of a Franco-German community, a stop to European unity and a Balkanization of Europe while among the opportunities are: the dynamics and vitality of the Italian economic system, the cultural heritage, the role of the Catholic Church and the role of Italian emigration around the globe.

34 See: Grabowsky (1960); Schöller (1961); Matern (1978); Kost (1988); Schultz (1989); Sandner (1994: 12–14); Buck (1996); Sprengel (1996); Faßler (1996); Brill (1998).

35 See *WeltTrends* No. 4 (1994): on the Hannover Conference: 177–181; and the articles by Lacoste (1994: 21–24); by Taylor (1994: 25–38); on *Hérodote* (1994: 150–152).

In this context, von Bredow in analysing 'international politics' as a 'spatial order', briefly addressed the impact of globalization on the loss of the spatial dimension and argued that it is not the spatial aspect of international relations that is being challenged but the territorial principle and national sovereignty due to the removal of the boundaries between the domestic and foreign space. Only few authors (Clark 1997; Menzel 1998) have addressed the opposite tendencies of globalization and fragmentation in the post-Cold War world.

94.3.5 The Geopolitical Tradition in Latin America

The classical geopolitical discussion in Sweden, Germany, and the UK as well as the new debates on geopolitics, geostrategy and geoeconomy in the USA, the UK, and France had a lasting impact on the conceptual discussion of the military in Latin America (Zea/Magallón 1999). Kelly (1997) reviewed the geopolitical assumptions of their foreign and domestic policies and actions by pointing to

> the influence of geopolitical theories originating in the ... German Realpolitik, 'scientific', organic-state schools on the thinking of Southern Cone military men and their civilian allies. The old school of organic concepts does not offer a serious theory of international relations or a satisfactory basis for policy; the military regimes were discredited largely because of the national security rationale for brutal repression at home. ... Kelly identifies ... three basic approaches to geopolitics: as the impact on foreign security policies of geographic features, such as locations, distances, terrain, climate, and resources; as the relationship between power politics and geography; and as a deterministic organic-state imperative (the original school of geopolitics identified above). These perceptions have collectively influenced the thinking and actions of both military and civilian policy-makers. [37]

In Brazil during the military rule, the geopolitical debate of the military focused on the national security state. Thus, it was a reflection of the Hobbesian obsession based on power politics and in many cases it directly legitimated the rule of the military regimes.

94.3.6 Contemporary Discourses of Critical Geopolitics

In the Anglo-American world, some geographers questioned whether a geopolitical ordering of the world into 'strategic regions', 'spheres of influence', 'buffer zones', and 'strategic locations' existed (Agnew 1993: 349).

> Rather, geopolitics could be viewed as any discourse about geographically defined interests including particular models privileging fixed geographical 'facts' about the world. From this point of view geopolitics did not disappear after World War II or when moral rhetoric replaced *Realpolitik* in the pronouncements of politicians. It is implicit in the practice of foreign policy. In line with this dynamic conception of geopolitics, as the world political economy changes the criteria used for ordering the world geographically change.

Beyond the geostrategic and geopolitical reasoning in the realistic tradition of power politics, a new school of '*critical geopolitics*' evolved in the framework of late modern or postmodern and deconstructivist approaches to international relations (Ashley 1984, 1988, Derrida 1981, Der Derian 1992). While geographers have long been interested in how geographical concepts work, Hartshorne (1950), influenced by Foucault (1980) and Lacoste (1976) the new critical approaches focused on geopolitics as a discourse and as a form of power and knowledge interpreting hegemonial power as rule writers. Critical geopolitics focused on the geopolitics of imperialism, the logics of American foreign policy, and how intellectuals of statecraft constructed geographical arguments to legitimate power (Ó Tuathail 1989, 1996; Ó Tuathail/Agnew 1992; Ó Tuathail/Dalby/Routledge 1998; Dalby 1991). On Ó Tuathail's version of *critical geopolitics* (1996), Agnew (2000: 96–98) noted:

> From the outset, the terms of geopolitics are situated in a set of discourses about statehood, state sovereignty, and the geographical divisions of the world upon which

36 See Diekmann, Krüger and Schoeps (2000), 2 volumes with a review of the debates on political geography in Germany and since 1990 also in France and Italy. Only two specialists of international relations are represented: von Bredow (2000: 433–452) and Fröhlich (2000: 559–590). The volumes ignore the new debate on *critical geopolitics* while the US geostrategic debate is covered. Among the 26 contributions one focuses on imperial, cultural and political borders, on frontiers and on anthropogenic research on political borders, border conflicts and border regions in the context of globalization and regionalization (Heller 2000: 325–350).

37 See the review of Kelly's survey of the geopolitical thinking in Latin America by G. Pope Atkins, University of Texas, Austin, in: *Journal of Interamerican Studies and World Affairs*, Summer 1998; at: <http://findarticles.com/p/articles/mi_qa3688/is_199807/ai_n8793265/?tag=content;col1>.

> the practices of international relations depend for their meaning and significance. ... Ó Tuathail sees the mapping of the world by academic theorists and political practitioners as involving a 'geo-graphing' in which meaning is never completely mapped, even as this is the claim all make. The goal of the book is to analyse the ways in which conventional geopolitical writing can be called into question or 'displaced' from its intellectual and political pedestal. Three main approaches ... are taken to task. The first is to open up traditional terminology of geopolitics by exposing it as anything other than self-evident and innocent. ... a second approach is to define geopolitics as a type of 'governmentability'. ... The third and most important approach explores the techniques of 'seeing' that make global political mapping possible. ... Overall, the three-pronged attack displaces the logic of geopolitics by pointing how it is discursively produced. Geopolitics does not simply 'happen'.

Other geography authors have focused on issues of economics, identity, and nationalism in global cities (Scott 1998; Agnew 1998; Herb/Kaplan 1999). David Newman (1999: 1–2) summarizes the factors that contributed to its renaissance:

> The collapse of the Soviet Union and the territorial reordering of Central and Eastern Europe, together with the impact of globalization and supra-national processes on what is traditionally seen as the Westphalian compartmentalization of the world into sovereign states, has raised a host of new questions concerning the nature of the world political map. The study of these topics has assisted in the re-legitimization of Geopolitics as an academic sub-discipline.

On the international scene, a reassessment of the geopolitical writings of Ratzel occurred at a meeting held in Trieste in December 1997 on 'Europe between Political Geography and Geopolitics' (Antonsich/Kolossov/Pagnini 2001), and a subsequent meeting in Israel in January 1998 focused on 'Geopolitics and Globalization in a Postmodern World'.[38] Newman (1999: 3–5) identified as key themes of the contemporary study of geopolitics:

- Globalization and the changing function of state sovereignty. ...
- The deterritorialization of the state and the associated changing roles and functions of international boundaries. ...
- The study of geographical texts, narratives and traditions. ...
- The geopolitical imagination. The relative location of a state in the global system. ...
- The 'reterritorialization' of the state and the emergence of new ethnic national and territorial identities. As globalization and boundary permeability affect the state at one end of the spectrum, so too do the emergence of new states and the associated creation of new boundaries affect the lower end of the system. ... Geopolitics should focus on the geographic differentiation of these processes, along a continuum from deterritorialization to reterritorialization and the way in which globalization affects different state activities unevenly.

Geopolitics or 'politics within a space' and globalization 'politics beyond space and borders' point to two extremes that are relevant for the analysis of the referent objects of security. Through both theoretical perspectives of '*géopolitique*' and '*globalization*' different features of the present political reality may be perceived and evaluated. But now the global environmental changes in the Anthropocene mean that all these matters have to be updated to take the new circumstances into account.

94.3.7 Bringing the Environment into the Geopolitical Discourse

The debate on *global environmental change* (GEC) and climate change (Issar/Zohar 2004, 2007, 2008, 2009) triggered new proposals for a spatialization of environmental issues with concepts such as: *ecological geopolitics* (Dalby 2000, 2002a, 2002b) and a *political geoecology* (Brauch 2003, 2003a, 2009a). This is important because the effects of climate change do not distinguish national borders but the specific impacts differ due to the socio-economic status of the affected countries and the degree of social vulnerability of its affected people (IPCC 1990, 1990a, 1996, 1996a, 1998, 2001, 2001a, 2007, 2007a, 2007c). The securitization of climate change started in the early 21st century (Brauch 2002, 2005a, 2007, 2007f, 2009a; chap. 42 by Scheffran). It did so in part by extending the earlier 1990's discussion of environmental security, although it seems that in at least some cases the earlier discussion has been overlooked and some of the lessons lost in the process (Floyd 2008). Clearly the focus in the early part of the twenty-first century focuses more explicitly on the theme of security broadly understood, than on the 1990's debate specifically about conflict (Detratz/Betsill 2009; Trombetta 2008)

Climate change is discussed as an issue of environmental and US national security[39], of international

38 Newman (1998); Kimmerling (1983); Biger (1990); Sucharow (1999); Bernstein (2000); Shilhav (1985).

and human security[40, 41], reflecting contemporary strategic concerns (Dyer 2008; Dupont 2008). The German Advisory Council on Global Change (WBGU 2007, 2008) in a report on *Climate Change as a Security Risk* discussed "climate change as a threat to international security" due to four climate-induced conflict constellations (chap. 41 by Bauer). This report used an extended security concept that included the securitization of environmental dangers including the risks associated with climate change, however, its referent object focused on the nation state.

International relations analyses of globalization, new regionalism, and geopolitics have mostly ignored both the environmental dimension and the securitization of climate change and desertification. According to Alker and Haas (1993), thinking on global environmental change and politics could develop into either a reworking of classical *geopolitics* or a new focus on *ecopolitics*. For Dalby (2000: 90) this ecopolitical analysis of the global environment requires thinking beyond "the state and the conceptual tools of contemporary neoliberal scholarship", but also beyond the spatializations of political processes (globalization, regionalism, geopolitics) with the state or non-state economic actors as major points of reference. To understand "politics and ecology as processes in motion, rather than as stable entities", requires according to Dalby (2000: 98), "a more sophisticated political ecology that understands environmental change as a series of complex social processes in specific geographical contexts". Dalby (2000: 99) concludes that the post-Cold War context permits a discussion of environmental security issues beyond geopolitical rivalry. Thus, environmental change should be incorporated into models of conflicts, geopolitical assumptions must be debated, and "ecopolitical considerations require that ecology and environmental history be taken seriously" (Dalby 1998b).

While Dalby (2000) approached *eco-geopolitics* from critical geopolitics (1998) and did so specifically to challenge the framing of environmental matters in terms of national security, Brauch (2003, 2003a) argued that a *political geoecology* is needed that combines the regional implications of global change and its potential outcomes: disasters, environmentally-induced migration, crises, and conflicts, and Oswald (2008a; chap. 72) insisted on the triggering factors and focused on social vulnerability. This approach requires an interdisciplinary discourse on global change and its impacts for security and conflict avoidance. As Trombetta (2008) notes adding climate into the discussion explicitly challenges the traditional meanings of security. It does so precisely because the new geopolitical context of the Anthropocene requires a forward looking, anticipatory understanding of security, not the old one that emphasizes monitoring borders, providing insurance or cleaning up after a disaster.

Traditional geopolitics frequently suggested that the environment in some ways determined or at least dramatically shaped human actions. The arguments were demolished by the middle of the 20th century (Sprout/Sprout 1965), but they are remarkably persistent in the popular discourse and elsewhere in political thinking (Kearns 2009). They have re-emerged in June 2009 when Robert Kaplan (2009) rearticulated Halford Mackinder's classic geopolitical text on the 'pivot of history' from 1904 in the pages of Foreign Policy magazine. Kaplan tries to use the Mackinder notions of nature being the ultimate arbiter to suggest that geopolitical rivalry in Asia is coming, regardless of what anyone in the West can do about it. This determinist argumentation ignores human-induced changes to the biosphere (Dalby 2009, 2009a). Returning to an old theme of geographically clashing spaces, suggesting that such clashes are inevitable because they are an objective given condition of the planet ignores change and redirects attention away from looming changes to focus on military and naval rivalries (Morrissey 2009), not the transformation of local and regional ecosystems and the large scale impacts of climate change.

Both the term geoecology and the notion of the Anthropocene suggest that the old assumptions of the environment determining human fate are no longer tenable, because carbon fuel use have already changed environmental conditions. Old fashioned geopolitics diverts attention from these new circumstances, and as such it is a distraction from the tasks at hand which conjures up an inappropriate geography to suggest the inevitability of conflict precisely when large scale cooperation is needed to deal with the changes that

39 Schwartz and Randall (2003/2004); CNA (2007); Campbell, Gulledge, McNeill, Podesta, Ogden, Fuerth, Woolsey, Lennon, Alexander, Smith, Weitz and Mix (2007); Campbell (2008); Pumphrey (2008).

40 GECHS (1999, 2005); Adger and Barnett (2005); Barnett and Adger (2005); Bohle and O'Brien (2007); Wisner, Fordham, Kelman, Johnston, Simon, Lavel, Brauch, Oswald Spring, Wilches-Chaux, Moench and Weiner (2007); Brauch (2009a, 2009b).

41 See the GECHS workshop on climate change and human security at: <http://www.cicero.uio.no/humsec/list_participants.html>; Barnett and Adger (2005); at: <http://www.cicero.uio.no/humsec/papers/Barnett&Adger.pdf>.

are already in motion due to profligate use of carbon fuels and the numerous other changes.

Political geoecology suggests a much more explicit focus on ecology, on the big scale in particular in terms of geo, and also a clear indication that human choices are shaping the world of the future. The recognition of the significance of our actions is only now registering in many parts of the world as the debate about climate change suggests to people the profound choices that our predecessors and ourselves have made in shaping the future condition of the biosphere. This terminology suggests the most important theme for all concerned about security in the 21st century, the inapplicability of traditional geopolitical notions of an external environment for discussions of human security in the future.

94.4 New Spatial Approaches in the Anthropocene: Geoecology and Earth System Analysis or Science

94.4.1 Combining Human, Social, and Geoecology

The analysis of the security impacts of global environmental change in the Anthropocene requires the knowledge produced by both the *geoecology* programmes that are located in physical geography, earth system science and numerous other disciplines, and by *social ecology* and *human ecology* approaches combining scientific efforts in geography, sociology, psychology and political science.

In trying to encapsulate numerous ecological processes, Huggett (1995, 2000) used the term geoecology to emphasize the importance of earth system processes, and the necessity of thinking carefully about the interactions of *pedosphere* (soils), *biosphere* (living things), *atmosphere* (air), *lithosphere* (minerals) and *hydrosphere* (water). All these 'spheres' matter in current thinking, but all are being changed by human activities. Climate change is obviously about the atmosphere, but what's changing the composition of the atmosphere is really a matter of extracting carbon from the lithosphere. Likewise the artificial use of nitrogen fertilizer is changing the pedosphere directly, while converting land to use for farming directly changes the pedosphere and the biosphere. When water is diverted to irrigate these fields the hydrosphere too is changed. Linking this to the term political makes it clear that humanity is actively changing the various 'spheres' that make up the geoecology of our planet.

The sheer scale of the human remaking of ecosystems requires that we now think about these matters at the global scale (MA 2005; UNEP 2007; IPCC 2007; Leemans 2009). Synthesizing these themes, the largest of scales has not been an easy scientific task, but in the last couple of decades putting the pieces together to understand the processes driving geoecology at a planetary scale have coalesced into a new perspective on humanity and the environment.

> The interactions between environmental change and human societies have a long and complex history, spanning many millennia. They vary greatly through time and from place to place. Despite these spatial and temporal differences, in recent years a global perspective has begun to emerge that forms the framework for a growing body of research within the environmental sciences. Crucial to the emergence of this perspective has been the dawning awareness of two fundamental aspects of the nature of the planet. The first is that the Earth itself is a single system, within which the biosphere is an active essential component. In terms of a sporting analogy, life is a player, not a spectator. Second, human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and accelerating ways; humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, upon which humans depend (IGBP 2001: 4).

94.4.2 Earth System Science Perspectives on GEC

During the 1990's, *Earth Systems Science* (ESS) gradually emerged from research on *global environmental change* (GEC). According to Ehlers and Krafft (2001: 3–4): "global change research ... started off as climate research and the climate research community contributed the first scientific breakthroughs in the understanding of climate variability stimulating further research". This triggered the interest of "geologists, hydrologists, biologists as well as representatives of the terrestrial and marine geo-sciences" who focused on the "biogeochemical impacts and processes in both marine and terrestrial environments". Many new insights were achieved within research in the contexts of the *World Climate Research Programme* (WCRP, see chap. 78 by Church/Asrar/Busalacchi/Arndt) and the *International Geosphere-Biosphere Programme* (IGBP, see chap. 77 by Noone/Nobre/Seitzinger).

With the creation of the *Human Dimensions of GEC Programme* (HDP) in 1989 that became the *International Human Dimensions of GEC Programme* (IHDP) the social sciences joined the community addressing psychological, cultural, economic, historical and political factors. During the initial phase, Ehlers and Krafft (2001: 11) noted during the initial phase of global change research (1985–2000) a "hesitance of social scientists to participate more actively in the promising and future-oriented endeavours of this new and huge research field" as they appeared "to be neither interested nor knowledgeable about GEC research". But also the natural sciences would have to reflect on the interpretative questions posed by social scientists who often preferred bottom-up or inductive approaches compared with the top-down or deductive modelling of many natural scientists. In identifying pathways towards sustainable development, Clark, Jäger, van Eijndhoven (2000: 2) stressed the need to reduce uncertainties:

> Efforts to manage humanity's interactions with the global environment ... will almost certainly be partial, contentious, and prone to failure. But the management of global environmental risk is also what an increasing number of political leaders, advocacy groups, scientific experts, and international organizations find themselves doing, not uncommonly with the best of motivations and the greatest trepidation.

Ehlers and Krafft (2001: 13–14) also referred to the debate on a new social contract between scientists and society, where the former offer "socially robust knowledge" (Gibbons 1999: C 84) and they stressed that the "grand challenges" of GEC research "can only be addressed through cooperation and interaction of both natural and social sciences". The need for integrative research on global change was taken up by Grunwald (2001: 23–24) who distinguished four levels of integration with regard to research on a) economic sectors, b) on the classic disciplines between the natural and social sciences, c) cultural predispositions, and d) on the dimensions of sustainability.

In *Earth System Science in the Anthropocene*, Ehlers and Krafft (2006: 7) provide a context of the emerging debates on global change research and Earth Systems Science, especially since 1990 that focuses on the "human role in the transformation not only of the earth's surface but of the earth and climate system", where "human-driven changes cause multiple effects that cascade through the earth system in a complex way".[42] But in none of these contributions, the relevant policy areas, the political process and institutions were analysed and – except for one chapter on food security (Zingel 2006) – the security impacts of GEC were not addressed.

From the vantage point of physics and climate impact research, the *Earth Systems Analysis* (ESA; Schellnhuber/Wenzel 1998) or *Earth Systems Analysis for Sustainability* (Schellnhuber/Crutzen/Clark/Claussen/Held 2004; Schellnhuber/Crutzen/Clark/Hunt 2005) and the *Earth Systems Science Partnership* (ESSP; chap. 74 by Leemans/Rice/Henderson-Sellers/Noone) have evolved since the 1990's as a new "scientific enterprise that tries to perceive the earth as a whole, a unique system which is to be analysed with methods ranging from nonlinear dynamics to macroeconomic modelling".[43] Schellnhuber and Wenzel (1998: vii) called *Earth System Analysis* (ESA)[44] a "science in *statu nascendi*" that combines the object "Earth System" with the method of "Systems Analysis".[45]According to both authors: It is a science as it has

1. a genuine *subject*, namely the total Earth in the sense of a fragile and 'gullible' dynamic system,

42 Ehlers and Krafft (2006) addressed four key themes: 1) "The Anthropocene"; 2) "Global Change and Human Security"; 3) "Interface between Nature and Society" and 4) "The Scientific Challenges for Anthropogenic Research in the 21st Century." Only one chapter addressed the security dimension for "food security in South Asia" (Zingel 2006: 229ff.) but without any reference to the debate on a reconceptualization of security.

43 See the back cover of Schellnhuber and Wenzel (1998).

44 The ESA concept has framed the programme of several multi-, inter- and transdisciplinary university departments and research programmes. At Enschede (Netherlands) the International Institute for Geoinformation Science and Earth Observation has a Department on *Earth System Analysis* <http://www.itc.nl/Pub/Home/Organisation/Introduction-Scientific-departments/ESA> that "concentrates on a number of societal issues and problem areas, including: i) earth resources management, exploration and exploitation; ii) land (soil) degradation; and iii) natural hazards and disasters; geo-environmental hazards. ... The department's activities include: a) spatio-temporal modelling for an improved understanding of earth systems and processes; b) development of methods, techniques and tools for the assessment and monitoring of these earth systems and processes; and c) earth and land resource information provision for planning and decision-making on the multi-functional use of space. ... ESA provides and applies relevant geo-information for an improved understanding of earth surface and subsurface processes in space and time, for the sustainable use of earth resources and the mitigation of natural and man-induced disasters.

2. a genuine *methodology*, namely transdisciplinary systems analysis based on, i.a. planetary monitoring, global modelling and simulation,
3. a genuine *purpose*, namely the satisfactory (or at least tolerable) coevolution of the ecosphere and the anthroposphere (*vulgo*: Sustainable Development) in the times of global change and beyond.

The ESA concept evolved from the inauguration of the scientific Advisory Board of the *Potsdam Institute for Climate Change Impact Research* (PIK) in 1994. In his introduction Schellnhuber (1998) offered the conceptual and formal framework in which he associated the 'scope of the challenge' with that of geo-cybernetics, or "the managed coevolution of nature and humanity". He defined as the task of *Earth System Analysis*:

> The scientific investigation of how the infinitely interrelated complex of ecosphere and anthroposphere responds as a whole to major perturbations, and how these reactions might be favourably influenced by wise global management. ... The ... Earth System Analysis clearly ought to be: i) interdisciplinary, ii) international, and iii) inter-objective. ... Its main task is to provide tools for managing Global Change in order to secure an *acceptable long-term coevolution of nature and civilization*. In other ... words, Earth System Analysis should yield a good deal of the information and methods required for defining and materializing 'Sustainable Development' (Schellnhuber 1998: 6–9).

The 'Integrated Earth System' concept was taken up by the *International Geosphere Biosphere Programme* (IGBP) in its study on *Global Change and the Earth System* that outlined a research agenda to meet the future challenges that is based on the following two key observations on the earth system functioning:

> First, that the Earth itself is a single system within which the biosphere is an active, essential component. Secondly, that human activities are now so pervasive and profound in their complex, interactive and apparently accelerating ways; humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, on which the human species depends (Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004: 1).

The Dahlem workshop on *Earth System Analysis for Sustainability* in May 2003 carried the discussion further (Schellnhuber/Crutzen/Clark/Claussen/Held 2004). According to Clark, Crutzen and Schellnhuber (2004: 1, 2005): "we live today in ... the 'Anthropocene' – a new geologic epoch in which humankind has emerged as a globally significant – and potentially intelligent – force capable of reshaping the face of the planet" (Crutzen 2002). The recognition of the role of humans as global transformers of the earth has gradually evolved since Alexander von Humboldt (1808) and was systematically developed by the Russian geochemist, Vernadsky (1926, 1998) in his lectures on the 'biosphere' delivered at the Sorbonne in the 1920's.

Clark, Crutzen and Schellnhuber (2004: 2, 2005) argued that "the last half century witnessed an accelerating program of scientific studies (e.g. Thomas 1956; Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004) that have broadened and deepened our understanding of what Turner, Clark, Kates, Mathews and Richards (1990) have convincingly characterized as an 'Earth transformed by human action'". In response to the gradual understanding of the anthropogenic contribution to GEC and climate change in the Anthropocene the normative concept of 'sustainable development' (Brundtland 1987) has been adopted in Rio de Janeiro in 1992 at UNCED and become a key policy goal of UN Secretary-General Kofi Annan's *Millennium Report* (UN 2000), and at the *World Summit on Sustainable Development* (WSSD) in Johannesburg (2002) where "the need for harnessing science and technology in support of efforts to achieve the goal of environmentally sustainable human development in the Anthropocene was generally recognized" (Clark/Crutzen/Schellnhuber 2004: 3, 2005).

At the Dahlem Conference in May 2003 these three scientists assessed the state of this transformation and called for an 'earth system science' (ESS) that requires a second Copernican revolution or a new scientific paradigm of a 'science for global sustainability'. The Amsterdam Declaration (2001) that established the *Earth System Science Partnership* (ESSP) contributed to a comprehensive earth system science research programme by formulating 23 basic analytical, normative, operational, and strategic questions (chap. 74 by Leemans/Rice/Henderson-Sellers/Noone).[46] Clark, Crutzen, and Schellnhuber (2004: 19, 2005) argued that efforts to synthesize the work on the resil-

45 For an overview of systems theory see Mesjasz (2008, 2008a, 2008b). For a recent assessment of systems theories with a special focus on issues of complexity, steering of structures vs. structural steering, as well as on concepts of negotiation and application from the perspective of geographers see Egner, Ratter and Dikau (2008).

ience of ecological systems and on the vulnerability of social systems

> have highlighted the importance of incorporating multiple stresses, teleconnections, explicit pathways of exposure, the possibility of threshold responses, explicit treatment of scale, and attention to the components of adaptive capacity in frameworks for the analysis of vulnerability and resilience (Turner/Kasperson/Matson et al. 2003). ... Needed now for management is problem-driven research that utilizes these conceptual vulnerability/resilience framework to illuminate the kinds, rates, and magnitudes of specific disturbances beyond which the 'ability of society to advance human well-being' can no longer be sustained.

However, all these conceptual as well as research and educational scientific efforts have left out the key component for the transformation of knowledge into action: *Politik* in its triple meaning of *policy* (field), *politics* (process) and *polity* (legal and institutional framework). Thus, the discourse on the reconceptualization of security in the Anthropocene has not yet reached the multidisciplinary global change community in the natural sciences.

However, a proactive security policy in the Anthropocene that addresses the *Global Challenges for Leviathan* (Cerutti 2007) must be science- and knowledge-based, and requires a different knowledge from what national intelligence agencies and the military establishment have offered policy-makers, and it calls also for different goals, strategies, and means than traditional security experts trained in the Hobbesian tradition of security studies can offer.

Such a new security policy in and for the Anthropocene necessitates for the new security dangers posed by GEC a new policy framework that integrates both the experience of past nature-human interactions as well as the scenario- and model-based projections of the probable societal outcomes of future trends. This emerging security policy makes a conceptual thinking for a new peace policy in the early 21st century necessary that combines the goals of 'sustainable development' with a 'sustainable peace' to cope with the 'survival dilemma' of humankind (Brauch 2008b; Oswald Spring 2008; Brauch/Oswald Spring 2009a).

Earth System Analysis for Sustainability (Schellnhuber/Crutzen/Clark/Claussen/Held 2004) uses an integrated systems approach to provide a panoramic view of planetary dynamics since the inception of life some four billion years ago and to identify principles for responsible management of the global environment in the future. Perceiving our planet as a single entity with hyper complex, often unpredictable behaviour, the authors use *Earth System Analysis* to study global changes past and future. They explore the question of whether the unprecedented human-originated changes transforming the ecosphere today will end a 10,000-year period of climate stability. *Earth System Analysis for Sustainability* (Schellnhuber/Crutzen/Clark/Claussen/Held 2004) analyses the driving forces behind global change and uses this knowledge to propose principles for global stewardship.

With so many interconnections and the growing realization that the scale of human activities is having widespread repercussions, and in ways that are not necessarily predictable, questions of how to synthesize the findings in numerous human and social sciences inevitably emerge. But from the review of the geoecology and earth systems in this sections five key findings emerge that are crucial to understanding the new context for thinking seriously about human security in the future.

First, a generation after James Lovelock (1979, 1988, 1995, 2006, 2009) suggested as much in his formulation of the Gaia hypothesis, earth system thinking notes the crucial, and relatively new, realization that life partly regulates the biosphere; it is an active part of the multiple processes that shape our world. Life is not, as it has frequently been understood to be until recently, a mere addition to a planet of oceans, atmosphere and rocks. It has actively changed the biosphere, nowhere more clearly than in producing the oxygen that is key to the life of most life forms. Thus environment cannot now be understood as something outside of life, or as the given context for humanity. The key separation that most of modern life has assumed, of humanity separate in importance senses from nature on the big scale, no longer makes any scientific sense.

Second, the important point is that the sheer scale of human activities is already now adding a new dimension to these earth processes. More than just climate change: "Human activities are significantly influencing the functioning of the Earth System in many areas; anthropogenic changes are clearly identi-

46 Thereof four are relevant for security studies, as e.g. 7: Which are the most vulnerable regions under global change? 8. How are abrupt and extreme events processed through nature-society interactions? 14. What are the most appropriate methodologies for integrating natural science and social science knowledge? and 23. What is the structure of an effective and efficient system of global environment and development institutions?

fiable beyond natural variability and are equal to some of the great forces of nature in their extent and impact" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore/Oldfield/Richardson/Schellnhuber/Turner/Wasson 2004: 4). Where the first finding suggests that life itself changes its context; that what we have called environment is substantially a product of life itself, now this second finding makes it clear that humanity as the now dominant form of life on earth, has become a major factor in shaping the context of life itself.

The third key finding notes that the various changes to the earth system intersect and may do so in ways that have 'cascading' effects. Changes in one part may have effects that influence others, which in turn, knock on effects elsewhere. Thus analysis has to try to understand these interconnections while also seeing the potential for 'cascades' as whole sequences of change are set in motion. The sheer complexity of ecological systems makes this difficult to predict, and analytical science that narrows a focus to examining a small part of life in detail has to be complemented by synthetic work that puts the particular parts back into the larger context. Change doesn't necessarily happen in simple patterns, nor does change of one factor necessarily cause a similar change in others.

Fourth, systems frequently have thresholds with potential instabilities, which when they are crossed cause abrupt changes. This finding emphasizes the importance of learning where the thresholds in ecological systems are so that dramatic changes do not come as surprises and in many cases so that policies can be put in place to prevent crossing the threshold in the first place. Humankind learned about one crucial threshold by accident in the 1980's when it was discovered that previously unknown chemical processes were seriously damaging the stratospheric ozone layer and endangering that crucial layer which blocks incoming ultraviolet 'B' radiation from the sun. The damage to this crucial ecological layer came as an entirely unintended consequence of humanity's production of chlorofluorocarbons. These chemicals had been thought to be benign, but they turned out to be both potent greenhouse gases and, when they broke down in the stratosphere over the poles in winter, key to removing the ozone from the upper atmosphere. Where the thresholds for rapid climate change may be we cannot yet be sure (Schneider 2004), but the recent rapid melting of ice at the poles is clear indication that we may already have crossed at least some important thresholds.

Finally, and probably the most important finding, is that the changes that we have already caused in the biosphere have pushed some of the key ecological processes of the planet out of the range for which we have detailed knowledge from the past. Over the last six hundred thousand years, detailed records of temperature and the composition of atmospheric gases show fluctuation within a fairly narrow range. Carbon dioxide and methane in particular are fairly closely correlated with temperature through this period that includes a series of ice ages. Reduced greenhouse gases coincide with ice ages, slightly higher concentrations with the warmer so-called interglacial periods; the most recent one of which has provided the relatively stable climatic conditions that allowed the emergence of human civilization. Nowhere in that period of recorded geological history is there any record of methane and carbon dioxide levels at current levels. There is no parallel situation that we might draw lessons from; in the scientific terms of the International Geosphere Biosphere Program (IGBP 2001) authors, we are in a 'no-analogue state'. Precisely because we are in this situation, and don't know exactly what is coming, the necessity to prepare to deal with a broad range of contingencies is clear.

If we do not think ahead then we may face the perilous fate that, thirty years after he published the 'Gaia hypothesis', James Lovelock (2009: 33) warned might befall us:

> We have enjoyed twelve thousand years of climate peace since the last shift from the glacial age to an interglacial one. Before long, we may face planet wide devastation worse even than unrestricted nuclear war between superpowers. The climate war could kill nearly all of us and leave the few survivors living a Stone Age existence.

Lovelock's dramatic "final warning" here in *The Vanishing Face of Gaia* addresses the security dimension of GEC, even though he avoids using the term.

94.4.3 Bringing Security Into the Ecological Discourse on GEC

The point about the Anthropocene is that humanity, and in particular the urban carbon fuelled industrial part of humanity, is making the biosphere increasingly artificial. We are a new forcing mechanism in the biosphere, shaping and changing many ecological processes while introducing new materials and geographies into the system. We are literally making our future by changing ecological and material arrangements for our immediate convenience. This is a very different set of circumstances from those depicted in the determinist literature of traditional geopolitics. We are increasingly shaping nature, but we have no

choice but to adapt to the new circumstances we are making. Getting this contextualization of the human condition right in our political thinking is key to intelligent planning and policies for the future. Hence the utility of phrasing matters in terms of 'political geoecology'. We are shaping the earth, literally producing nature as a consequence of our industrial metabolism, a metabolism that has very uneven geographical results as development transforms our political spaces and natural circumstances simultaneously (Smith 2009).

Traditional geopolitical thinking with its themes of environmental determinism in the 19th century and early 20th century frequently operated to both obscure social processes and simultaneously pin the blame for disaster on the supposedly cruelty and fickleness of a stingy and unreliable nature. The famines that Mike Davis (2001) acidly calls the late Victorian holocausts were blamed on unreliable weather, not the disruptions caused by imperial political economy and the social and economic dislocations as traditional systems were integrated into the expanding global grain trade. Speculation and the failure of imperial administrators to manage food supplies or provide for those people in their charge was evaded by the attribution of cause to rainfall, temperature fluctuations, and the like. This was supported by the early data from the new network of meteorological monitoring stations being established by Europeans around the world in the late 19th century. Meteorology, and in part the data which were much later to be interpreted in terms of the *El Niño Southern Oscillation* (ENSO) climate pattern, provided the alibi for imperial neglect. Millions died, the environment got the blame.

Now *earth system science* (ESS) makes it clear that the environment is not out there beyond our control determining our fate. Today one billion people suffer from hunger, during 2009 100 million more due to speculation and biofuels production from grains (IFPRI 2009). The environment is an increasingly artificial entity whose processes we are remaking without usually realizing that this is in fact what we are doing. More so than that, the crucial insight in earth system science is that life is a key component of the biosphere, not a late addition to a pre-given system of atmosphere, land, and water. Life is a player, not a spectator, as the IGBP (2001) authors reminded us. For much of earth's history life has been removing carbon from the atmosphere, making limestone from skeletons of sea creatures, coal, petroleum and gas from the buried remains of terrestrial life forms. What's new about the Anthropocene is that humanity has been reversing this process, literally turning rocks into air every time we use our vehicles or ship goods around the world. Globalization is a physical process in addition to a cultural or economic one. That crucial point needs to be incorporated into our thinking. The Anthropocene emphasizes that there is a new form of life transforming things; industrial urban humanity fuelled by those fossil fuels.

This is important because it is now clear that we can no longer use the environment as an alibi for our inactions or unsustainable actions on many things. In the Anthropocene we are disrupting many natural processes, turning forests into fields, wetlands into solid land for building, migration routes are being blocked, many species extirpated either directly by hunting or frequently simply by destroying their habitat as our resource extraction spread to all corners of the planet. In the process the ecological services these systems used to provide are being changed or lost (UNEP 2007). So too is the ability of natural systems to adapt and change; resilience to reorganize and recover after disruption works only within thresholds, and many of those thresholds may be crossed without humanity knowing they even exist (MA 2005).

From this it follows that a focus on the politics of what we are making is crucial for thinking about the future. Our environments are increasingly artificial; there is no longer a plausible case to be made that the environment determines our fate in general, even if it appears that way to people going hungry or thirsty. Clearly we are increasingly making the circumstances of our own existence, making decisions about how we all will live in the future. In short, this is a very political exercise in which power is used to shape the human context. But this is not a context given by political boundaries however much themes of sovereignty and security are expressed and practised in terms of spaces and supposed autonomies.

Globalization has made it clear that the economies of the planet are interconnected in many ways; earth system science now makes it clear that a geopolitical model of the human condition that starts with separate bits of territory and assumes that this is what determines our modes of life is completely misleading, and dangerously so. Especially so when security is invoked in these terms to maintain the privileges of the powerful by excluding the demands of the poor and marginal. Erecting boundaries and barriers to migration and blaming the poor for their fate is not new, but now it is clear that the circumstances which may set the poor in motion are more our doing than theirs. This is a very unsettling thought, but it is the

unavoidable conclusion that derives from considering the political geoecology of living in the Anthropocene.

It is important to understand vulnerability as a two-fold process, or as Leichenko and O'Brien (2008) put it, a matter of 'double exposure'. People's circumstances are increasingly artificial in the sense that they depend on technology, trade, and manufactured materials for food, water, shelter and clothing. But they are also increasingly subject to storms, droughts, and other disruptions precisely because the technology, trade, and artificial places they live in are at least indirectly now disrupting weather systems. Thinking about vulnerability and the manner in which institutions provide safety and protection, the rationale for security in the first place, now requires that these new circumstances be worked into the thinking. Linking security with environmental change makes this new context of humanity the starting point for analysis (Brklacich/Bohle 2006).

94.5 From Ecological Geopolitics to Political Geoecology

The two discourses on the spatialization of international relations and security as well as on the nature-human interactions have two major deficits:

- the discourse on geopolitics, geostrategy and geoeconomics in the social sciences has been dominated by the Hobbesian pessimism and ignoring environmental concerns and issues of global environmental change as dangers for security and survival;
- the newly emerging research in the natural sciences on Lovelock's Gaia hypothesis, on geoecology in geography, and on *Earth Systems Analysis* (ESA) or *Earth Systems Science* (ESS) has so far to a large extent ignored the political dimension of transforming this new systemic knowledge into proactive policy initiatives.

94.5.1 Bringing the Environment into Security Discourse

Critical geopolitics tackles some of the most basic assumptions used to structure the political discourse. It challenges the taken for granted specifications of the world, its divisions into states, blocs, territories, North and South, rich and poor, and so on justified by discrimination processes (chap. 72 by Oswald Spring). Emphasizing that most geographical categories used in politics are social constructions, rather than the given context for discussion, critical geopolitics then examines the political identities that inhabit the world designated in terms of regions, states, nationalities, etc. (O'Tuathail/Dalby/Routledge 1998). National histories, and the claims to territory which usually unproblematically support the expressions of national pride, turn out to be much more contentious than conventional accounts suggest. The apparently obvious designation of 'Europe' turns out to be highly disputed through history (Heffernan 1998), a matter that is obvious to anyone reflecting on the current debates about what it means to be European, but complexities that are obscured in so much political discussion when security is invoked (Kuus 2007). Even naming continents, seemingly the most natural of all geographical categories, turns out to be a complicated matter of cartographic controversy and change through history (Lewis/Wigen 1998).

On the smaller scale nation states are usually the product of political and power struggle rather than the natural outgrowth of some inevitable process (Agnew 2007). Identities and territories are invoked in the logics of national security too, specifying the context for struggle and rivalry by using apparently unproblematic geographical specifications of the world to structure their discourse. How social representations (chap. 66 by Flores/Wagner) justify fears of strangers, and how threats and dangers work their way through popular culture has also become a matter for scholarly analysis, and it links geographical categories directly to matters of culture and the specification of secure spaces and places and those that are deemed threatening (Pain/Smith 2008; Ingram/Dodds 2009).

At the very largest of scale, that of the planet, contemporary geopolitics looks at how the world is imagined, divided up, and specified in the discourse of contemporary politics (Agnew 2003). Much of this concerns how the world is viewed from the capital cities of the North, the places where rivalries among the great powers for access to cheap natural resources are a preoccupation. How and where dangers originate, and what threatens the metropoles of the global system, is a long-standing geopolitical theme directly connected to matters of inter-imperial rivalry (Kearns 2009) and superpower behaviour. But now too, as environmental matters come to the fore, critical geopolitics asks how climate and other 'environmental' dangers and threats are specified in geographical terms (Dalby 2002b). Where the dangers lie, what their source of threat to whom where, is the theme of

much of the environmental security discussion of the last couple of decades. But upon closer investigation much of this discourse still draws unreflectively on formulations from earlier times, colonial and imperial assumptions of dangerous peripheral places threatening the populations at the centre of empire, but affecting also the survival of the periphery (hunger, illnesses, disasters, urban slums).

More dangerous in terms of thinking intelligently about ecological transformation is the link between old-fashioned geopolitical thinking and environmental determinism[47]. Long discredited in the scholarly literature, not least because it was so obviously wrong in many cases and besmirched with racist themes, the arguments that environments determine human behaviour are powerful in so far as they can be used to suggest that human behaviour is shaped and determined by forces beyond human control. Linked to the ideas of Thomas Malthus, and his articulation of eighteenth century European fears of the collapse of civilization due to the depredations of impoverished populations, the arguments that scarcity is a matter of nature, not economy, and that the Third World is a matter of environment rather than of the history of colonization and resource extraction, provide powerful support for suggestions that the rivalries of great powers are the only terms in which security can be understood. Rearticulated forcibly by Robert Kaplan once again in 2009, where he explicitly drew on Halford Mackinder's 1904 formulations of "the pivot of history" to interpret the political possibilities of the next few decades, these suggestions conveniently reprise the imperial administrator's view of the world, not the ecological scientists nor the historian's nor the geographer's view (Dalby 2009). If environment determines the fate of particular places, then all that can be done is to manage the chaos to ensure that the peoples of the metropoles, the only people who matter to the Robert Kaplan's of this world, do not suffer from the disruptions that are inevitable.

While no serious scholar doubts that environmental matters constrain human societies in numerous ways, as the world system historians have recently begun to investigate in a fairly systematic way (Hornburg/McNeill/Martínez-Alier 2007) the assumptions that environment necessarily causes polities to behave in particular ways is a different matter. Arguments that states inevitably have to expand or die, the organicist geopolitics of the nineteenth century, legitimates war-fighting and conquest, and in so far as such arguments suggest the inevitability of warfare then they link a misunderstood notion of the environment to a competitive notion of national security. Although not much commented upon, nor even noticed it seems, this mode of thinking persisted through much of the Cold War in terms of the arguments about Soviet foreign policy. In the 1970's prominent 'hawks' in Washington dusted off Friedrich Ratzel's figures of nineteenth century Russian agricultural production and used these figures to suggest that the long-term pattern of Russian expansion, followed through by the Soviet Union, subsequently was driven initially by stingy and unproductive agricultural lands and the search for better food supplies to the south (Dalby 1990). This was linked directly to the nuclear containment strategies of the Reagan administration.

Even if determinist arguments, and their Malthusian variations in particular, once had some merit, what is clear now is that the current changes set in motion are as a result of abundance, and changes wrought by the rapidly expanding global economy. Climate change is a matter of greenhouse activities and massive land clearance, not a matter of scarcity implicit in nature. But this does not stop journalists repeatedly arguing that water wars are inevitable, food will run out, and starving millions will be set in motion, triggering security problems caused by environmental factors (Kaplan 1994). There is nothing inevitable about this formulation; it is not the only way to think about global politics. As the science of global change and the detailed social science arguments elsewhere in this volume make clear, it doesn't have to be the case that environmental change necessarily causes conflict. Even Jared Diamond (2005), frequently criticized for his supposed determinism, argues in his big book on environmental *Collapse*, that we can use these histories to think our way out of the difficulties our present circumstances present.

Alker and Haas (1993) draw a crucial distinction between geopolitics and ecopolitics as frameworks for thinking about environmental change on the largest scale. Geopolitics draws, they argue from organicist notions of the state, from metaphors of competition drawn ostensibly from Darwin, and from assumptions that states were inevitably in competition. Coupled to territorial specifications of states

47 New threats are linked also to the justification of military bases with destruction of environment in other countries (Viesca) or Kissinger with the food power policy in 1972, when the USA became the most important grain exporter of the world and was able through subsidies, food prices, and market restriction to control emerging power interests in several countries.

and their powers this leads to an understanding of politics as competitive struggles between territorial states. While clearly the era of territorial aggrandizement ended in the 1940's; the United Nations and the norms of non-intervention and fixed boundaries have nearly entirely superseded conquest as the *modus vivendi* for state behaviour (Jackson 2000), the assumptions of competitive states and territorial struggle have remained a powerful interpretive framework for contemporary politics. In particular this notion of competitive spaces undergirded much of the Cold War rivalry; in that case it was competition between blocs, large parts of the globe tied into competing territorial entities. Since the Cold War such tropes have continued to structure the narratives of geopolitics. Now competition is understood in terms of rivalries over trade, control of financial flows, military capabilities and prestige, if less so about territorial conquest. It is still premised on clashing territorial entities, even in Samuel Huntington's (1993, 1996) infamous arguments about the clash of civilizations.

In this view, starting with territorial blocs in rivalry as the key focus, and the provider of security, climate change is somehow natural, beyond control, the cause of numerous difficulties that need to be managed, but pretty much outside any effective control. Among the arguments concerning the security implications of climate change are fears of migration, climate refugees being one prominent argument for the need for military preparation to deal with the national security consequences of change (Smith 2007; Busby 2008). The presupposition behind such thinking is once again the assumption of territorial states as the key to political life, and the exceedingly odd assumption that people are normally fixed in place rather than in motion. Given the rapid changes in the human condition, and the movement of people from rural to urban parts of the planet, migration is the human condition these days. Understanding that this is being accelerated by environmental changes in many places is important. Some of these migration attempts do run up against state boundaries that impede movement. But viewed from the migrant's perspective, it is precisely these barriers that prevent them getting access to shelter, livelihood, food, and medical attention. It is precisely the imposition of geopolitical modes of rule that may endanger their lives. But viewed from the metropoles, it is precisely these migrants who are the security problem because of the social disruptions that supposedly follow from their arrival.

In contrast, ecopolitics is a framework in which the earth is understood as a single dynamic system, one where interconnections between places and peoples are part of a larger ecological story (Alker/Haas 1993). Precisely because of a focus on competition between states and the priority given to economic development to fuel the war machines of the superpowers, ecological matters were downplayed through the period of the Cold War. But these matters cannot be addressed by assuming that what is most important in politics is the rivalries of the great powers. The appropriation of resources to fuel the rivalry is part of the cause of the dramatic environmental changes that are now the cause of so much concern, especially with the issue of climate change. But even when environmental matters do make it onto the political agendas of the big powers' old habits of 'imperial' behaviour, and how they are reported in media discussions of these events, are very persistent. In 1992 when the world's political leadership met in Rio de Janeiro to discuss the fate of the planet, a huge meeting to tackle numerous environmental themes, it was reported in the *New York Times* in terms of international prestige and the activities of the leaders at the event, not in terms of the ecological matters needing attention (Dalby 1996).

Now however, such modes of thinking are increasingly untenable precisely because the ecopolitical mode of thinking turns out to be the one supported by the science that studies environmental change. The shift in focus in earth system science makes it clear that humanity is not the hapless victim of a determining nature. Earth system science now makes it clear that life is not simply an afterthought on a planet of rocks, air and oceans. Life has shaped all three quite fundamentally. Life makes soils and has made the atmosphere one that is oxygen rich. Life has, over the long course of hundreds of millions of years, made the materials that fossil fuels. Now the latest dominant form of life on the planet, industrial humanity, is reversing this process of lithogenesis by turning those rocks back into air, and in the process setting numerous other ecological processes into motion, only most obviously the phenomenon that we now call climate change.

This transformation is key to the reason why earth system scientists now say we are living in the Anthropocene, the new geological era marked by this new transformation of the planet's surface systems by a new form of life. Thus, we need a very different formulation of security, one that is based on the insights that we are well on the way to transforming the biosphere such that it operates in a new way (Dalby 2009). Understanding ourselves as having taken our

fate into our own hands, albeit inadvertently, is key to thinking about how to slow climate changes (mitigation) to facilitate adaptation to the new circumstances we are creating. The old notions of environmental determinism, organicist models of states, and the focus on rivalries and territorial actions are completely inappropriate intellectual and political tools for grappling with the ecological context within which we now have to think about security.

Neither do the traditional frameworks have anything useful to say about the artificial ecologies of the cities and megacities where the majority of human beings now dwell. These are new ecologies, ones dependent on long commodity chains and infrastructure that has replumbed and rewired much of the planet to feed, fuel, and supply these cities. The supplies of food, fuel, biofuels, building supplies, not to mention automobiles and endless electronic gadgets, cross national frontiers, linking the world together in a global economy that provides urban dwellers the necessities for this increasingly artificial existence. Disruptions to this system are the new context for thinking about human insecurity (Graham 2010). Determinist arguments connected to discussions of territorial rivalries are simply inappropriate starting points for a serious discussion of security in the Anthropocene. Worse than this, they are a dangerous distraction from thinking through the ecological connections that are the key to providing security in the new circumstances of the Anthropocene.

Friedrich Ratzel's geopolitics with his 'evolutionism' and 'diffusionism' influenced the consolidation of political anthropology. He sustained theoretically the understanding of primitive organizational structures that must evolve to complex systems to get modernized. The justification of colonization was linked to the "vacío imaginario"[48] ('imaginary void', Macías Zapata 2004) explaining the expulsion of indigenous populations from fertile land to marginal zones (zonas de refugio, Aguirre Beltrán/Pozo 1991) by powerful interests, first the conqueror, later landlords, and today multinational corporations (MNC). On the other side, the critical anthropology supported social movements in their struggle for urban land, peasants for new agricultural extensions, and the displaced people due to modernization projects for creating a new livelihood. Recently, the combination of ecological anthropology with geopolitics opened the field for bottom-up approaches, but also for the integration of complex social failures such as drug trafficking linked to environmental forced migrants related to human trafficking, pornography, arms trade, and prostitution gangs (Oswald Spring 2009c). Another approach was related to the overexploitation of groundwater in drylands for cash crops, biofuels creating biodiversity loss and water scarcity, expulsion of people from their livelihood, but also the rise of new illnesses linked to the overuse of agrochemicals and unhealthy productive processes in the 'maquila'.[49]

In Latin America, the analysis of the implication of the Free Trade Agreement of the Americas and the support of opposition movements was analysed by anthropologists, such as the proposal of the Plan Puebla Panamá with the Mesoamerican Corridor promoted by the World Bank and the Mexican and Central American governments, where huge displacements of people are planned, due to the construction of more than 80 big dams. The interconnection of electricity among the whole region is the first step for the control of land and resources in the hands of multinational elites, and the expulsion and displacement of the indigenous and peasants from their ancestral land. Guerrilla movements and opposition are temporarily stopping the process, but the repression of leaders and the criminalization of social movements are the new arms to impose a hegemonic way to dispossess the poor and to concentrate the wealth in a few hands.

94.5.2 Introducing the Political Dimension into the Research on Nature-Human Interactions

A major shortcoming of the multiple approaches on geoecology and earth systems analysis or science, and of the research programmes and university degrees that have been set up during the past three decades in many parts of the world, is that the key "action" aspect necessary for the realization of a Copernican revolution towards a sustainability science has been lack-

48 This Spanish term does not refer to the Latin legal term 'terra nullius' which means empty land, or to land to whom no-one has a legal title. It is communal land that was in use and that was taken away from the original users, which were not linked to a personal system of ownership but to a collective one and therefore their collective rights were destroyed.

49 The Spanish term 'maquila' refers to an enterprise that imports materials and equipment without paying customs for assembly or manufacturing and then re-exports the final product by using the cheap labour force in Mexico and Central America.

ing. The transformation of knowledge into action with regard to scientific schools, social movements, and political forces and institutions that translate the new knowledge of a sustainability science into policies that aim at proactive security policies has been slow to emerge. What is clearly needed is the goal of achieving a policy vision of a sustainable peace that is based on economic strategies of sustainable development. However, this requires a fundamental change in our action-oriented thinking where a mere reference to intellectual traditions is not sufficient.

The non-linear and possibly chaotic challenges in the Earth System that may trigger multiple tipping points in the global climate would have severe policy and security implications that cannot be attributed to a specific enemy against whom military forces can be employed. In Lovelock's *Vanishing Face of Gaia* as well as in work documented by Lenton, Held, Kriegler, Hall, Lucht, Rahmstorf and Schellnhuber (2008) it is clear that we may be close to important tipping points in the earth system. This suggests that we are close to key transitions in the earth system, threshold points where the earth system will change in unpredictable but potentially disastrous ways, at least as far as humanity is concerned.

Thinking about such changes emphasizes the point that the traditional geostrategic views of Cold War policy-makers are irrelevant to contemporary times. The assumption of clashing states and geopolitical blocs that were key to Cold War security thinking are completely irrelevant if solutions to problems of ecological change are to be considered. Earth system analyses make it clear that the appropriate geopolitical premises for thinking are now about humanity collectively living in a small biosphere that we are destabilizing. Assuming that we are still living in separate territorial boxes struggling to control, or at least dominate what happens in other territorial boxes, is precisely the wrong set of geopolitical assumptions to now formulate appropriate security policies. Our geographical context has changed; security thinking needs to catch up.

The additional danger is that should disastrous disruptions of part of the earth system happen shortly the traditional mindsets, locked into an inappropriate and outdated geography would once again invoke the priorities of "national security" to try to protect particular states from "external" disruptions. This, in so far as it undercuts international cooperative efforts is both inappropriate policy and counterproductive both because it is ineffective, and because it perpetuates practices that are violent and unhelpful.

94.5.3 Towards a New Political Geoecology

The suggested new concept of a *political geoecology* should, by bringing the environment into the spatializations of international politics and security, as well as by introducing a political and economic dimension into the discourses on geoecology and earth systems analyses (ESA) or science (ESS), overcome these dangers. Thus, *political geoecology* combines three components:

- the '*political*' dimension of the transformation of complex knowledge into innovative and proactive action:
- the spatial of '*geo*' contextualization of this new knowledge and action;
- the *ecological* focus on the human-nature interface during the Anthropocene that combines the approaches of geo-, social, human and political ecology.

Thus, below the new concept of a *political geoecology* will be used in a wider sense than it is being used in the more narrow approach of geoecologists so far.

Two aspects in overcoming this dual deficit will be discussed below with regard to the actors of the needed proactive policy response and the role of new transdisciplinary knowledge that reflects Wilson's (1998) plea for 'consilience' and anticipatory learning as a precondition for perceiving a need for proactive policies as suggested by the *Millennium Ecosystem Assessment* (MA 2005) and many other recent international reports (UNEP 2007).

94.5.3.1 Actors, Processes, and Levels of Analysis of Political Geoecology

The classic geopolitical and geostrategic approaches were state-centred with the nation state as the key referent object and in the security realm posing the main threat to the well-being and survival of one's own country, but also as the single protector that controls the means and the decision on their employment.

Due to modern weapons (Herz 1959), the subsequent growth of satellite communications, monitoring and transparency (Deudney 1983), and more recently the other processes of globalization, national sovereignty has been disconnected from its image in terms of Westphalian boxes. Sovereignty has also been progressively undermined by the activities and effects of actions by non-state actors, both transnational corporations but also less 'visible' organized crime cartels and terrorist networks. However, with the observed and projected increase in the number and intensity of

hydro-meteorological extreme events, a new category of threats for human survival is evolving for which neither another state or alliance nor a criminal actor can be held responsible. This new quality of the danger to our well-being, security, and survival in the Anthropocene necessitates a new conceptual thinking that overcomes the Hobbesian obsession that has been guiding geopolitical and geostrategic worldviews and mindsets that so far have resisted adapting to the triple reasons that have triggered a reconceptualization of security: a) the end of the Cold War, b) the impact of globalization, and c) the impact of GEC in the Anthropocene era.

In the Anthropocene, a single nation state or a military alliance cannot protect its citizens or allies anymore against the impacts of GEC, neither with its adopted military and political strategies nor with its military means: armed forces and weapons. This insight undermines a fundamental rationale and function of the nation state as a protector of its people. If as a result of the projected sea level rise, countries lose important parts of their highly urbanized coastal land, or if due to the impact of a tipping point in the climate system the Gulf Stream in the North Atlantic is shut off, the most modern navies, armies, and air forces offer no protection although they might be used for evacuation and rescue missions.

With the social construction of the new knowledge on the changing human-nature interface scientists have acquired a new role not only to create new knowledge on the complexities of the earth system but also to communicate it to both the citizens and to the actors in the states, as well as in the society and in the economic sector. As the potential of the nation state in guaranteeing protection of its people against these new challenges may be rapidly declining, the need for an empowerment of its people is rapidly rising to create public awareness and to build a culture of resilience by diverse self-organization.

If 'we' – a part of the human species through our lifestyles, productive and consumptive patterns – 'are the threat', how are the actors: states, societies and economic community reacting to these new threats? In the Anthropocene human security – by countering the multiple causes of GEC and their impacts – can be achieved not any more with military means of the state but by the individual decisions of citizens to reduce energy consumption by efficiency improvements and by a radical switch from fossil to renewable energy sources.

However, on behalf of globalized trade, finance and communication systems, the state still plays a major role by creating legal and institutional frameworks ('polity') that encourage both the society and the economic sector to use the inducements and to avoid the punishment by increasing taxation. As national and human security against these new environmental security dangers cannot be guaranteed any longer by the military and by justice and home affairs, new policy fields become increasingly security relevant: science, technology, education, the environment but also sustainable development cooperation, negotiation processes and international agreements.

Thus, coping with both the causes and the impacts of global environmental and climate change requires both global strategies, policies, measures and guidelines as well as national, regional and local human action for adaptation, mitigation and resilience-building. This also requires new top-down policies that create frameworks and space for bottom-up initiatives.

Recently, Bolivia, one of the poorest countries in Latin America, has become a success story for improving integral sustainable development. Bottom-up indigenous movements changed the power relations among different stakeholders. These processes require a scaling up from the state's legal and economic frame, where social movements and small businesses can offer space for an economy of solidarity. *Multinational corporations* (MNC) may support a process of ethical business, where micro-credits can be linked to micro-insurance in seriously affected regions, thus permitting the victims a faster recovery and resilience-building (Oswald Spring 2008, 2009c). These bottom-up efforts are normally very labour intensive but the reinforcement from top-down facilitates the organization and consolidation process, finally benefiting both the state and the poor people with dignified livelihoods.

A *political ecology* approach must take into account the research in international environmental governance. According to the WSSD Plan of Implementation, "good governance, within each country and at the international level, is essential for sustainable development". UNEP's work to support a coherent structure of international environmental governance has been greatly enhanced by the *Global Ministerial Environment Forum* (GMEF).[50] According to the *World Resources Institute* (WRI):[51]

50 See at: <http://www.unep.org/IEG/>.

51 See at: <http://www.wri.org/publication/content/8542> (10 September 2009)

> The current system of international environmental governance consists of three basic elements. One component is a collection of intergovernmental organizations [UNEP, UNDP] ... and other specialized UN agencies and commissions with a variety of other international organizations, such as the World Bank and the World Trade Organization (WTO). A second element ... is the framework of international environmental law that has evolved over the last century or so. ... A third element is financing mechanisms to build capacity to carry out treaty commitments, to supplement national efforts toward sustainable development in poorer countries, and to support the UN agencies and treaty secretariats that coordinate and carry out environmental efforts (GEF).

However, none of these three elements deals with security issues. In the scientific realm several research networks[52], programmes and projects (e.g. at UNU[53], The Free University of Amsterdam[54], Yale University[55]) have contributed to the analysis of global environmental governance, however, nearly all exclude analysing its linkage to specific security concepts and policies in the Anthropocene and a bottom-up approach oriented to consolidate the resilience-building and survival of the vulnerable. IHDP's core project has defined 'Earth system governance' as:

> the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development. The notion of governance refers here to forms of steering that are less hierarchical than traditional governmental policy-making (even though most modern governance arrangements will also include some degree of hierarchy), rather decentralized, open to self-organization, and inclusive of non-state actors that range from industry and non-governmental organizations to scientists, indigenous communities, city governments and international organizations.

However; its science plan does not directly address 'security' among its analytical problems (architecture, agency, adaptiveness, accountability, allocation and access) and crosscutting themes of power, knowledge, norms and scale or in its first four case studies on the water, food, the climate, and the global economic system.[56]

In their structure for a new international governance they pointed to the key sectoral interactions between and among three major groups, that is, government (state), private sector (economy) and civil society based on the nine universal principles embodied in the UN's Global Compact, among them human and labour rights and these three environmental principles: i) precautionary principle; ii) environmental responsibility, and iii) environmental friendly technology. But they also avoided considering the new security dimension of global, national, and local environmental governance in the Anthropocene.

94.5.3.2 Role of Innovative Knowledge and Anticipatory Learning

Environmental stress and climate-induced natural hazards often cause extreme impacts: forced migration, domestic crises and low-level conflicts that may be resolved by the state in cooperation with societal groups and the business community. These three actors are influenced by their use of knowledge in facing and coping with the social challenges posed by *Global Environmental Change* (GEC) for international, national, environmental and human security. A better understanding of these complex nature-societal interactions empowers societal, economic and state actors to respond to these challenges by preventing that extreme societal outcomes lead to violent conflict. Instead, proactive strategies that link top-down and bottom-up initiatives may assist societies to face and cope with the social challenges of global change.

In this regard the role of modern and traditional knowledge[57] matters for the 'policy response' in different nature-society relationships, or 'pressure response models' such as those suggested by OECD, UN-CSD, EEA and in the PEISOR model (chap. 47 by Brauch/Oswald Spring).

> The boundary between research-based knowledge and decision-making is not hard and fixed, but rather semi-permeable, moveable and negotiated (Jasanoff 2003;

52 The "Earth System Governance Project" builds on the former IHDP project on the *Institutional Dimensions of Global Environmental Change* (IDGEC); see at: <http://www.earthsystem governance.org/>.

53 See UNU-IAS; at: <http://www.ias.unu.edu/binaries/NYPrepComReport3.pdf>; Green (2005); Rechkemmer (2006).

54 See: Biermann, Siebenhüner and Schreyögg (2009).

55 See at: <http://environmentalgovernance.org/about/> (10 September 2009) on the Global Environmental Governance Project of The College of William and Mary and the Yale Center for Environmental Law and Policy.

56 Its first project report refers repeatedly to food security and peripherally at human and environmental security; see: Biermann, Betsill, Gupta, Kanie, Lebel, Liverman, Schroeder and Siebenhüner (2009).

> Jasanoff/Wynne 1998). Earth system governance thus requires a reflexive and carefully designed approach to organize and utilize some boundary functions, like mediation or translation ... (Cash/Clark/Alcock/Dickson/Eckley/Guston/Jager/Mitchell 2003, Guston 2001). Some research suggests that boundary organizations do best when they are dually accountable to both the research and policy communities. In some situations, the two community views may not be very accurate: there are policy savvy and connected researchers, scientifically literate policy-makers or well-informed stakeholder groups (Van Kerkhoff/Lebel 2006).
>
> Science is not free from politics or politics from science (Mitchell 2002). Competing knowledge claims may be sorted out through joint fact-finding, assessment or validation exercises (Cash 2000; Karl/Susskind/Wallace 2007) and action strategies. Knowledge is pertinent also in the role of scientific assessments in earth system governance. Research suggests that assessments that are perceived by all key stakeholders to be legitimate, credible and salient, are those that have the most influence (Mitchell/Clark/Cash/Dickson 2006). Assessments that are overly driven by science easily become trapped by their framing of the issue (Rayner 2003). Tacit, practice-based, experiential and research-based knowledge may be complementary and usefully hybridized (Forsyth 1998, 2003), but they can also be pitted against each other and against other systems of belief.[58]

Since 2000 climate change has been 'securitized' and the links between climate change and conflicts are being addressed in scientific studies and policy declarations. This new knowledge challenges the traditional narrow conceptualization of security as a state-centred, power-based and interest-centred concept, and has contributed to the development of an environmental dimension of human security where 'freedom from hazard impacts' has been suggested as a fourth pillar as well as to a shift from a 'security dilemma' to a 'survival dilemma'. A proactive policy response to the social challenges of global change requires a joint international and human security approach that integrates traditional and modern knowledge and aims at both top-down and bottom-up policy responses in facing and coping with the potentially extreme and violent societal outcomes of GEC.

The Cold War has convincingly demonstrated that individual 'events', whether as the outcome of policy decisions by policy-makers, societal leaders or the business community, cannot be predicted. The other, the temporal dimensions of Braudel's historical analysis (of long-term 'structures' and medium-term 'conjunctures'), can be better predicted and have been projected in the past as both determinants and constraints on policy actions. But the emerging debate on tipping points of the climate system has also pointed to the limitations of linear projections of demographic and climatic trends, once they cross an unknown 'threshold'. While neither the unpredictable chaotic interactions of the geophysical systems of the human-nature interface can be foreseen, even less so the specific human response to such surprising events can be predicted or modelled. Both traditional knowledge, based on thousands of years of communicated experience, as well as modern narrow disciplinary scientific knowledge will be challenged by the societal impacts of potential tipping points in the climate system.

Thus, in the Anthropocene period of earth and human history, earth systems science research can address potential geophysical constellations, while the social sciences can point to probable and possible conflict constellations, but both will remain unable to predict if, when, and how these constellations may or will become reality. The societal impacts of the linear, exponential or chaotic developments in the global climate system can even less be predicted or projected. Past historical developments on the human-nature interface and their catastrophic consequences have contributed to the decline of the collapse of high civilizations and forced peoples to move.

To sensitize the people on the effects of potential catastrophes, the results of earth systems sciences should be communicated through the media and the education process. This may also contribute to a readiness for anticipatory learning. Learning is a bottom-up process. It is human beings that learn, not states. But the policy-makers as the representatives of the people must allocate resources to foster the development of new knowledge, and respond proactively to action-oriented knowledge by adopting strategies, policies and measures, and implementing them.

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57 Hess and Ostrom (2007: 7–8) in following Davenport and Prusak (1998: 6) wrote: "knowledge derives from information as information derives from data". They used the term knowledge by referring "to all types of understanding gained through experience or study, whether indigenous, scientific, scholarly, or otherwise non-academic". Knowledge is both a constitutive force of society and a commodity; it is both a human need and an economic good, both a common and also a private good. "Acquiring and discovering knowledge is both a social process and a deeply personal process."

58 See the lengthy discussion of scientific knowledge by the IHDP core project on global environmental governance; <http://www.earthsystemgovernance.org/publications/2009/Earth-System-Governance_Science-Plan.pdf>.

There is also a fundamental difference in the production, dissemination, and access to knowledge for understanding the causes of these new security dangers, and on the needed policy responses. While military knowledge often relies on classified intelligence collected, processed, and assessed by intelligence services that are beyond the reach of the citizens, the new scientific knowledge is open to everybody but must be understandable from the elementary to the advance levels, and disseminated by journalists and responsible media.

94.6 Political Geoecology as a New Field of Research and Education

The new concept of a political geoecology focuses on the linkages or transmitters of translating knowledge into action. It aims at a conceptual integration of two research approaches in the social and natural sciences that requires an integrative approach to address the biophysical and societal causes and impacts of nature-human interaction in the Anthropocene. The most important point of all is the simple one implicit in the use of the term Anthropocene; the context for thinking about security has been changed by our actions. Knowledge has to be recontextualized if it is to be useful for policy, research, education, and political action.

94.6.1 Areas for Research on Political Geoecology

The new security dangers posed by GEC in the Anthropocene pose a dual challenge for scientific endeavours and political action. In science transdisciplinary approaches are needed that address the linkage themes of several disciplines both within the natural (geoecology, ESA, ESS) and the social sciences (political science, law, economics, anthropology, sociology, psychology) and between both reflecting Wilson's (1998) call for 'consilience'.

Scientific research programmes, academic courses and degrees in geoecology and on earth systems science should incorporate a policy dimension that goes beyond the legal and institutional framework (*polity*). This requires also that the knowledge assessment, e.g. by the IPCC, should be expanded beyond the narrow focus on assessing only the peer-reviewed scientific findings in the natural (on causes and impacts) and engineering sciences (on adaptation and mitigation) by including the findings of the social sciences on the linkages between the nature-human interactions and their societal outcomes, i.e. as migration, crises, and conflicts.

In foreign and international politics, *learning* of key decision-makers has often been in response to severe political, economic, and military crises[59]. But *anticipatory learning* and *forward looking* strategies are more ambitious. They require that both analysts and decision-makers foresee challenges that may have an impact on *future governments* and generations, and that may require unpopular decisions today to avoid crisis events in the future. With regard to 'sustainable development' *anticipatory learning* requires the formulation and *implementation of sustainable policies* with respect to industry (pollution), water management, soil preservation, agriculture etc. in all countries. Anticipatory learning as a tool of crisis prevention (Burton 1990; 1990a; Burton/Dukes 1990, 1990a) is far more ambitious and difficult than the requirements of *crisis management* as a centrepiece of national emergency planning.[60]

As national priority areas for upgrading crisis management, several major tasks exist: a) a wider *innovative risk assessment;* b) a better integration of national *regulation and design* into international structures, and c) an intensive planning and preparedness involving large-scale operations and transcending the civil-military divide as well as the management of uncertainty and complexity, whereby the knowledge production in social science research and transfer to operating units is crucial (Hart/Stern/Sundelius, 1998: 219–21).

But during the Anthropocene, past experiences may be of limited relevance and policy guidance, especially with regard to the security dangers posed by GEC and by the unpredictable potential tipping points in the global environmental system. Traditional worldviews often filter out new information, especially from other schools of thought and disciplines,

59 For example, during the final phase of the Cold War, for Gorbachev and Shevardnadze *learning* was an instrument of domestic crisis management responding to complex challenges in an innovative way beyond traditional patterns (Grunberg and Risse-Kappen 1992: 104–46; Stein 1994: 155–83; Levy 1994: 279–312).

60 Hart, Stern, and Sundelius (1998: 207–8) argue that learning from past experience remains an important building block for efforts to cope with future crises (Stern, 1997: 69–86). From past successes in crisis prevention, they point to three obstacles: a) the *problem of complacency* that excludes the unconventional challenges; b) the *vulnerability paradox*; and c) the *balance between prevention, adaptation and resilience.*

and may thus be resistant to learning. Booth (1979, 1987: 39–66) argued that 'old mindsets' often have distorted the assessment of 'new challenges'. These mindsets[61] include ethnocentrism, realism, neoliberal free-market dominance, ideological fundamentalism, and strategic reductionism.

Thus, *anticipatory learning* requires that both analysts and policy-makers foresee the negative impacts and the socio-economic consequences of the global environmental change that can pose a *survival dilemma* in the decades to come. *Anticipatory learning* remains the domain of long-range and interdisciplinary discourses, and to a more limited extent of foreign policy planning staffs of national governments. As these long-term *structural challenges* do not require urgent responses, sufficient time exists for the establishment of conceptually focused and policy-oriented *epistemic communities* with gender and regional balances.

Joint North-South *anticipatory learning requires* as a debate on longer-term development for the well-being, security, and survival of humankind, and a mutual understanding of their relevance. Further, a multidisciplinary search for complex strategies is needed to cope both with the root causes and their effects and the socio-economic implications of global environmental change. This anticipatory learning must be on four different levels: a) across the boundaries of scientific disciplines; b) across the North-South cultural and political divide; c) beyond the glass ceiling of gender discrimination, and d) between conceptually oriented academics and action oriented decision-makers. The policy relevant task of this undertaking must mitigate, prevent, and avoid these crises from occurring.

94.6.2 Areas for Political Initiatives on Political Geoecology and Organized Civil Society

In the political realm, a horizontal interdepartmental or interministerial cooperation within governments and between different international organizations is needed to overcome the lack of coordination. Initiatives for action on the security dimension of the nature-human interface are needed on behalf of the state as well as by societal and economic actors to set up the political agenda-setting, with a prioritization of goals and the allocation of resources for adaptation, mitigation, and resilience-building. This new socially constructed knowledge that has emerged during the past three decades affects all three features of the political dimension of *policy*, *politics*, and *polity* that are outlined below (table 94.1).

Socially constructed knowledge of earth systems science on the nature-human interface of global environmental change issues may create the basis for proactive policies if the societal forces overcome the interest-based and ideology-driven worldviews and mindsets that are often determined by past experiences and short-term political and profit interests.

94.7 From Anticipatory Knowledge to Proactive Action: Towards a Policy Vision of a Political Geoecology

Anticipatory knowledge deals with the structural and conjunctural dimensions of time addressing longer-term structural trends (e.g. demography, climate change, etc.), while future events as the outcome of specific circumstances, challenges, conditions, human actors and their decisions may be anticipated (as a possibility) but not predicted (with a probability).[62]

The suggested *political geoecology* should introduce into research, teaching, and education on earth systems science and analysis a political dimension that helps to translate and disseminate new scientific knowledge that will affect and constrain the range of political options available to policy-makers in the Anthropocene during the 21st century to initiate a process of anticipatory learning to address the causes, effects, impacts, and possible societal outcomes of global environmental change.

Anticipatory learning is the necessary precondition for proactive strategies, policies, and measures to face and cope with the possible extreme societal outcomes by supporting efforts to build local resilience by the peoples most likely to be affected most severely who often lack the knowledge on these complex

61 The dominance of 'old mindsets' in the Administration of George W. Bush challenged the thesis of anthropogenic contribution to global climate change and tried to block the implementation of the Kyoto Protocol and significant progress towards legally binding international obligations towards a progressive decarbonization of the economy. Thus, established theoretical or ideological worldviews and mindsets of policy-makers have been major constraints and obstacles to any anticipatory learning and proactive policy strategies.

62 One specific case has been the failure of the social sciences to predict and to foresee the end of the Cold War (Gaddis 1992/1993) with the symbol of the fall of the Berlin Wall on 9 November 1989.

Table 94.1: Political dimensions of nature-human interactions on the security dangers posed by global environmental change. **Source:** The authors.

	Three political dimensions		
Actors/level of analysis	**Policy**	**Politics**	**Polity**
Definition	Field of analysis and action, e.g. environment and sustainable development with a sustainable peace policy	Political process of actors (stages of policy formulation, decision and implementation)	Legal and institutional framework for policies and for the political process
Object of action: nature-human interaction and global environmental change (GEC)	Knowledge creation (basic and applied research) and dissemination (teaching, training, education)	Process of political agenda-setting, formulation, adoption, legitimation, funding and implementation (sometimes against the opposition of interest groups)	• Adoption of Agenda 21, • UN Framework Convention on Climate Change (UNFCC). • UN Convention on Biodiversity (CBD) • UN Convention to Combat Desertification (UNCCD) • National laws of implementation and establishment of national bodies
Security Linkages (international, national, community, human, environmental, gender, water, etc.)	• Disaster preparedness, planning and response • Internal displacement and migration • Humanitarian assistance [international, national and human scales]	• World of states (G-8, G-5, G-20, G-77) • Societal world (social movements, business communities, trade unions)	• UNOCHA • UNISDR • EU-ECHO • OAS, AU, LAS, OSCE • NATO
State	A system of priorities, goals and guidance, and their implementation with sanctions for non-compliance	Process of articulation of goals, strategies, policies and measures at the local, national, regional and global level	Laws implementing global frameworks or setting the framework for policy implementation and proactive policies, scaling up and down (glocal)
Society	Family, local communities, ethnic tribes, religious communities, social movements and NGOs all forming civil society	Transparent political process of actors identifying challenges, formulating goals, adopting and implementing environmental, economic and security policies	The legal and institutional framework for policies that set the goals and boundaries for the political process
Economic sector (policy instruments, role of the business community in politics)	• Support of technology developments • Regulation and taxation • Scientific and technological innovation and its application	Dual role: • opposition, obstacle, constraint for political action • promotion of new technologies (green economy)	Technological innovation creates political opportunities for coping with the physical and social impacts of GEC
Knowledge (as a precondition for anticipatory learning and proactive policies).	Areas of science, technology and education policy and of its transmission via scientific and popular media	Science offer basis for anticipatory knowledge, for innovative, proactive strategies, policies and measures	Factors influencing and being affected by processes of global environmental change

interactions, and even more the economic resources to adapt and to mitigate against environmental change.

This requires a fundamental paradigm shift also in the strategic and in the security debate. For the environmental security dangers posed by anthropogenic

GEC the answers of the prevailing power-based realist worldview and of the mindset of military strategic thinkers, policy-makers and their advisers will rapidly become obsolete. If we – as human beings and as the human species represented by humankind – are the threat, then totally different answers are needed for coping with these new rapidly emerging environmental dangers.

Besides the linear projections assessed by the IPCC in the available climate modelling, the reference to tipping points in the Earth and climate system makes rapid and totally different proactive policies inevitable to reduce the probability that such tipping points occur, such as the shutoff of the Gulf Stream in the North Atlantic, the depletion of the glaciers in the Andes and in the Himalayas, and their negative impact on the water security in the megapolises of Latin America (Mexico City, Lima, La Paz) and Asia (Beijing, New Delhi, Calcutta, Dhaka, etc.).

From a security perspective the societal impacts of these possible tipping points in the climate system may confront humankind in this new millennium with revolutionary social changes far more severe than the extreme weather events during the 1780's and 1840's that have triggered in Europe the revolutions of 1789 and 1848[63] or in Mexico the revolution in 1910 and independence in 1810 (Sánchez/Oswald Spring/Díaz/Cerano/Inzunza/López/Villanueva 2010).

The global economic and banking crisis has once more illustrated the prevailing political structure and behaviour that 4.3 trillion US dollars (IMF 2009) are not too high to bail out and to maintain the existing speculative banking system with minor constraints by the community of states, while for the bold and long-term decisions the dominance of short-term interests still prevails likewise in democracies and in non-democratic states.[64] Even the EU countries (chap. 83 by Egenhofer/Behrens/Georgiev) and also the new US administration by President Obama have fallen victim to this dominance of interest-based short-term perspectives to stay in power as a member of a parliament, as a government or as a president.

Clark, Crutzen, and Schellnhuber (2004, 2005) have called for a 'Copernican revolution' towards a sustainability science, even if that language isn't used it is clear that a fundamental paradigm shift in political and strategic thinking on security is needed during this century to move from future-oriented rhetoric to bold policy decisions (chap. 95 by Oswald Spring/Brauch). This requires overcoming the shortcomings and constraints of classical approaches to geopolitics, geostrategy and geoeconomics. In October 2007, in the *Potsdam Memorandum* the participating Nobel Laureates argued that "a great transformation is needed to respond to the immense threat to our planet. This transformation must begin immediately".

The employment of military force will not enable future policy-makers to deal with the challenges humankind will face during the Anthropocene because environmental security difficulties are caused by the modern industrial mode of life, and the benefits and consequences are unevenly spread, and numerous political issues of responsibility haunt discussions of climate change. Climate change presents numerous challenges to equity both at present and in relation to future generations (Roberts/Parks 2007; Vanderheiden 2008).[65] The historical and present emitted GHG should finance the adaptation of EFM of people within their countries or the region the affected consider adequate for establishing a new livelihood. This is not the normal political discussion concerning security or refugees, but such formulations are consistent with new thinking that is now needed in light of earth systems analyses of the Anthropocene.

For the new environmental dangers posed by GEC, the security policy in the Anthropocene must drop the Hobbesian obsession and move towards a more pragmatic Grotian vision of international relations that stresses multilateral cooperation, early and proactive action aiming at a policy vision of a sustainable peace where the cooperative implementation of sustainable policies becomes the core for a new peace strategy in the Anthropocene. This cannot be enforced from the top down, rather it has to be requested, accepted, and implemented from the bottom up by civil society in close cooperation with the economic sector where the state represented by the governments from the national level down to the local level has to become a major catalyst and allocator of

63 Drew (2000); Weiss and Bradley (2001); Webster (2002); Demarest, Rice and Rice (2004); Gill (2000); Zhang, Cheng, Edwards, Chen, Wang, Yang, Liu, Tan, Wang, Liu, An, Dai, Zhou, Zhang, Jia, Jin, and Johnson (2008).

64 In many oligarchic states regime security has been the upmost goal, while in many democratic societies the dependence on short-term economic interests seems to prevail that remains unchallenged by the media that partly depend on the same economic interests for advertisements.

65 See at: <http://climatecongress.ku.dk/speakers/schellnhuber-plenaryspeaker-12march2009.pdf/>.

resources to implement a 'sustainability revolution'. In short, force is irrelevant for the solution. The employment of force may make the needed solutions even more difficult and takes away scarce and crucial resources. In this needed sustainable transformation the involvement of societal actors becomes inevitable.

Thinking on and conceptualizing a new 'political geoecology for the Anthropocene' is just a modest contribution to the change in prevailing worldviews and mindsets in international relations focused on 'international peace and security'. Indeed, as our conclusions suggest here, the Anthropocene makes the point about establishing conditions of respect for treaties and laws ever more important, because these conditions are now increasingly of our own making, in both the infrastructure that powers society and, on the large scale, shapes the condition of the biosphere for future generations.

94.8 Conclusions

In terms of traditional notions of security, and the application of violence to control spaces, and not only borders, the earth system analysis suggests that this is simply inappropriate for dealing with global environmental change and human security. More so than this the assumption that security is a spatial strategy, one of dominating and controlling an external environment, is also now clearly an inappropriate categorization of things. The environment is not external to the human enterprise; it is the increasingly artificial context that allows us to live our lives. Commodities from the other side of the planet, the highways and railways that bring us food and all the material things of living are not constrained by national frontiers. Moving these things and building the farms and factories that make the material conditions of our life are an ecological process too. We are not on the Earth; we are part of the earth, once one starts to think in ecological rather than environmental terms.

This is not primarily a philosophical point, although it does challenge the key categories of modern thinking fundamentally (Walker 2006), but rather it is the key underpinning to new notions of security in the Anthropocene. Obviously, wars between states cannot be fought over climate change, nor conducted easily over other modes of ecological change, but numerous people can suffer and die as a result of these transformations unless we think seriously about how ecological structure are to be provided to secure humanity. Floods and famines are increasingly anthropogenically-induced events, not only in terms of ecological disruptions and the political economies of scarcities in crisis situations, but also in terms of the infrastructure that is essential to providing the materials for life for most of us. Vulnerabilities are not solely a matter of economic and social entitlements and their disruption, although these things matter as much now as they did in early famine events, but they are also about the contexts in which we live, and the connections through social and ecological systems that link us to the processes of life.

In these terms security is common for all of us because we are all connected albeit in ways that are not frequently obvious. We are not geographically separate from many of our peers. And if these fellow humans are forced to migrate in search of a livelihood, whether because of slow environmental changes or rapid onset disasters, our security is involved. But how that response happens is crucial. International aid efforts are frequent in the face of disaster, but in terms of their ability to prevent and cope they are frequently inadequate, mostly absent, and often too late.

One obvious lesson from recent disasters is that state capacities have been undermined after a generation of neo-conservative policies and a neo-liberal economic model that prioritizes economic 'efficiency' or accumulation for a few over all else. But as has become clear, efficiency frequently removes duplication and redundancy in complex systems. It's precisely these redundancies that provide the resiliency to systems in crisis. State capacities to help and provide for citizens have been stripped in the interests of efficiency; now as the global economic crisis of 2008 and 2009 has made clear, states have to intervene and do so cooperatively in the face of disruptions. The lessons of cooperation are key to thinking about the larger crisis of changing the material circumstances in the Anthropocene. Habits of cooperation and aid are what are going to be needed; geopolitical rivalries are not the solution to the novel circumstances, however tempting such strategies may be to political elites more concerned to remain in control than assist the citizens in their charge.

Viewing disasters in terms of ecology suggests another key lesson too. Systems change, adapt, and learn new modes of functioning under crisis. Cities are dynamic systems, not collections of bricks and cement. The innovative efforts of the marginal young men in Mumbai during its huge flood in 2005, the men Hollywood subsequently made known to the rest of the world as 'slumdogs', stepped into the absence of official state emergency services (Dalby 2009). Im-

provization saved many lives, suggesting that security in adversity is not a matter of official provision in many cases. Adaptation in these circumstances wasn't about planning; it was about generosity and practical assistance.

Likewise, in many parts of the world people are already trying numerous new ideas to deal with ecological changes, but coping strategies are frequently asset stripping exercises where things are sold until destitution arrives. This is not security; it is a downward spiral. Here matters traditionally understood as development are key, and the global political economy, in particular the dominance of the West in matters of food trading and the downward trends in many food crops, has made the lot of marginal people even more difficult. These people are frequently subject to a double exposure, vulnerable to both the economic forces of globalization and the ecological disruptions of global change (Leichenko/O'Brien 2008). Thinking clearly about this as the context of insecurity precludes policy responses in terms of traditional modes of geopolitics; it is the flows and connections that matter, not the sovereign spaces of state mappings. Political geoecology shifts this understanding of the contexts of danger, and does so by putting interconnections at the heart of the analysis, rather than using the spatial abstractions of earlier modes of thinking. Rethinking context is what both the earth system science and the formulation of political geoecology require. It is essential to rethinking security in the new times in which we now live.

This leads us to three policy relevant conclusions. A strategy aiming at the realization of the approach of a political geoecology requires scholars and policymakers to shift from looking backward to looking forward, to move from confrontative or power-focused and national interest-based to global cooperative negotiation-focused concepts, and from reactive to proactive concepts of action, from aid to justice, equity and solidarity.

In this new context of the Anthropocene, security can no longer be understood in the traditional geopolitical thinking in terms of using force to prevent external depredations. Ecological thinking, and the recognition that we are literally making our future, requires us to look to vulnerabilities, and to the multiple causes and reinforcing processes of these vulnerabilities in particular places. But rescuing people and picking up the pieces after a crash, dealing with emergencies and using exceptional measures in extraordinary times, while sometimes necessary, fails to grapple with the terms and conditions of insecurity, for the marginal rural populations of the planet obviously, but also as hurricanes, heat waves, etc. in particular demonstrate, for the residents of metropolitan places too.

Security now needs to be thought of in terms of what we are making (Dalby 2009). Building schools with proper seismic structures in earthquake zones, ensuring bridges are big enough to survive large floods and ensuring that pipelines[66] don't rupture in extreme weather, are the kind of policies that help mitigate hazards and stop severe events turning into disasters. But the other side of this argument is also crucial; building things that don't cause ecological disruption is also now necessary. Houses without furnaces simultaneously reduce ecological disruptions if they don't emit greenhouse gases and are not vulnerable to disruptions of fuel supplies either. Agricultural and forestry plantation have to be ecologically diverse so as to better adapt to changing climate and overcome all the dangers of monocultures. Windmills and solar panels likewise reduce emissions and are not dependent on long supply lines for fuel (Sachs/Santarius 2007), but support a decentralized sustainability.

But the poor and the marginal, while they too may benefit from technological innovations, are vulnerable in economic development all the time, not just to immediate shocks from extreme events. Without economic options they have little flexibility in the face of disruptions; this key theme, of poverty as vulnerability is now emphasized as the implications of disrupted subsistence systems are focused on in the increasing literature on adaptation to climate change (Adger/Lorenzoni/O'Brien 2009). The precise terms and conditions of interconnection are of course what international trading negotiations are about; but clearly over the last few decades winning the game of competition by writing the rules has not benefited the marginal producers. As such their insecurity remains, now exacerbated by the unpredictable ecological changes set in motion both by local strategies for coping, and now by GEC.

With their proposed 'political geoecology for the Anthropocene' the authors want to launch a debate among scientists of the natural and the social sciences. While the old geopolitical and geostrategic research and policy debates have left the 'environment out' and have become obsolete, the new research pro-

66 Alternative energy would substitute pipelines and a decentralized energy network would reduce the necessity of huge amounts of investment in the hands of multinational enterprises.

grammes in physical geography on 'geoecology' as well as the multidisciplinary programmes on 'earth systems science' (ESS) and on 'earth systems analysis' (ESA) have so far left 'politics out', as the fields, processes, institutions, and legal frameworks that are needed for the implementation of sustainable development.

However, the call for a new fourth green revolution requires a long-term global cooperative political strategy in a multilateral context at which the proposed perspective of 'political geoecology for the Anthropocene' aims at. It also requires a rethinking and adaptation of the key goals of the United Nations Charter "to maintain international peace and security" to reflect these new challenges humankind is facing in the 21st century and to develop a new strategy for a sustainable peace based on a gradual decarbonization of the global economy in order to cope with the impacts global environmental change is posing.

The proposed new approach of a political geoecology combines the necessary *political orientation*, with a *spatial focus* that combines different scales – from the local, regional, national, continental, and to the global by implementing the many visions, perspectives and programmes for a sustainable development into action in order to prevent that both the linear projections of 'dangerous climate change' and the possible tipping points in the earth system become reality. Securitization implies that policy-makers upgrade the dangers posed by global environmental change to issues 'of utmost importance' that 'require extraordinary measures'.

However, this new securitization must overcome the narrow focus on 'national security'. If humankind and humans poses these new security dangers, then the traditional military strategies, policies, measures, and tools will gradually become obsolete. These new security dangers do not distinguish among countries and they cannot be countered by military superiority, they cannot be addressed by weapons of mass destruction, nor can they be prevented by any sophisticated missile defence systems or intercontinental missiles.

The new security policy in the Anthropocene to cope with the dangers posed by GEC requires primarily non-military instruments. It requires a gradual reallocation of scarce resources for technological innovations for strategies of adaptation and mitigation with the impacts of GEC and global and regional climate change. This requires foremost a change of thinking of nationalist and fundamentalist ideologies in order "to save succeeding generations from the scourge of war" but also "to promote social progress and better standards of life in larger freedom", and finally "to establish conditions under which justice and respect for the obligations arising from treaties and other sources of international law can be maintained". Technical solutions are bound to fail if a comprehensive political strategy for a progressive global green economy, but also a change in human lifestyles and social responsibility, is lacking.

95 Coping with Global Environmental Change – Sustainability Revolution and Sustainable Peace

Úrsula Oswald Spring and Hans Günter Brauch

95.1 Introduction: Focus and Hypothesis

In the Anthropocene era of earth and human history we are confronted with opposite :

- *Business-as-usual* in a Hobbesian world where economic and strategic interests and behaviour prevail leading to a major crisis of humankind, in inter-state relations and destroying the Earth as the habitat for humans and ecosystems putting the survival of the vulnerable at risk (see the 'market first' and 'security first' scenarios of UNEP 2007).[1]
- The need for a *transformation* of global cultural, environmental, economic (productive and consumptive patterns) and political (with regard to human and interstate) relations (see the 'sustainability first' scenario of UNEP 2007).

Both visions refer to totally different coping strategies with *Global Environmental Change* (GEC):

- In the first vision of business-as-usual *cornucopian perspectives* prevail that suggest primarily technical fixes (such as geo-engineering, increase in energy efficiency or renewables), defence of economic, strategic and national interests with adaptation strategies that are in the interest of and affordable for the 'top billion' of OECD countries in a new geopolitical framework, possibly based on a condominium of a few major countries.
- In the alternative vision of a comprehensive transformation a *sustainable perspective* has to be developed and implemented into effective new strategies and policies with different goals and means based on global equity and social justice.

The consequences of both opposite scientific visions and competitive policy perspectives are:

- The vision of *business-as-usual* with minimal reactive adaptation[2] and mitigation[3] strategies will most

1 The *International Geosphere-Biosphere Programme* (IGBP) in its analysis of *Global Change and the Earth System* (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner II/Wasson 2004: 286) defined the *Business-as-usual* approach as: "This strategy is built around the belief that no explicit measures need to be taken with respect to global change, either to attempt to slow or prevent it or to adapt to it." In their interpretation this approach is based on these assumptions: "(i) threats to the global environment are overstated or misrepresented by green organizations and sometimes even by the scientific community; (ii) the Earth System is more robust towards perturbations that most people, including many scientists, believe; (iii) the existing market-oriented economic system will be able to solve any environmental problems, including global-scale ones; and (iv) resources that might be used to mitigate global change would be better spent on more pressing problems, such as provision of clean water, improvement of public sanitation systems in the developing world, etc." This strategy involves "taking great risks".

2 The IGBP diagnosis argued that the "the business-as-usual is not appropriate to deal with global change" and that different adaptation and mitigation strategies are needed. It suggested that "serious research questions, both biophysical and socio-cultural, remain to be considered before informed and reasonable interventions in the functioning of the Earth System may be contemplated, if ever" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner II/Wasson 2004: 286–293).

3 The mitigation approach tries "to diminish or eliminate the problem itself rather than react to it". By taking off pressure on the Earth System, "mitigation represents an attempt to manage human activities and not the functioning of the Earth System itself, with the aim to allow the System to function in a more natural way" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner II /Wasson 2004: 289–291).

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likely increase the probability of a 'dangerous climate change' (Schellnhuber/Cramer/Nakicenovic/Wigley/Yohe 2006) or catastrophic GEC with both linear and chaotic changes in the climate system and their socio-political consequences that represent a high-risk approach.

- To avoid these consequences the alternative vision and sustainability perspective requires a change in *culture* (thinking on the human-nature interface), *worldviews* (thinking on the systems of rule, e.g. democracy vs. autocracy and on domestic priorities and policies as well as on interstate relations in the world), *mindsets* (strategic perspectives of policy-makers) and new forms of national and global *governance*.

This alternative vision refers to the need for a "new paradigm for global sustainability" (Clark/Crutzen/Schellnhuber 2004)[4], for a "transition to [a] much more sustainable global society" (Raskin/Banuri/Gallopin/Gutman/Hammond/Kates/Swart 2002), aimed at peace, freedom, material well-being and environmental health. Changes in technology and management systems alone will not be sufficient, but "significant changes in governance, institutions and value systems" are needed, resulting in a fourth major transformation after "the stone age, early civilization and the modern era". These alternative strategies should be "more integrated, more long-term in outlook, more attuned to the natural dynamics of the Earth System and more visionary" (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner II/Wasson 2004: 291–293). These many changes suggested above by natural scientists require a 'Fourth Green Revolution'.[5]

After briefly introducing the four key concepts of an alternative vision (95.2) and reviewing the dangers humankind is facing in the Anthropocene (95.3), the argument is further developed by moving from the vision of business-as-usual towards a vision for a global sustainable transformation (95.4). This is followed by a discussion of policy strategies for coping with GEC by distinguishing between both visions, the business-as-usual and the sustainability vision (95.5). To assist the transition towards a sustainable transformation, a brief analysis of specific threats posed by GEC (95.5.1), an assessment of the failure of COP15 (95.5.2.) is offered that broadens the scope to national and international obstacles in adopting and implementing such a strategy (95.5.3) that are needed to link sustainable development with sustainable peace (95.5.4) and a discussion of non-military means (95.5.5) for achieving the goals of sustainable development, security, and peace in the Anthropocene (95.6) concludes this discussion.

95.2 Four Key Concepts of an Alternative Vision

The four key concepts in this alternative vision of a new 'Fourth Green Revolution' are a radical change in *culture*[6], *worldview*, *mindset* and *participative governance* in the thinking and action on sustainability laying out an alternative development path with a total transformation of productive and consumptive

4 The IGBP report suggested that the future management of the Earth System will rely on "a mix of current and more visionary approaches implemented by an imperfect and only partially efficient decision-making system based on an evolving, but never complete knowledge base. ... In these conditions; adaptive management is the only way forward", which they defined as "an interactive process of learning by doing and doing based on learning" that are based on imperfect information (Steffen/Sanderson/Tyson/Jäger/Matson/Moore III/Oldfield/Richardson/Schellnhuber/Turner II/Wasson 2004: 295–299).

5 After the agricultural, industrial and the technological-communication revolution this 'Fourth Green Revolution' goes further than the new Copernican revolution proposed by Clark, Crutzen and Schellnhuber (2004). Besides a paradigm shift, this 'Fourth Green Revolution' requires a deep cultural change which should include overcoming the present consumer society. This implies to significantly reduce the global demand for natural resources and industrial products and to increase the supply of goods to satisfy basic human needs through green productive processes. Instead of mitigating against pollution at the 'end of the tube', pollution itself must be avoided. This Fourth Green Revolution includes a change of 'habitus' (Bourdieu 1972, 1980, 1980a, 1997) and a transformation of existing social relations and identities. This also requires to eliminate the exploitation of nature and human beings by small elites. Furthermore, it is necessary to care about humans and ecosystems and to overcome vulnerabilities by reinforcing environmental services.

6 Any of the three former revolutions implied a cultural reorganization of the whole productive system, the social relations, and the representations and identity processes inherent to these changes: the agricultural revolution produced stable human settlements, the industrial revolution the consolidation of urban areas, and the technological and communication revolution the globalization process with a glocal (global and local) restructuring of networks and nodes.

processes aiming at equity, social justice, and solidarity with the most vulnerable and marginal people and the poorest countries.

95.2.1 Culture

Culture is a globally organized way of life based on values, norms, beliefs, institutions and productive processes including the development of science and technology. Culture is transmitted from generation to generation by formal and informal processes. Therefore culture is a learning process which includes acculturation and enculturation processes. Cultural products are shared by the members of a society and they link people together who live and think in ways that can bring about identity patterns and social representations (chap. 66 by Flores/Wagner). As a constant practice that is culturally and mutually constructed and transformed through social interaction, language, thought and beliefs are creating symbols and symbolic meanings. Culture is therefore not based on natural laws but socially constructed, where interests are able to maintain and reinforce structures of power and mechanisms of control. Finally, culture is so deeply internalized that it is perceived by the people as natural. They take it for granted and defend their cultural habitus[7] against other beliefs and different power structures, often against their proper interests. Thus, culture can be understood as the sum of learned behaviour and a collective programming of the mind, where the present globalization is widening the number of people belonging to the dominant culture. These people consider that the present global tradition was transmitted from generation to generation and they often forget a critical understanding or that culture is a socially constructed category.

Cultural differences manifest themselves in different ways and in differing levels of depth. Symbols represent the most superficial and values the deepest manifestations of culture, gods and goddesses, heroes and rituals are located in between. Boudon and Bourricaud (1989) argued that cultural expectations are reinforced by the media, governments, religious institutions and educational systems, but also by internet and by other modern communication systems that are disseminating the present 'American' or 'Western way of life' of a consumerist society. Different cultural approaches may be identified by clusters.

Hofstede (1997) analysed the cultural awareness and the extent of global involvement within enterprises. His different layers could also be used for the analysis of the globalization process of the dominant culture, where transnational enterprises and their powerful interests are linked to formal institutions and dominant governments, creating a culture of the 'top billion'.

Boas's (1932, 1940) cultural anthropology allows us to understand that the other five billion – the excluded – are also aspiring to form part of the top billion. He believed in the psychic unity of humankind and in the universality of culture and therefore his emphasis was oriented to overcome the local context and cultural diversity by achieving one sole universal culture, based on occidental, patriarchal, exclusive and violent elements with a hierarchal power structure and one sole worldview and mindset.

Later, Talcott Parson (1937, 1951) developed the structural functionalism of social actions, where the behavioural system of biological needs, individual characteristics of the personality system, the patterns of units of social interaction of a social system have created social status and role patterns and the cultural system of norms and values that is regulating social actions symbolically for a complex functioning structure of society. This pragmatic liberal-pluralist tradition was criticized by the Frankfurt School and by Althusser, but especially by the critical neocolonialst analysis (César 1972; Fanon 1969) and the dependency theory in Latin America (Marino 1974; Faletto 1983; dos Santos 1968), and it was further reinforced by the epistemological studies of feminists (Harding 1988, 1991; Reardon 1996; Mies 1998; Longino 1990).

These critical studies analysed the perception and the cognition process that legitimized the deep and often unconscious structures of beliefs and behaviour. These reflections permitted also to understand the complex relationship between the natural and the human systems, their interdependence, but also the progressive destruction of the natural system by an irrational human exploitation. Therefore, individual and social actors, institutions, regimes, and worldviews require a fundamental change to adapt to the present conditions, where the cornucopian view does not permit the survival of the complex biological-human system. Thus, this radical cultural change is related to overcome an anthropogenically dominated worldview and to return to a dynamic understanding of the complex interrelations between nature and humankind and to analyse the boundary processes between differ-

7 As Bourdieu (1977) argued his understanding of habitus is "a socialized subjectivity".

ent disciplines, but also between the natural and the human system.

Culture represents the accumulation of material and immaterial processes humankind has been able to create. It includes systems of knowledge and understanding, experiences, attitudes, social representations, identities and meanings. Within the communication process culture has been changing and thus the suggested 'Fourth Green Revolution' responds to established hierarchies, beliefs, values, notions of importance, space and time, division of labour, and to the establishment of new roles. This alternative model must also alter social and spatial relations, the concept of universe and nature, the material possessions of objects and acquired knowledge. In a broader sense, cultivated behaviour that is socially transmitted and controlled must be changed into care for nature and humans. This green revolution conveys also the symbolic communication of this paradigm shift, where the *anthropos* is no longer in the centre of the universe but the dynamic interrelationship between humans and nature. As a collective memory of the mind, a sustainable culture may also transform worldviews and mindsets along with deeply rooted habits, which are understood as social representations (Flores 2001), behaviour and beliefs.

95.2.2 Worldview

The *worldview* concept evolved from the German term 'Weltanschauung' that refers to a wide world perception and to a framework of ideas and beliefs through which an individual interprets the world and interacts with it. A comprehensive worldview includes the fundamental cognitive orientation of a society, its values, emotions, and ethics through which a society or a group interprets the world in which it interacts (Palmer 1996: 114). Hiebert (2008) suggested that worldview is the fundamental cognitive, affective, and evaluative presupposition a group of people makes about the nature of things, and which they use to order their lives. The 'construction of integrating worldviews' begins from fragments of worldviews offered to us by different scientific disciplines and various systems of knowledge to which different perspectives contribute in the world's cultures. According to Aerts, Apostel, De Moor, Hellemans, Maex, Van Belle and Van der Veken (1994), a worldview should comprise seven elements: 1. an *ontology* (descriptive world model); 2. an *explanation*; 3. a *futurology*; 4. *values*; 5. a *praxeology* or a theory of action on how we should attain our goals; 6. an *epistemology*, or a theory of knowledge on what is true and false; and 7. an *etiology* or a constructed worldview with an account of its own building blocks, origins and construction. Krell ([1]2000, [2]2003, [3]2004, [4]2009) used this concept for distinguishing among several macro-theoretical approaches in international relations.

95.2.3 Mindset

The concept of *mindset* includes a fixed mental attitude or disposition that predetermines a person's responses to and interpretations of situations by referring to different patterns of perceiving and reasoning. Fisher ([2]1997) used it as 'cultural lenses' that filter our view of and reaction to the world. With regard to the 'Fourth Green Revolution' this concept refers to a discussion of a post-carbon society, where solidarity, equity, and social justice are the key drivers instead of the maximization of profits and the destruction of the Earth without thinking of the next generations or of the collapse of ecosystems.

95.2.4 Governance

Weiss and Thakur (forthcoming), defined global governance as "the complex of formal and informal institutions, mechanisms, relationships, and processes between and among states, markets, citizens and organizations, both inter- and non-governmental, through which collective interests on the global plane are articulated, rights and obligations are established, and differences are mediated". The concept has been widely used in international relations and in international environment policy since the 1990's, and several specific research centres, projects, and programmes were set up[8]. In the context of the 'Fourth Green Revolution' participative governance is needed combining processes of policy initiation and adoption (bottom-up) and the implementation of the required fundamental transformations (top down). This requires peaceful negotiation processes based on diversity and tolerance.

As these four concepts show, all dominant paradigms have been socially constructed, but are deeply involved in the complex process of civilization of global society; therefore a mere 'paradigm shift' is not

8 Rosenau and Czempiel (1992, [2]1995); Rosenau (1999); see the global governance project in the context of the IHDP: Biermann, Betsill, Gupta. Kanie, Lebel, Liverman, Schroeder and Siebenhüner (2009); Biermann, Siebenhüner and Schreyögg (2009).

enough. One shortcoming of the debate in the natural sciences so far has been that the political dimension and the emerging thinking in the social sciences, e.g. the postmodern approaches in philosophy, sociology, in political science and specifically in the programmes on peace, security, development and environment have not been taken up in the discourses in the natural sciences while their conceptual suggestions are only gradually being considered in the debate in the social science communities on GEC, on natural hazards and security (chap. 1 by Brauch/Oswald Spring).

An isolated approach from the natural or social science alone will not be able to develop the required revolutionary changes in thinking and policy (Held/Hervey 2009).[9] Therefore, we need a 'Fourth Green Revolution' where material and immaterial processes, beliefs and behaviours are changed, including power relations and control mechanisms. The transformation in the thinking on the human intervention into the Earth System must be accompanied by fundamental changes in the cultural, social, and political systems.

95.3 Dangers Humankind is Facing in the Anthropocene

Since the 1970's, scientists have gradually socially constructed new diagnoses of the dangers to human well-being, livelihood, and security:

- From the perspective of the natural sciences the focus has turned to human interventions into the Earth System during the Anthropocene and their physical impacts on the climate system (temperature rise, precipitation change, sea-level rise and increase in number and intensity of natural hazards), the hydrological cycle, the ecosystems and on the land.[10]
- From the perspective of the social sciences (human geography, economics, political science, sociology, law, etc.) the focus has shifted from perspectives of exploiting nature for human prosperity based on unequal accumulation and distribution patterns using economic and military power towards more complex systems' analyses on the human-nature interactions and their inherent risks using modern energy, transportation, and communication systems which have increased greenhouse gases and thus became a major cause of anthropogenic climate change.

From the perspective of the humanities (culture, philosophy, anthropology, psychology, etc.) the focus has shifted to new lifestyles (from rural to urban contexts, from extended to small families), dependency structures (from the family and local community networks to socio-political institutions), and changes in norms, values, preferences and behaviour.

An outcome of these new socio-cultural constructions of reality have been different scientific research results and insights based on new theories and empirical assessments on the human predicament with a gradually evolving understanding of the social impacts of the severe interventions of human activities into the Earth System that may fundamentally undermine the very basis of human life on Earth. These multiple new scientific results have been referred to before as the first stage of a *scientization* of *global environmental change* (GEC) issues.

Partly based on these scientific findings, concerned citizens, social movements, NGOs as well as governments and international organizations have placed in the 1970's environmental pollution, drought and desertification and later ozone depletion and since the late 1980's also global environmental issues such as climate change, water degradation and biodiversity loss on the local, national, and global political agenda. This agenda-setting resulted in the creation of a new policy field with an institutionalization at the national (ministries, agencies) and international level (programmes such as UNEP, financial instruments, such as GEF and conventions creating new environ-

9 Held and Hervey (2009: 14f.) suggested as elements of a global deal in combating climate change that it should be "broadly inclusive, multi-faceted, state-centric and sustainable". Held and Hervey (2009: 5, 10, 17) pointed to various deficiencies in democratic systems facing climate change, such as a) *short-termism* (electoral cycle); b) *self-referring decision-making* (reliance on local constituencies); c) *interest-group concentration* that often paralyzes and prevents bold decisions; and d) *weak multilateralism* with a limited compliance with environmental regimes. They suggested guiding principles for governance and policy at the level of the nation-state (broadening and deepening of the deliberative process, transformation of private preferences, active involvement of citizenry, leadership overcoming narrow interests) and at the global level (promotion of inclusive, broadly representative global decision-making process, assistance for developing countries, broader mandate of GEF, increase of status and responsibility of UNEP).

10 See the preface essay by Müller, Lotze-Campen, Huber, Popp, Svirejeva-Hopkins, Krause and Schellnhuber; chap. 77 by Noone, Nobre and Seitzinger; chap. 74 by Leemans, Rice, Henderson-Sellers and Noone.

mental processes and regimes, such as UNFCC etc.), which has been conceptualized as a process of *politicization*.

Due to both the social construction of these new threats and their perception by a global audience, some policy-makers have stressed the sense of urgency and thus upgraded these new environmental dangers as issues of 'utmost importance' that require 'extraordinary political means' in both facing and coping with global climate change, water scarcity and degradation (Oswald Spring/Brauch 2009b), as well as desertification (Brauch/Oswald Spring 2009 and chap. 47; Oswald Spring/Brauch 2009). This process in framing these dangers and concerns in a human, national or international context has been referred to as '*securitization*' (Wæver 1995, 2008; Buzan/Wæver/de Wilde 1998).

The analysis of the linkages within the climate system has focused first on linear interactions resulting in modelling and projections of physical impacting on economic sectors (agriculture, industry, habitat, health, etc.), ecosystems or bioms (coastal, marine, forests, deserts, etc.) and geographic regions (Africa, Asia, Latin America, Arctic, etc.) that may trigger extreme societal outcomes (BMU 2002; WBGU 2008; Brauch 2009a).

Since the early 21st century the scientific attention has shifted to chaotic processes such as a nonlinear and abrupt climate change (NAS 2001). Once linear processes cross certain thresholds they may result in fundamental contextual changes, as, for example, the shutoff of the Gulf Stream, the collapse of the Amazon rain forest, the ENSO cycle or the change of the Indian monsoon. These chaotic changes have recently been conceptualized as 'tipping points'[11] in the climate system that may fundamentally change the linear projections. Their socio-political and cultural impacts have not yet been addressed and may pose major uncertainties for the survival of several civilizations and also for global security.

95.4 Moving from a Business-as-Usual Towards a Global Vision of Sustainable Transformation

From the vision of *business-as-usual* in a Hobbesian world the dangers posed by GEC have been addressed as new national and military security threats. From the prevailing geopolitical and geostrategic mindset of policy-makers and of the institutions of the national security state[12] their traditional priorities, strategies, and hard military instruments are often applied to these fundamentally different and new security dangers and concerns.

This mode of thinking was first expressed – with regard to the U.S. national security impacts of abrupt climate change – in a study funded by the Pentagon by Schwartz and Randall (2004) that applied the dominant geostrategic thinking to a fundamentally different threat environment where the security dangers are not any longer represented by the other (nation or ideology, etc.) but by one's own 'way of life' and the inherent risks it entails, expressed by the unlimited right to consume the limited natural resources.

The prevailing Hobbesian mindset of the political and military elites applies power concepts, strategic rationales, and military instruments (armed forces, weapons, intelligence) for dealing with a new and fundamentally different security danger that it is not any longer 'them' (China, India, Russia, Brazil, South Africa, the developing countries, and the new rapidly rising GHG emitters) that poses the threat but 'us' due to our fuel-intensive mode of production and consumption patterns where the externality of the costs have been ignored far too long.

11 For Lenton, Held, Kriegler, Hall, Lucht, Ramsdorf, and Schellnhuber (2008: 1186) the term 'tipping point' has been used in discussions of global change "to describe a variety of phenomena, including the appearance of a positive feedback, reversible phase transitions, phase transitions with hysteresis effects, and bifurcations where the transition is smooth but the future path of the system depends on the noise at a critical point". They offered "a formal definition, introducing the term 'tipping element' to describe subsystems of the Earth System that are at least subcontinental in scale and can be switched – under certain circumstances – into a qualitatively different state by small perturbations. The tipping point is the corresponding critical point – in forcing and a feature of the system – at which the future state of the system is qualitatively altered".

12 See Hogan (1998); Nelson-Pallmeyer (1992): refers to its seven features: 1) the military is the highest authority; 2) political democracy and democratic elections are viewed with suspicion, contempt, or in terms of political expediency; 3) the military and related sectors wield substantial political and economic power; 4) its obsession with enemies; 5) the enemies of the state are cunning and ruthless why any means used to destroy or control these enemies are justified; 6) restricts public debate and limits popular participation through secrecy or intimidation; and 7) the church is expected to mobilize its financial, ideological, and theological resources in service to the National Security State.

The rapidly progressing 'militarization' of climate change in the context of the national security discourses (chap. 1 by Brauch/Oswald Spring) that are often instrumentalized for adjusting the national security apparatus to new tasks by creating new military missions and larger budgets – an approach that totally obfuscates the fact that this security threat cannot be solved with military means but requires a fundamental transformation of the economic system and of human values and aspirations, as well as an adaptation of political processes.

This emerging scientific discourse and interest-driven policy debate that frames GEC solely as national security dangers and concerns aims at stabilizing the hegemonic position of the one remaining superpower, and of the dominance of multinational corporations. This is also reflected in proposals to address the challenges posed by climate change outside the UN system by a condominium of a few leading countries without binding legal obligations.[13]

While from the perspective of major industrialized countries no price was too high to bailout the consequences of the global financial crises since 2008, at COP 15 in Copenhagen, many of those countries that referred to climate change as a major new threat to international security were neither ready and willing to treat climate change as an issue of 'utmost importance' nor to commit even less than one per cent of their bailout costs of the global financial crisis for a global fund to assist developing countries in coping with the impacts of global climate change.[14]

The same policy response has applied to the food crisis since 2007 when major industrialized countries were unwilling in November 2009 to commit significant food-aid and financial resources to counter the hunger of 1 billion people.[15] Many of the same countries have used food crops for biofuels, creating an artificial scarcity of food commodities that resulted in major food price hikes (partly due to speculation). They have also spent much more in subsidizing ethanol and biodiesel than would have been needed to launch a strategy for combating hunger.[16]

However, from a human security perspective on GEC the focus has shifted from the states and international organizations to humankind and human beings as referent objects of security. The people have become the primary victims of the global financial crisis and who were the first to lose their employment, income, and livelihood. It will also be the people who will become the primary victim of the physical effects of GEC and their social repercussions. As a result of the reconceptualization of security the focus has widened from the narrow political and military focus to include the economic, social, and environmental security dimensions. Many chapters in this handbook have applied the human security perspective to this extended scope (chap. 74–96 in Brauch/Oswald Spring/Grin/Mesjasz/Kameri-Mbote/Behera/Chourou/Krummenacher 2009).

From the alternative vision of a need for the transformation of global cultural, environmental, economic, and political relations, both scientists and policy-makers have repeatedly declared to shift towards a sustainable development perspective (Brundtland

13 See for the debate in the USA immediately after the failure of COP 15 in Copenhagen: Lisa Friedman: "Negotiations: Some climate experts seek alternative to U.N. process", in: *ClimateWire*, 21 December 2009; at: <http://www.eenews.net/public/climatewire/print/2009/12/21/1>; Suzanne Goldenberg and John Vidal: "UN should be sidelined in future climate talks, says Obama official", in: *The Guardian*, 14 January 2010; at: <http://www.guardian.co.uk/environment/2010/jan/14/climate-talks-un-sidelined>.

14 In 2009, the estimates of the total costs of economic bailout have reached 25 trillion US$ (see: *Wall Street Journal*, 28 October 2009; at: <http://247wallst.com/2008/10/28/financial-crisi/>). The requests for financial aid to developing countries by 2020 that were discussed at COP 15 in Copenhagen amounted to 100 billion US$, OECD countries were unable to commit for a major challenge to the security and survival of humankind in this century. US Secretary of State indicated in December 2009 at COP 15 in Copenhagen that the USA would join a $100 billion aid package for developing countries by 2020 and the EU promised short-term finance for developing countries of $30 billion up to 2012 and $100 billion by 2020 while African countries called for financial means of $200 billion a year by 2020 for technology transfer and capacity building, besides US$67 billion a year for adaptation against climate change. See Fred Oluoch-Ojiwah: "The Road to Copenhagen Did Not Pass Through Africa", in: *The New Times* (Ruanda), 5 January 2010; at: <http://allafrica.com/stories/201001050069.html>.

15 Subejo: "Lesson learned from World Food Security Summit 2009", in: *The Jakarta Post*, 6 December 2009; at: <http://www.thejakartapost.com/news/2009/12/06/lesson-learned-world-food-security-summit-2009.html>; "Wealthy countries' leaders lack the political will to commit to solving these problems. There was no increase in financial commitments to eradicate hunger, as developed nations would not agree to allocate the hoped for US$44 billion in agricultural aid per year."

16 See Rudaheranwa (2009). The EU support for Ethanol in 2006 was 1,282 million Euros and for biodiesel was 2,437 million Euros.

1987; Annan 2000, 2005). However, the adopted declaratory politics during the past two decades has so far only marginally been implemented into policy activities that transform economic processes according to these goals.

From a sustainability perspective, natural scientists suggested to shift towards an *Earth Systems Science* (ESS) that requires many human-induced changes oriented at global sustainability by advancing sectoral wisdom, aiming at a stewardship of the Earth System and moving towards a new paradigm for global sustainability.[17]

From the perspective of the technical disciplines, many institutions and authors – from both North and South – have suggested a total transformation of the energy system by enhancing efficiency and replacing fossil fuels with renewables, thus creating new sustainable production, production lines, and jobs.[18] Others suggested a gradual dematerialization and decarbonization of the production, transportation, and consumption processes.[19] Based on these proposals some economists in the North suggested a new global and green deal (Stern 2009; Calvo 2009); while others called for a transformation of the terms of trade, a different debt policy (chap. 5 by Mesjasz; Jubilee 2000, 1998) and fundamental reforms of the global financial system with enhanced national and international control mechanisms. While the massive economic growth based on cheap fossil energy was the major cause of pollution and global warming, it did not overcome underdevelopment and poverty, and has so far contributed very little to the achievement of the MDGs.

Furthermore, sociologists (Giddens 2009) and political scientists (Held/Harvey 2009) called for new global governance systems or a new geopolitics of climate change. These multiple initiatives for a transformation of the global economic system of production, services and consumption, a needed sharing of knowledge and technology, will create many new and additional employment opportunities for the rapidly growing population both in the South and in the North.

In the South, many initiatives based on local needs and capabilities have created a different development path that aims at self-reliance, empowerment, solidarity, and more equitable social relations (Mies 1998).[20] As GEC has been seriously affecting many developing countries, and most particularly their poor and marginalized people, various mitigation and adaptation processes have already been launched from the bottom-up (MST, Vía Campesina, Cadena 2009).[21]

From the perspective of the humanities[22], philosophers proposed an ethics of responsibility for nature (Jonas 1979; Hösle 1990, 1991, 1997; Tamayo 2010) and a deep ecology (Capra 2002; Menke-Glückert 1994; Lovelock 1979); some anthropologists (Aripze 2009) suggested material and immaterial learning processes to combine modern and traditional knowledge, livelihood diversification, to move towards a new culture of consumption (Schumacher 1973), and a long-term land planning and sustainable land management.

While many conceptual contributions have been made from the vantage point of the natural and social sciences and the humanities to reflect on the meaning and use of the sustainability concept in the respective disciplines, so far only very few integrated and policy-focused sustainability scenarios have been developed that translate the broad calls for a new deal, for an energy and sustainability revolution through a decar-

17 See chap. 74 by Leemans, Rice, Henderson-Sellers and Noone; chap. 94 by Brauch, Dalby and Oswald Spring; Steffen, Sanderson, Tyson, Jäger, Matson, Moore III, Oldfield, Richardson, Schellnhuber, Turner II and Wasson (2004).

18 See Girardet and Mendonca (2009); EREC (2008); Friedman (2008); Randolph and Masters (2008); Edwards and Orr (2005); Tester, Drake, Driscoll and Golay (2005); Heinberg (2004); Geller (2003); von Weizsäcker, Lovins and Lovins (1997).

19 See Luderer, Bosetti, Jakob, Steckel, Waisman and Edenhofer (2009); Edenhofer, Carraro, Hourcade, Neuhoff, Luderer, Flachsland, Sassi, Waisman, Crassous-Doerfler, Monjon, Dröge, van Essen, del Río (2009): *RECIPE: The Economics of Decarbonization – Synthesis Report.* Potsdam: Institute for Climate Impact Research, Germany; Shinnar and Citro (2008); Ausubel (2003): UNDP, Human Development Research Office 2007/21 (New York: UNDP); at: <http://hdr.undp.org/en/reports/global/hdr2007-2008/papers/de%20Buen _Odon. pdf>.

20 An example is the economy of solidarity in Latin America. Another example is the Graheem Bank in Bangladesh.

21 Via Campesina; at: <http://viacampesina.org/main_en>; Vandermeer, Smith, Perfecto and Quintero (2009).

22 According to Maxwell White (1997: 263) "the humanities ... offer models and methods for addressing dilemmas and acknowledging ambiguity and paradox. They can help us face the tension between the concerns of individuals and those of groups and promote civil and informed discussion of conflicts, placing current issues in historical perspective. ... The study of the humanities provides a venue in which the expression of differing interpretations and experiences can be recognized and areas of common interest explored."

bonization of the economy to achieve at least a global emissions reduction by 50 per cent by 2050, and to limit the increase of the global average temperature to 2 °C by the year 2100.

To move from the still prevailing *business-as-usual vision* in a Hobbesian world of the early 21st century towards the alternative sustainability vision in a more cooperative world where hegemonial aspirations and great power games are replaced by cooperation in a multilateral world based on an effective implementation of international law and specifically of the global environmental conventions, more integrated multidisciplinary scientific scenarios are needed that translate the sustainability goals into concrete short-, medium-, and long-term priorities for action.

In the political realm, moving towards the alternative sustainability vision requires both the political will and the determination to implement the many international and national action plans that have been adopted by numerous conferences, and to make the agreed resources available that would permit their effective implementation. But this requires overcoming the constraints of the democratic process and besides new forms of governance. Also, many new policies to better cope with the impacts of climate change on the national and global level are needed.[23]

To move from mere policy declarations to effective action towards sustainability requires both courage, bold and realistic schemes in the industrialized countries but also in developing countries by sharing knowledge and technologies, by enhancing energy efficiency and replacing fossil fuels with renewables on the local, national, regional, and global level in the production, transportation, communication, and consumption systems.

The alternative sustainability vision fundamentally challenges individual, local, and national economic and political preferences and interests. This requires a wide political awareness of the population, a willingness of the media to report on these alternatives and of the people to vote for societal forces and politicians that are capable of translating their policy goals into effective action and to launch a political struggle to shift political preferences.

To move from mere national political rhetoric and weak multinational policy declarations to determined and effective political action requires to challenge, contain, and overcome the many policy constraints and restrictions posed by the actors and their economic and political interests that are often linked to the *business-as usual* vision on responding to sustainable development needs and to the dangers posed by GEC and climate change.

On the political and security realm this requires to recognize that we and not they are the primary threat to the Earth System, and that we are causing the physical and social climate change impacts. Moving towards the vision of a sustainable peace with human security requires overcoming the Hobbesian obsession of a militarization of the climate change impacts for national security.

95.5 Policy Strategies for Coping with GEC: From the Business-as-Usual Towards the Sustainability Vision

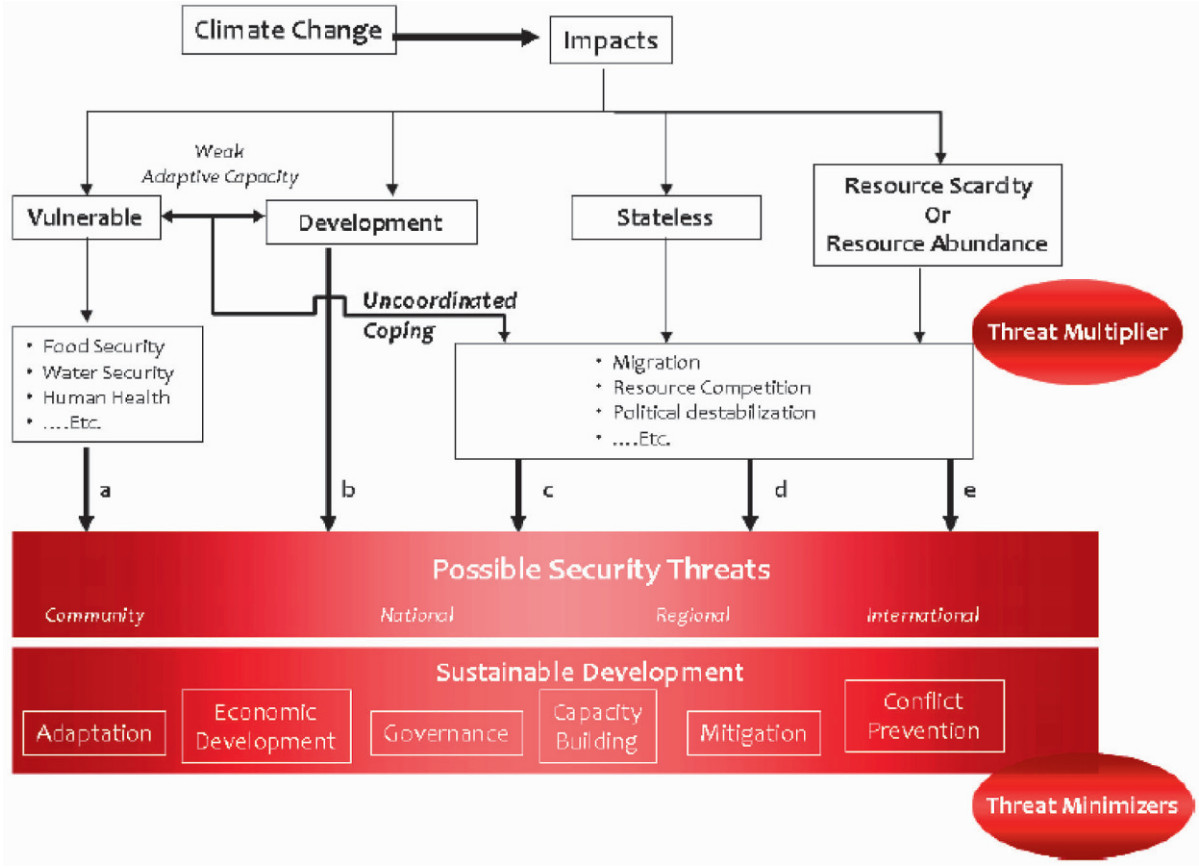
Policy strategies for coping with *Global Environmental Change* (GEC) in the Anthropocene during the 21st century require a shift from the dominant *business-as-usual* towards a *sustainability* vision within society, the business community, and the political realm (Brauch/Oswald Spring 2009a). To assist the transition towards a sustainable transformation, an analysis of the specific threats posed by GEC (95.5.1), a brief assessment of the reasons for the failure of COP 15 and of the 'Copenhagen Accord' (95.5.2.) is provided that will broaden the scope to the multiple national and international obstacles to the adoption and even more to the implementation of such a strategy (95.5.3) and that need to be overcome and to link sustainable development with sustainable peace (95.5.4); this section concludes with a discussion of the non-military means to be used in the economic, societal, and political sectors for achieving these goals (95.5.5.).

95.5.1 Analysis of the Threats Posed by GEC

As a result of human intervention into the Earth System, global environmental change and specifically global climate change is projected to pose multiple security threats, challenges, vulnerabilities and risks in the environmental and societal dimension for international, national, and human security. The report by

23 Held and Hervey (2009: 17) suggested on the national level taxation and just and equitable markets for carbon and other GHGs, applied scientific research, early high-cost investments, regulatory changes, infrastructural development and information instruments; on the global level they proposed: effective offset schemes for developing countries, establishment for environment dispute settlement mechanisms and a world environment organization.

Figure 95.1: Channels of threat multipliers and threat minimizers. **Source:** UN-SG (2009: 7).



(a) *Vulnerability*: Climate change threatens food, soil and water security and human health, and increases human exposure to extreme events.
(b) *Development*: If climate change results in destroying crucial ecosystem services, it will slowing down or reversing the development process, this will exacerbate vulnerability and could undermine the capacity of states to maintain stability.
(c) *Coping and security*: Migration, competition over natural resources, and other coping responses of households and communities faced with climate-related threats could increase the risk of domestic conflict with international repercussions.
(d) *Statelessness*: There are implications for rights, security, and sovereignty of the loss of statehood because of the disappearance of territory (small islands).
(e) *International conflict*: There may be implications for international cooperation from climate change's impact on shared or non-demarcated international resources.

the Secretary-General (11 September 2009) and the joint paper by the EU Commission and Council (14 March 2008) referred to climate change as a 'threat multiplier' for various potential security problems posed by global climate change.

The report by the Secretary General (2009) addressed possible security implications for climate change based on an analysis of "governmental views and relevant research" that referred to five channels through which climate change could affect security (figure 95.1).

This report distinguished among five types of threats to a) human well-being, b) economic development, c) uncoordinated coping, d) loss of territory and statelessness, and e) to international cooperation in managing scarce resources. It referred to multiple impacts of climate change that pose dangers for food, water and health security and for coastal regions, human settlements and infrastructure. For economic development, climate change poses serious challenges that:

> can cause a number of economic disruptions, negatively impacting growth, eroding the revenue base of governments and undermining governance capacities. ... Through its effects on nutrition and health, it may diminish human and animal productivity. It may also contribute to land degradation and cause damage to other natural capital ... and man-made infrastructure like roads, ports, power grids, etc., diminishing an economy's productive potential. ... Sea-level rise, increased risk of extreme weather events and damage to coral reefs and other coastal ecosystems will have an adverse effect on tourism and fisheries, on which many SIDS and other developing countries depend economically. ... In ... fragile states [with] internal tensions, increased climate-induced environmental stress could overstretch existing coping strategies and, in combination with a number of political, economic, and societal factors, could result in: (i) growing tensions over increasingly scarce natural resources, (ii) decreased state authority and increased risk of domestic strife, and (iii) political instability and radicalization.

Furthermore, the "adaptive capacities of individuals, communities, and even nation states may be severely challenged". Also, "uncoordinated coping and survival strategies may come to prevail, including migration and competition for resources, possibly increasing risks of conflict". The report argues that it is impossible to predict "whether and when climate impacts might induce large-scale involuntary migration and/or violent conflict", and it refers to projections that by 2050 migration "due to climate change and environmental degradation [may] vary between 50 million and 350 million" (IOM 2009).[24]

But the report also noted that "The empirical evidence on the relationship between climate change and conflict remains sparse and largely anecdotal." This is changing with new research that links climate and conflict models. Even if quantitative studies on environmental causes of conflict are lacking, this does "not mean they do not exist. Rather, environmental factors may exacerbate conflict dynamics and risk through multiple and indirect pathways, interacting in complex ways with social, political, and economic factors, which tend to be more direct and proximate drivers of armed conflict". Campbell (2007) referred to three regions: South Asia (Bangladesh), sub-Saharan Africa (Nigeria and East Africa) where climate induced migration "could pose the risk of heightened tensions and conflict". The existence of some Small Island Developing States (SIDS) countries is threatened by sea level rise (Kinnas 2009), e.g. "the Maldives, where 80 per cent of land is less than one meter above sea level and could therefore disappear over the next 30 years". The UNSG's (2009: 23) report also noted that

> climate change poses a fundamental threat to cultural survival for those societies whose territories and ways of life are threatened by sea-level rise and inundation, as noted by SIDS. Some Member States have noted that ... cultures ... of indigenous peoples may be at risk from destruction or radical alteration of ecosystems and habitat by climate change. Such peoples may also face challenges in using migration as a coping strategy as a result of discrimination in receiving locations. Thus, climate change's impacts on vulnerable societies will need to be addressed not only as an issue of sovereignty and statelessness but also as a threat to cultural identity.

The competition over scarce transboundary water resources (e.g. in the Indus, Ganges and Brahmaputra, Mekong, Nile and Zambezi basins) due to climate change may result in a deterioration of international relations and in some cases may even trigger or intensify conflicts. The UNSG's (2009) report also referred to the potential for cooperation and that climate change could thus become a 'threat minimizer' due to

> effective international and national mitigation actions, supported by finance and technology flows from developed to developing countries; strong support to adaptation and related capacity building in developing countries; inclusive economic growth and sustainable development which will be critical to building resilience and adaptive capacity; effective governance mechanisms and institutions; and timely information for decision-making and risk management. International cooperation will also need to be reinforced to address transboundary effects and to prevent and resolve climate-related conflicts in accordance with the Charter of the United Nations. Most submissions highlight the central role of sustainable development in enhancing adaptive capacity and as the overarching framework to address existing vulnerabilities which may be exacerbated by climate change.

The joint paper of the EU Commission and Council (14 March 2008) distinguished among these security threats posed by climate change for international security that may occur in different parts of the world: i) conflict over resources; ii) economic damage and risk to coastal cities and critical infrastructure; iii) loss of territory and border disputes; iv) environmentally-induced migration; v) situations of fragility and radicalization; vi) tension over energy supply; and vii) pressure on international governance. These potential

24 IOM Policy Brief: "Migration, Climate Change and the Environment" (2009). Based on recent studies, the report argued that in some cases migration due to climate variability and environmental degradation resulted in violent conflicts (Reuveny 2007).

security threats were discussed for 1) Africa, 2) the Middle East, 3) South Asia, 4) Central Asia, 5) Latin America and the Caribbean, and 6) the Arctic.[25]

These manifold potential threats – due to both the natural climate variability in addition to the anthropogenic climate change – to international and human security will not be caused by a specific enemy represented by a rival country. Rather 'we', as human beings, have produced the potential threats posed by climate change through our economic behaviour, therefore it is up to 'us' as human beings and part of humankind – representing both the cause and the victims – to initiate the 'Fourth Green Revolution' and to launch the transformation from the dominant vision of business-as-usual towards a sustainable vision in a multilateral cooperative world.

Thus, climate change poses primarily challenges for human and international security that can only be overcome by human ingenuity (knowledge on understanding the causes but also technical knowledge producing the artefacts that may assist us in coping with their multiple impacts) and peaceful multilateral cooperation. However, COP 15 in Copenhagen has shown that key mental, economic and political obstacles must still be overcome to prevent the security dangers referred to above from triggering violent conflicts during this century. As these obstacles are deeply rooted in our way of life, in our selfishness and our egotistic aspirations for our own economic well-being, overcoming these deeply ingrained constraints cannot be solved by convenient technical fixes but requires much deeper and radical changes in our own aspirations and consumption patterns and those of civil society, the business community, and finally also those of our governments and international organizations. This transition towards a 'Fourth Green Revolution' will not be without an intensive political struggle and repeated setbacks, as seen most recently at COP 15 of UNFCCC in Copenhagen.

95.5.2 Failure of COP 15 and the 'Copenhagen Accord'

Yves le Boer, Executive Secretary of the UNFCCC Secretariat, referred to three outcomes of COP 15 in December 2009 in Copenhagen: "1) It raised climate change to the highest level of government. 2) The Copenhagen Accord reflects a political consensus on the long-term, global response to climate change. 3) The negotiations brought an almost full set of decisions to implement rapid climate action near to completion."[26] COP 15 noted the 'Copenhagen Accord' that was drafted and approved by a few governments (USA, China, India, Brazil and South Africa) outside the negotiation framework and without any legal obligations and only 'noted' by the governments who were willing to do so, where these governments agreed on several goals and "to communicate their efforts to limit greenhouse gas emissions every two years, also listing their voluntary pledges before 31 January 2010". This legally nonbinding 'Copenhagen Accord'[27] refers to these agreements:

- Developed countries for the first time commit to a goal of jointly mobilizing $100 billion annually by 2020 from both public and private sources. There is a collective commitment to provide "new and additional, predictable and adequate funding" amounting to $30 billion for the period 2010–12, with "balanced allocation between adaptation and mitigation" with adaptation funding being prioritized for the most vulnerable developing countries.
- There is an explicit acknowledgement to act on deforestation and forest degradation and the establishment of a mechanism, i.e. a body to mobilize the required resources.
- Action and cooperation on adaptation, particularly in the least developed countries, small island developing states, and Africa have been given 'urgent' attention with developed countries com-

25 In a synopsis of selected reports Maas and Tänzler (2009) reviewed these six geographical regions focusing on the climate change trends, the converging developments, and the specific security implications.

26 See UNFCCC, Press Release, Copenhagen, 19 December 2009; at: http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/pr_cop15_20091219.pdf and the press briefing by Mr. De Boer, Bonn, December 2009; at: <http://unfccc.int/2860.php>

27 The *Climatico Assessment* (2010: 24–25) on the Copenhagen Accord noted: "The Copenhagen Accord ... is a weak document, which fails to fulfil the UN's requirements of consensus among the 192 members to the Conference of Parties (COP), but also falls short of requirements for a robust global climate policy framework. ... It's likely that future discussions about tackling climate change might be more effectively raised at other forums [G8/G20 meetings] ... where approximately 30 countries ... represent over 90% of global emissions. This smaller group of nations will tackle a narrower agenda of issues, like technology sharing or the merging of carbon trading markets, without the chaos and posturing of the United Nations process."

mitting to provide financial resources. This could open the way to addressing a key concern of developing countries.[28]

However, the proposed annual US$ 100 billion falls far short of the US$ 400 billion per year that negotiators of the G77 + China called for during the conference. It remained unclear how many individual developing countries would commit and who would manage these additional funds, e.g. the World Bank, as the USA proposed, or an independent body under the UNFCCC, as many developing countries preferred.[29]

95.5.3 Obstacles for Coping with GEC and their Security Impacts

While during the past two decades a wide political consensus has emerged based on the four IPCC assessment reports (1990, 1995, 2001, 2007) that besides climate variability there has already been an anthropogenic climate change that will increase significantly during the 21st century based on the strategy, policies and measures to be adopted, the implementation of the goals of UNFCC and for the Annex I countries of the quantitative reduction goals under the Kyoto Protocol referred to major implementation deficits, and specifically under the post-2012 climate regime still to be negotiated. Gradually an understanding is evolving that climate change also increasingly poses security dangers.

While the public awareness on the political urgency has increased, the failure of COP 15 referred to a) major mental obstacles due to old worldviews and mindsets of many decision-makers in the societal, economic and political world, b) short-term interest-driven opposition, and c) deficient governance processes that are all a reflection that business-as-usual strategies still prevail, and that the willingness, courage and determination to move towards the alternative vision of a comprehensive transformation as part of a new global green deal has so far still been rather limited.

In synthesis, among all levels of society and geographical regions, a cultural breakthrough is crucial to change deep-rooted behaviours, beliefs, habits, and power structures to overcome the existing interests, and to promote in favour of nature and humankind a carbon free economy.

95.5.3.1 Mental Obstacles Due to Old Worldviews and Mindsets

In December 2009, COP 15 in Copenhagen has demonstrated that several leading actors were either unwilling or not capable to enter into legally binding commitments due to conflicting goals on the quantitative reduction targets, e.g. between the US (-15 per cent based on 2005) and the EU (-20 to -30 per cent based on 1990) and between developed and developing countries as well as on the financial commitments of industrialized countries to assist poor countries to adapt to climate change impacts (offers of US$ 100 billion vs. Third World demands of up to US$ 400 billion annually by 2020).

These and many other obstacles that have emerged during the UNFCCC since COP 1 (1995) refer to several mental obstacles based on the worldviews of societal, political, and economic elites in many countries, and on the mindset of key decision-makers that were expressed by: a) the *lack of will* to take the challenges posed by climate change seriously; b) the prevailing *thinking in terms of short-term, often selfish, national, state, local community and individual interests* that have put the climate change challenge down on the individual national and global priority list; and c) the *lack of readiness for a global climate deal* based on the "common but differentiated responsibilities" under Art. 4,1 of the UNFCCC and the lack of thinking in terms of common obligations based on solidarity and aiming at equitable sharing of the global resources.

Some of these obstacles are due to traditional human practice and experience, to the knowledge and preferences that have influenced, framed, and often determined the worldviews and mindsets of the elites, of the media and of social, economic and political institutions that have inhibited socio-environmental learning. Some of these deeply rooted determining factors may have been influenced by religious beliefs, patriarchal patterns, and the market-based capitalist system that is primarily driven by a profit motive and less by a sense of societal and global obligations to the Earth System or – in belief terms to 'creation'.

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28 For early assessments of UNFCCC COP 15 and the 'Copenhagen Accord', see: Christian Egenhofer; Anton Georgiev: *The Copenhagen Accord - A first stab at deciphering the implications for the EU* (Brussels: CEPS, 25 December 2009); Noriko Fujiwara: *Reinvigorating the EU's Role in the post-Copenhagen Landscape* (Brussels: CEPS, 15 January 2010);

29 Climatico: *Copenhagen De-briefing. An Analysis of COP15 for Long-term Cooperation* (January 2010); at: <www.climaticoanalysis.org>.

Overcoming these prevailing mindsets and worldviews cannot be achieved solely by a new Copernican revolution towards sustainability, as some leading natural scientists suggested. While such a shift in our thinking on the Earth System is deeply needed, it will not be sufficient unless it is accompanied by a fundamental cultural transformation, or in our words by a 'Fourth Green Revolution' that addresses also the 'deep structures' of our mental processes that influence our perceptions, beliefs, symbols, interpretations and assessments. The prevailing power relations are deeply embedded within the patriarchal system of human relations. They prevent the change towards a sustainable relationship with nature, but they are also limiting the solidarity with other human beings and nations that are less favoured or more affected by the effects of climate change.

95.5.3.2 Short-term Interest-driven Opposition

The negotiation positions and strategies of the 192 negotiation partners at the Copenhagen Conference have been constrained by the national mandates of their respective governments, irrespective of whether they are democratic or authoritarian. Among social scientists it has been disputed whether democracies are more likely to protect the environment (Holden 2002) and to enter into stringent and legally binding global commitments for coping with GEC than non-democratic regimes. A better access to information, an open scientific debate, and the active role of societal environmental groups and coalitions, even though in some cases they have overwhelmed business interests (Bernauer/Caduff 2004; Falkner 2007; Held/Hervey 2009) are no guarantee that even liberal and progressive governments will take courageous negotiation positions for fear that they would later be defeated by their respective parliaments (e.g. the opposition of the U.S. Senate to the Kyoto Protocol of 1997 and the difficulties to adopt a climate bill in 2009 and 2010).

On the other hand, authoritarian governments may be less accountable to their public opinion and lobby groups (Congleton 1992) and more inclined to control and to distribute a large portion of the national wealth among a small elite (Bueno de Mesquita/Smith/Siverson/Morrow 2003); but once they are convinced of the urgency they may more easily disregard opposition and integrate significant GHG emission reductions into their longer-term national development planning.

However, as a comparison between the USA, Canada, Japan and Australia on the one hand and the 27 countries of the EU has shown, fundamental differences have existed between COP 1 and COP 15 among democracies. While some have adopted legally binding commitments and have fully implemented them, and as well are committed to 20, 30 or even 40 per cent GHG emission reductions (based on 1990 emission levels) until 2020, the most powerful democracy has opposed since 2001 any legal obligation and significantly increased its GHG emissions since 1990. But also within the EU the implementation of the Kyoto Protocol has widely differed during the past decade, with Mediterranean EU countries, where the impacts of climate change will be most severe, showing the weakest implementation record (chap. 26 by Brauch).

India and China may become test cases in the years to come as to whether the system of rule determines the climate change attitude of their governments. Both countries are projected to be the two major GHG emitters by the year 2030 and 2050.[30] While the political commitment of democracies to climate change in most cases has been higher, their effects on policy outcomes (GHG emission reductions) have often been ambiguous (Battig/Bernauer 2009).

But not surprisingly those countries whose existence is at risk from sea-level rise, the *small islands development states* (SIDS) in the Pacific as well as in the Indian and Atlantic Ocean, have been the most active in addressing climate change as an issue of their security and survival as nation states and cultures (PSIS 2009).

In some – but not all – democracies short-term orientation and interest-driven opposition has prevailed, and powerful economic lobby groups have successfully torpedoed any legally binding commitments by putting pressure on their governments or parliaments. Thus, the prevailing worldviews oriented at business-as-usual visions and Hobbesian worldviews (we have the means to adapt and can use our military instruments to fend off climate-induced migration and to deal with violent outbreaks after natural hazards) as well as short-termism, self-referencing decision-mak-

30 India and China have invested in renewables and China relies heavily on state-owned enterprises and public investments. In both countries the investment in talents has paid huge dividends. Their business practices account for slim profit margins, but a large domestic demand. They have promoted 'disruptive innovations' for new products. This term is used by the Harvard Business School for the setting up of hybrid companies with job creation and mass production techniques, e.g. for renewables.

ing and interest group concentrations (Held/Hervey 2009) are reflected in major deficits in both national and international structures and processes of governance.

95.5.3.3 Deficient Governance Processes

Among the major shortcomings of national systems, structures, and processes of governance pertaining to climate change and GEC we can cite:

- competition and a lack of horizontal coordination among ministries in this policy field;
- lack of information, training and competence;
- dominance of short-term reactive over long-term proactive strategies and policies;
- lack of longer-term visions, commitments and planning;
- mismanagement and corruption; and
- short-term, narrow and selfish economic, political, military and social interests and desires where the environmental consequences and costs have been ignored for far too long.

On the international level a weak multilateralism prevails with an anarchic inefficiency of international organizations, due partly to the unwillingness of governments to transfer parts of their sovereign decision-making power to these institutions, and partly to the absence of legally binding compliance obligations and of the instruments to enforce them. The concern with maintaining national sovereignty and control, which has already been fundamentally eroded by globalization processes and by the activities of multinational corporations and uncontrolled financial flows, have resulted in narrow and limited mandates for international organizations and in insufficient funding provided by the states. Thus, the UN system has been referred to as a scapegoat to cover up major deficiencies and failures by nation states.

To overcome the mental shortcomings, the short-term interests and the governance deficits and to efficiently cope with the physical and security impacts of global climate change requires an alternative vision beyond the adaptive strategies guided by business-as-usual considerations but also a perspective beyond the Hobbesian obsession that economic and military power and control remain the decisive means for protecting national security in a context of rapidly changing climate parameters by often ignoring the human security needs of its people.

95.5.3.4 Towards the Vision of a Global Sustainable Transformation

To move from the presently dominant socio-economic vision of *business-as usual* towards the alternative vision of a *global sustainable transformation* requires a new negotiated global deal among the nation states, their societies, and the national and transnational economic sector. Parts of the economic sector and of the business elites have already become major drivers towards a sustainable transformation of the economy by realizing more energy efficient production lines, thus reducing the material and energy needs and costs.

Wind energy alone has created more than 700,000 jobs in Europe, and microcredits in Bangladesh and India are able to promote solar energy in remote areas where there is no electricity. The development of locally designed green energy offers new development patterns,[31] creating also jobs for young people that are better trained and able to develop these technologies further. Electricity in these abandoned areas offers new work potentials that may improve their health and food situation and livelihood without charging the planet with new carbon emissions.

Increasingly organizations of the business community (e.g. the World Business Council on Sustainable Development; WBCSD) and new industrial branches (e.g. of the solar and wind power industry) have become key drivers towards a sustainable transformation of the economic sector. The private sector has become an important source of climate finance.

Moving towards a global sustainable transformation requires for the *Earth System* major activities both with regard to the four key components of the *environmental quartet* of climate change, water, soil and biodiversity. Additional measures are also needed regarding the *Human System* and especially pertaining to the four factors of the *societal quartet* that refer to population change, to rural and urban systems, and to various socio-economic processes.

On behalf of UNEP Achim Steiner, the Executive Director of UNEP and Under Secretary-General of

31 The International Energy Agency stated in 2010 that Chinese companies are rapidly bringing down the costs of photovoltaic systems that ranged from US $200–600 a megawatt-hour, while a MWh for onshore wind power costs US $50–70 in the USA. (See "The rise of Big Solar - Growing pains", in: *The Economist*, 15 April 2010; at: <http://www.economist.com/business-finance/display-story.cfm?story_id=15911021>).

the UN, has suggested in October 2008 a "Global Green New Deal" (see foreword by Achim Steiner).[32] This policy-initiative has been backed by many leading economists and social and natural scientists that have made specific proposals for a gradual sustainable transformation of the global economy as was suggested by UNEPs (2007) scenario of *Sustainability First*.

95.5.4 Analysis of Needed Measures and Means

To move towards this alternative medium- and long-term vision requires already now many bold initiatives and concrete policy measures that reduce GHG emissions to be still able to reach the goal of a global average increase of temperature of 2 °C by the end of this century, through:

a) enhanced energy efficiency, a shift towards renewables and a gradual dematerialization and decarbonization of the economy;
b) ecosystem recovery and restoration to maintain environmental services;
c) integrated water basin management, rain harvesting, providing safe water, sewage facilities (including recycling and reuse), enhancing irrigation efficiency and substitution with less water demanding plants;
d) combating soil erosion, degradation and desertification by integrated waste management, composting of organic waste; terracing, restoration of salinized and degraded soils, recovery of soil fertility by crop rotation;
e) changes in our 'ways of life' and 'lifestyles' by changing meat-intensive diets to vegetarian food (food culture);
f) reduction of advertisements and incentives for a consumerist waste economy and of individual demand for non-essential goods and enhancement of intellectual and spiritual aspirations possibly leading to a new modesty;
g) political reforms of democratic governance to enhance longer-term orientations over short-termism, proactive over reactive policies.

For this needed 'Fourth Green Revolution' the scientific community can make manifold contributions by

- specifying proposals for moving further towards a sustainability revolution from the perspective of the natural and technical sciences;
- outlining strategies and steps for anticipatory learning and proactive long-term policies from the vantage point of the social sciences;
- initiating public debates on changes of ways of life, of lifestyles, values, and on individual and collective aspirations and needs by thinkers from the humanities;
- promoting the goals, institutional structures as well as the strategies, policies, and means of global multilateral relations aiming at the vision of a sustainable peace; and finally
- negotiating contradictory development processes with opposed interests in favour of the common goods.

The Report of the Secretary-General (2009) on the security impacts of climate change suggested that the international community must:

- take bold action on climate change mitigation to avoid an intensification of security threats to human well-being;
- provide stronger support to climate change adaptation in developing countries through investments in capacity building on water management, food security and agricultural resilience; public health systems to deal with increased disease incidence and risk; disaster prevention, preparedness and response; early warning systems for various climate change impacts.
- redouble its efforts for sustainable and equitable development through meeting of international commitments on development assistance; continued economic growth in developing countries, and financial and technological support towards a low-carbon path.
- anticipate and prepare for unprecedented challenges beyond existing mechanisms through
  - climate-induced displacement and migration beyond existing legal protective regimes;
  - 'statelessness' of citizens of SIDS and impacts on sovereignty, claims over marine resources, and rights and relocation of their citizens;
  - prospect of water scarcity and stress for millions due to melting of glaciers and snow pack.
  - prospect of competition over newly accessible Arctic natural resources and trade routes.

32 See UNEP Press Release on "'Global Green New Deal' – Environmentally-Focused Investment Historic Opportunity for 21st Century Prosperity and Job Generation" of 22 October 2009; at: <http://www.unep.org/ Documents.Multilingual/Default.Print.asp?documentid=548&articleid=5957&l=en>.

The Report of the Secretary-General (2009) further argued that

> Climate change can only be tackled at a global level with the UNFCCC as the central negotiating body. This requires increased policy coherence and cooperation within the UN system and with other relevant organizations with the goal to enhance its capacity to respond to increased climate-induced disasters and humanitarian crises. Furthermore, research is needed on causal pathways and conditioning factors to better explain why, in different situations, similar physical impacts of climate change may have very different implications for human well-being and security.
>
> Without doubt, the process of negotiation of existing and resulting conflicts is key in this process, and from the peaceful resolution of controversies depends the success of the proposed measures.

95.5.5 Proactive Strategies for Coping with GEC and Hazards

While many reports have convincingly argued that reactive policies are suboptimal (MA 2005) and more costly (Stern 2006, 2009; UNEP 2007) and that proactive policies will in the long run be cheaper and less violent, the impact of this new insight in declaratory politics on the needed bold policy decisions has so far been minimal, as the failure of the agricultural summit in November 2009 in Rome and of the climate conference in December 2009 in Copenhagen have shown. So far the securitization of climate change by upgrading it to an issue of 'utmost importance' has not resulted in the 'extraordinary measures' that are needed for coping with GEC and climate change by avoiding major humanitarian tragedies and complex emergencies which the Earth and global politics may increasingly face during this century.

95.6 Sustainable Development, Security, and Peace in the Anthropocene

The 'Fourth Green Revolution' proposed in this chapter requires radical changes in the four key elements of peace, security, development and environment, including deep transformations in the daily habits, beliefs and social representations, but also in the power structure at the international, national, and local levels. The prevailing worldview of the elites and of the people who are often manipulated by the mass media, and also the mindsets of policy-makers and their advisers must drastically change. The threats of GEC require anticipatory learning, resilience building, and preventive mitigation with proactive conciliation processes to get prepared for future non-linear and complex emergencies.

While the 1987 Brundtland Report suggested the sustainable development concept as a new development path, the call for a sustainable security and a sustainable peace policy suggests a fundamental change in the conceptual thinking on international relations and eventually in the practice among countries during the Anthropocene era of earth and human history. In the scientific realm the proposed political geoecology (chap. 94 by Brauch/Dalby/Oswald Spring) is to link the disparate worlds of the rapidly emerging Earth Systems science with the discourses on global earth governance by integrating the political and security dimensions into natural sciences research as well as by sensitizing the social sciences and the humanities on ongoing research in the natural sciences.

This call for 'consilience' (Wilson 1998b) requires complementing the progressing trend of overspecialization in the scientific world with a holistic concern for the linkages between the Earth and the Human Systems. The suggested 'Fourth Green Revolution" after the agricultural, industrial, and communication revolutions is a huge undertaking that has become necessary as a result of the human interventions and changes in the Earth System and its future unpredictable and complex reactions humankind may face and will have to cope with during the Anthropocene.

Changes in the Earth System and the inescapable consequences put humankind in a predicament: We know that our actions put our survival at risk but due to short-term profit thinking we do not seem to have to change our behaviour and to avert the destruction of our planet. Even if the survival of the present generation is probably not at stake, that of future generations will be. This should be sufficient motive for a radical cultural change in all the spheres of production, circulation, and consumption processes. This requires that we all must act now and avoid postponing needed decisions to the next generation to cope then with more severe challenges and more costly impacts of global environmental change.

Abbreviations

A1B	One of the IPCC SRES scenarios
ABM	anti-ballistic missile
AA	Auswärtiges Amt [Federal Ministry for Foreign Affairs, Germany]
ACOTA	African Contingency Operations Training Assistance
ACRS	Arms Control and Regional Security
ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
ACSYS	Arctic Climate System Study
ACUNU	American Council for the United Nations University
AD	anno domini [after Christ]
ADAM	Adaptation and Mitigation Strategies: Supporting European Climate Policy (EU funded project)
ADB	Asian Development Bank
ADRC	Asian Disaster Reduction Centre
AESI	Asociación Española de Ingeniría Sísmica [Association for Earthquake Engineering of Spain]
AfD	African Development Bank
AFD	Agence Française de Développement
AFED	Arab Forum on Environment and Development
AFES-PRESS	Arbeitsgruppe Friedensforschung und Europäische Sicherheitspolitik – [Peace Research and European Security Studies]
AFP	Agence France Presse (French Press Agency)
AGO	Agor Gauchar Oran
AGRHYMET	AGRronomy HYdrology METeorology: Regional Centre for training and application in agrometeorology and operational hydrology
AGRHYMET	CILSS body on agronomy, hydrology and meteorology in Niamey (Niger)
agroBIO-DIVERSITY	DIVERSITAS Cross-cutting Network on relationships between biodiversity and agriculture
AGY	Adarsh Gaon Yojana (way towards Gandhi's dream village)
AIA	Advanced Informed Agreement (in the context of the Cartagena Protocol on Biosafety (2000) to the CBD (1992))
AIACC	Assessments of Impacts and Adaptations to Climate Change (in Multiple Regions and Sectors)
AIDS	Acquired Immunodeficiency Syndrome
AIMES	IGBP's Analysis, Integration and Modelling of the Earth System project
AIP	American Institute of Physics
AIS	Asociación Colombiana de Ingeniería Sísmica [Colombian Association for Earthquake Engineering]
AKOM	Afet Koordinasyon Merkezi [Istanbul Metropolitan Municipality Disaster Coordination Centre]
AKP	Adalet ve Kalkinma Partisi [Justice and Development Party]
AKUF	AG Kriegsursachenforschung [Study Group on the Causes of War] (at Hamburg University)
AL	Arab League
AMMA	African Monsoon Multidisciplinary Analysis Project
AMU	Arab Maghreb Union
An. 1	Annex 1 countries (under UNFCCC)
An. B	Annex B countries (under Kyoto Protocol)
ANAP	Anavatan Partisi [Motherland Party]
ANU	Australian National University
AOSIS	Alliance of Small Island States
AP3A	Early Warning and Agricultural Productions Forecasting, project of AGRHYMET
APEC	Asia-Pacific Economic Cooperation
APHES	Assessing Public Health in Emergency Situations
API	Annual Population Increase
APIICL	Andhra Pradesh (one of 27 States in India) Industrial and Investment Corporation Limited
APN	Arab Group for the Protection of Nature
APN	Asia-Pacific Network for Global Change Research
AR4	Fourth Assessment Report of the IPCC released in 2007
ARC	Australian Research Council
ARC	American Red Cross
ARC/INFO	(ESRI GIS software)
ArcGIS	Arc Geographic Information System (computer software)
ARIJ	Applied Research Institute, Jerusalem
ASEAN	Association of Southeast Asian Nations
ATOL	Assembling the Tree of Life (project)
ATT	Arms Trade Treaty
AU	African Union
AUS	American University of Sharjah
AYM	Afet Yönetim Merkezi [Istanbul Governorship Disaster Management Centre]
B.U.	Boğaziçi University
BADEA	Arab Bank for Economic Development in Africa
BAHC	Biospheric Aspects of the Hydrologic Cycle

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BAP	Budget Allocation Process
BASIC	Brazil, South Africa, India, China
BBC	(model developed by) Bogardi, Birkmann and Cardona
BCM	billion cubic meters (volume unit)
BCM/yr	billion cubic meters per year (yield or capacity unit)
BCPR	Bureau for Crisis Prevention and Recovery of UNDP
BECC	Border Environment Cooperation Commission (of NAFTA)
BID	Banco Interamericano de Desarrollo [Inter-American Development Bank]
BiH	Bosnia-Herzegovina
bio-DISCOVERY	DIVERSITAS Core Project on assessing and monitoring current biodiversity, and understanding and predicting its change
bioGENESIS	DIVERSITAS Core Project on documenting biodiversity, its diversification, and the effects of human-induced changes
bioSUSTAINABILITY	DIVERSITAS Core Project on finding ways to support conservation and sustainable use of biodiversity
BJP	Bharatiya Janata Party (national political party in India)
BMD	Ballistic Missile Defence
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit [Federal Ministry on the Environment, Nature Conservation and Nuclear Safety, Germany]
BMVg	Bundesministerium der Verteidigung [Federal Ministry of Defence, Germany]
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung [Federal Ministry for Economic Cooperation and Development, Germany]
BOLI	Barcode of Life Initiative
BRIC	Brazil, Russia, India, China
BSE	Bovine Spongiform Encephalopathy
Bt	Bacillus turengiensis
BU	Boğaziçi Üniversitesi [Boğaziçi University]
C	coping
C	degree of Celsius
c	capita
C&C	contraction and convergence
C^3	Command, control, communications
CABI	Centre for Agriculture and Biosciences International
CAMRE	Council of Arab Ministers Responsible for the Environment
CAP	Common Agricultural Policy
CAPMAS	Central Agency for Public Mobilization and Statistics
CARE	Child Care Aware
CARICOM	Caribbean Common Market
CAS	complex adaptive systems
CBD	Convention on Biological Diversity
CBMs	Confidence Building Measures
CBN	Central Bank of Nigeria
CBO	community based organization
CBOL	Consortium for the Barcode of Life
CCA	climate change adaptation
CCAD	Comisión Centroamericana de Medio Ambiente y Desarrollo [Central American Commission on Environment and Development]
CCAFS	(Challenge programme) Climate Change, Agriculture and Food Security
CCC	Greenhouse scenario simulation model developed by the Canadian Centre for Climate
CCCCC	Caribbean Community's Center for Climate Change
CCEMA	Climate Change, Environment and Migration Alliance
CCIS	Climate Change and International Security
CCS	Carbon Capture and Storage
CCS	Consortium of Insurance Compensation
CD	Compact Disc
CD	Conference on Disarmament
CDC	Centres for Disease Control and Prevention
CDC	common-but-differentiated convergence
CDERA	Caribbean Disaster Emergency Response Agency
CDM	Clean Development Mechanism
CDP	Center for Disaster Preparedness
CDRN	Citizens' Disaster Response Network
CEC	Commission for Environmental Cooperation (of NAFTA)
CE-DAT	Complex Emergency Database
CEDAW	Committee on the Elimination of Discrimination against Women
CEDEAO	Communauté Économique des États de l'Afrique de l'Ouest [Economic Community of West African States]
CEDERI	Centro de Estudios sobre Desastres y Riesgos (de la Universidad de los Andes, Bogotá) [Centre of Studies on Disasters and Risks, University of the Andes, Bogota, Colombia]
CEDIM	Center of Disaster Management and Risk Reduction Technologies, Karlsruhe University
CEE/EEC	European Economic Community
CEHA	Centre for Environmental Health Activities
CEN	Caribbean Environment Network
CENAPRED	Centro Nacional de Prevención de Desastres [National Centre for the Prevention of Disasters, Mexico]
CENTED	Centre for Technology, Environment, and Development (Clarke University)
CEP	Caribbean Environmental Programme
CEPAL	Comisión Económica para América Latina y el Caribe [Economic Commission for Latin America and the Caribbean]
CEPS	Centre for European Policy Studies (think tank, Brussels, Belgium)

CERDI	Centre d'Études et de Recherches sûr le Développement International
CESR	Center for Economic and Social Rights
CEW	conflict early warning
CEWARN	Conflict Early Warning and Response Network
CF_2Cl_2	Dichlorofluorocarbon
$CFCl_3$	Trichlorofluorocarbon
CFCs	chlorofluorocarbons
CFE	Treaty on Conventional Armed Forces in Europe (signed on 19 November 1990)
CFSP	Common Foreign and Security Policy (European Union)
CGCF	Copenhagen Green Climate Fund
CGIAR	Consultative Group on International Agricultural Research
CH_4	methane
CHP	Cumhuriyet Halk Partisi [Republican People's Party]
CHS	Commission on Human Security
CI	Critical Infrastructure
CI	Continental intercalaire
CIA	Central Intelligence Agency of the United States of America
CIBIOGEM	Comisión Intersecretarial de Bioseguridad y Organismos Genéticamente Modificados [Intersectoral Commission of Biosecurity and Genetic Modified Organisms]
CIE	Centro de Información Estadística [Statistics Information Centre]
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas [Centre for the Study of Energy, Environment and Technology]
CIL	Coal Industries Limited
CILSS	Comité Permanent inter Etats de Lutte Contre Secheresse dans le Sahel [Permanent Interstate Committee for Drought Control in the Sahel]
CIMNE	Centro Internacional de Métodos Numéricos en Ingeniería (de la UPC, Barcelona) [International Centre of Numerical Methods in Engineering, UPC, Barcelona]
CIS	Commonwealth of Independent States
CLAIP	Latin American Council on Peace Research
CliC	Climate and Cryopshere
CLIVAR	Climate Variability and Predictability
cm	centimetre (length unit)
CM	Coupled Modelling
cm/yr	centimetre per year (velocity unit)
CMP	Conference of Member Parties to the Kyoto Protocol
CNA	Comisión Nacional del Agua [National Commission for Water, Mexico]
CNA	Center for Naval Analysis
CNAS	Center for a New American Security
CNRS	Centre national de la recherche scientifique (France)
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CONABIO	Comisión Nacional de la Biodiversidad [National Commission on Biodiversity, Mexico]
CONAM	National Environmental Council (Peru)
CONAPO	Consejo Nacional de Población [National Population Council]
CONAZA	Comisión Nacional de Zonas Aridas [National Commission of Arid Zones]
Congress party	(national political party in India)
COP	Conference of Parties (of an international environmental regime, e.g. of UNFCCC)
COWI	Consulting Engineers and Planners (consultancy form, Denmark)
CPACC	Caribbean Planning for Adaptation to Global Climate Change
CPCB	Central Pollution Control Board
CPIA	Country Policy and Institutional Assessment (World Bank)
CPTEC	Centro de Previsao de Tempo e Estudos Climaticos (Brazil)
CRED	Centre for Research on the Epidemiology of Disasters (Université Catholique de Louvain, Belgium)
CRIC	Committee for the Review of the Implementation (of UNCCD)
CRU	Climate Research Unit (University of East Anglia, UK)
CSIRO	(Australia's Commonwealth) Scientific and Industrial Research Organisation
CSIS	Center for Strategic and International Studies
CSP	Concentrated Solar Power
CSSCR	Center for Security Studies and Conflict Research
CST	Committee for Science and Technology (of UNCCD)
CSTO	Collective Security Treaty Organization
CT	Continental Terminal
CTBT	Comprehensive Nuclear Test Ban Treaty
CTF	Clean Technology Fund
CTR	Cooperative Threat Reduction Program
CUBEC	Centro Universitario Europeo per i Beni Culturali, Ravello [European University Centre for Cultural Heritage]
CVA	Capabilities and Vulnerability Analysis
CWD	Coarse woody debris
CZM	Coastal Zone Management
d	day
D/CEW	Disaster and Conflict Early Warning
D3E	(Centre for Development, Economy, Ecology and Equity, Porto Alegre, Brazil, established by the World Social Forum)
DAC	Development Assistance Committee
DALY	Disability Adjusted Life Years

DANE	Departamento Administrativo Nacional de Estadística [National Administrative Departmentt of Statistics]
DASK	Doal Afet Sigorta Kurumu [Turkish Catastrophe Insurance Pool]
DCB	Delhi Cantonment Board
DCS	Department of Census and Statistics
DDA	Delhi Development Authority
DDC	Drylands Development Centre (of UNDP)
DDP	Dryland Development Paradigm
DDPG	Draft Defense Planning Guidance
DDR	Disarmament, Demobilization and Reintegration
DDT	Dichloro-Diphenyl-Trichloroethane
DEHAP	Demokratik Halk Partisi (Democratic People's Party)
DEM	digital elevation model
DEP	Demokrasi Partisi (Democracy Party)
DESA	Department of Economic and Social Affairs (United Nations)
DESD	Decade of Education for Sustainable Development
DESERTEC	(Concept for generating electricity in the deserts of the MENA region)
DEW	disaster early warning
DEWA	Division of Early Warning and Assessment (UNEP)
DFID	Department for International Development (UK)
DFO	Dartmouth Flood Observatory
DG	Directorate General (European Commission)
DG Relex	Directorate General, External Relations (European Commission)
DHA	Department of Humanitarian Affairs
DHI	Danish Hydrological Institute (Denmark)
DHS	Department of Homeland Security
DIAPER	Permanent Diagnosis (project of AGRHYMET)
Diconsa	Distribuidora e Impulsora Comercial Conasupo [Commercial Distribution and Promotion of Conasupo] (a governmental commercial body for food distribution for marginal people)
DIHMA	Departamento de Ingeniería Hidráulica y Medio Ambiente (Universidad Politécnica de Valencia) [Department of Hydraulic Engineering and Environment, Polytechnic University of Valencia]
Dii	Desertec Industrial Initiative
DIS	Data and Information Service
DIVERSITAS	(international research programme on biodiversity science)
DJB	Delhi Jal Board
DJF	December, January, February (northern hemisphere winter season)
DLDD	Desertification, Land Degradation and Drought
DLR	Deutsche Gesellschaft für Luft- und Raumfahrt [German Aerospace Establishment]
DM	Disaster Mitigation
DMI	Disaster Mitigation Institute
DNA	DeoxyriboNucleic Acid
DNAs	Designated National Authorities
DNPAD	Dirección Nacional de Prevención y Atención de Desastres (Colombia) [National Directorate of Disaster Prevention and Attention]
DoD	Department of Defense
DPAD	Dirección para la Prevención y Atención de Desastres (del Ministerio del Interior, Bogotá) [Disaster Prevention and Attention Directorate of Interior Ministry, Bogota, Colombia]
DPG	Defense Planning Guidance
DPJ	Democratic Party of Japan
DPT	Devlet Planlama Tekilat [Turkey's State Planning Organization]
DRC	Desert Research Center (Egypt)
DRC	Democratic Republic of Congo
DRF	Debt Reduction Facility
DRI	Disaster Risk Index
DRM	disaster risk management
DRR	disaster risk reduction
DRU	Disaster Response Unit
DSAs	Debt Sustainability Analyses
DSP	Demokratik Sol Parti [Democratic Left Party]
DSSAT	Decision Support System for Agrotechnology Transfer
DTP	Demokratik Toplum Partisi [Democratic Society Party]
DYP	Doru Yol Partisi [True Path Party]
E. Coli	Escheriquia Coli
EAC	East Africa Community
EACHFOR	(EU-funded research project on forced migration)
EAS	Eastern Aquifer System
EAW	European Arrest Warrant
EC	European Community
EC	European Commission
ECHAM4	(atmospheric general circulation model by the Max Planck Institute for Meteorology, Hamburg, Germany)
ECHO	European Commission's Humanitarian Aid Office
ECLAC	Economic Commission for Latin America and the Caribbean
ecoHEALTH	(DIVERSITAS Cross-cutting Network on relationships between plant and animal biodiversity and (re)emergence of infectious diseases and the consequences for wild biodiversity and human societies)
ECOMICI	ECOWAS Mission in Cote d'Ivoire

ECOMOG	Economic Community of West African States' Monitoring Group
ecoSERVICES	(DIVERSITAS Core Project on relationships between biodiversity and ecosystem functioning and services)
ECOSOC	Economic and Social Council (United Nations)
ECOWAS	Economic Community of West African States
EDI	Economic Diversification Index
EDRI	(Urban) Earthquake Disaster Risk Index
EEA	European Environment Agency
EEC	European Economic Community
EEI	equal emissions improvement per GDP
EEOC	Equal Employment Opportunity Commission
EERI	Earthquake Engineering Research Institute
EEZ	Exclusive Economic Zone
EFP	European foreign policy
EGTT	Expert Group on Technology Transfer
EHCAM5	Max Planck Institut für Meteorologie, model version 5
EHS	Institute for Environment and Human Security (United Nations University)
EIA	environmental impact assessment
EIB	European Investment Bank
EM(-)DAT	Emergency Disasters Database (of the Centre for the Epidemiology of Disasters of Catholic University of Lovain, Brussels)
EMAA	Euro-Mediterranean Association Agreement
EMCCF	Euro-Mediterranean Climate Change Framework
EMI	Earthquakes and Megacities Initiative
EMP	Euro-Mediterranean Partnership
EMS	European Macro-Seismic Scale
EMS	Eosinophilia-Myalgia Syndrome
EMSA	European Maritime Safety Agency
ENAC	Estrategia Nacional de Cambio Climático [National Strategy on Climate Change]
ENCOP	Environment and Conflicts Project
ENN	Environmental News Network
ENP	European Neighbourhood Policy
ENSEMBLES	Ensemble-based predictions of climate changes and their impacts (a European Commission-funded project developed to quantify the uncertainty in long-term predictions of climate change)
ENSO	El Niño-Southern Oscillation
ENVSEC	Environment Security Initiative (OSCE, UNEP, UNDP, NATO)
EOL	Encyclopedia of Life
EOLSS	Encyclopaedia of Life Support Systems (UNESCO)
EPA	Environment Protection Agency (USA)
EPB	Environmental Protection Bureaus
EPI	Environmental Performance Index
EQA	Environmental Quality Authority
ERC	Environmental Research Centre
ERN	Evaluación de Riesgos Naturales (Consorcio de Ingenieros Consultores) [Bogotá Natural Risk Evaluation, Consortium of Engineering Consultants]
ERT	Emergency Response Team
ESA	Earth System Analysis
ESDP	European Security and Defence Policy
ESF	European Science Foundation
ESG	Earth System Governance
ESI	Environmental Sustainability Index
ESS	European Security Strategy
ESS	Earth System Science
ESSIC	Earth System Science Interdisciplinary Center (University of Maryland, USA)
ESSP	Earth System Science Partnership
ET	emissions trading
ETA	Euskadi Ta Askatasuna [Bask Land and Liberty]
ETC	(Action Group on) Erosion, Technology and Concentration
ETH-Zurich	Eidgenössische Technische Hochschule Zürich (Swiss Federal Institute of Technology Zurich)
ETS	emission trading system
EU	European Union
EU-MENA	European Union – Middle East and North Africa
EuroMed	European-Mediterranean
EMP	European-Mediterranean Partnership
EVI	Environmental Vulnerability Index
EVI	Economic Vulnerability Index
f	function of
FAO	Food and Agricultural Organization (United Nations)
FCPF	Forest Carbon Partnership Facility (World Bank)
FDA	Food and Drug Administration (USA)
FDI	Foreign Direct Investment
FEMA	Federal Emergency Management Agency (USA)
FER	Force, Event, Response Diagram
FHS	Friends of Human Security
FIRST	Facts on International Relations and Security Trends
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
FMCT	Fissile Material Cut-off Treaty
FMHUD	Federal Ministry of Housing and Urban Development (Nigeria)
FoE	Friends of the Earth
FOEME	Friends of the Earth Middle East
FOGAR	Forum of Global Associations of Regions
freshwaterBIO-DIVERSITY	(DIVERSITAS Cross-cutting Network on freshwater biodiversity)
FRIEND	Flow Regimes from International Experimental and Network Data
FSI	Failed States Index
FSU	former Soviet Union

FY	fiscal year
G20	Group of twenty (most important industrial and threshold states)
G77	Group of 77 (developing countries)
G-8	Group of eight (major industrialized countries: Canada, France, Germany, Italy, Japan, Russia, UK, US)
GAIM	Global Analysis, Integration, and Modelling
GAP project	Güneydou Anadolu Projesi [Southeastern Anatolian Irrigation Development Project]
GAR	Global Assessment Report on Disaster Risk Reduction (2009)
GATT	General Agreement on Tariffs and Trade
GCA	Global Climate Action
GCAS	Gaza Coastal Aquifer System
GCC	Gulf Cooperation Council
GCC	global climate change
GCCA	Global Climate Change Alliance
GCIM	Global Commission on International Migration
GCM	global circulation model
GCOS	Global Climate Observing System
GCP	Global Carbon Project (ESSP project)
GCTE	Global Change and Terrestrial Ecosystems
GDP	Gross Domestic Product
GEC	Global Environmental Change
GECAFS	Global Environmental Change and Food Systems (ESSP project)
GECHH	Global Environmental Change and Human Health
GECHS	Global Environmental Change and Human Security
GEF	Global Environment Facility
GEHSHA	Global Environmental and Human Security Handbook for the Anthropocene
GEI	Gender Equity Index
GEI	Green Economy Initiative
GEO	Global Environmental Outlook (UNEP)
GEO BON	Group on Earth Observations Biodiversity Observation Network
GEWEX	Global Energy and Water and Experiment
GFDL CM2.0	Geophysical Fluid Dynamics Laboratory, Model version CM2.0
GFDL-R30	Greenhouse scenario simulation model
MODEL	(developed by NOAA's Geophysical Fluid Dynamics Laboratory)
GFDLT	(one of the Global Circulation Models)
GGAVATT	Grupo Ganadero para la Validación y Transferencia de Tecnología [Livestock producers group for transferring and validating technology]
GHG	greenhouse gas
GHI	Global Hunger Index
GINI	(index on income inequality of UNEP)
GIS	Geographic Information System
GISP	Global Invasive Species Programme
GISPRI	Global Industrial and Social Progress Research Institute
GLADA	Global Assessment of Land Degradation and Improvement
GLASOD	Global Assessment of Human Induced Soil Degradation
GLOBEC	Global Ocean Ecosystem Dynamics
GLOCHA-MORE	Global Change in Mountain Regions Programme
GLOWA	Globaler Wandel des Wasserkreislaufs [Global Change of the Water Cycle]
GLP	Global Land Project (IHDP research project)
GM	Global Mechanism (UNCCD)
GM	Genetically modified
GMBA	Global Mountain Biodiversity Assessment
GmbH	[limited liability company]
GMEF	Global Ministerial Environment Forum
GMEI	Greater Middle East Initiative
GMFA	Greece Ministry of Foreign Affairs
GMOs	Genetically Modified Organisms
GMP	Global Mediterranean Policy
GMP	Genetically modified products
GNI	Gross National Income
GNP	Gross National Product
GOE	Government of Egypt
GOESS	Geostationary Operational Environmental Satellite System
GOI	Government of India
GOOS	Global Ocean Observing System
GRAVITY	Global Risk and Vulnerability Index
GRC	Gulf Research Center
GRID	Global Resource Information Database
GSPC	Groupe Salafiste pour la Prédication et le Combat [Salafist Group for Preaching and Combat]
GTI	Global Taxonomy Initiative
GTOS	Global Terrestrial Observing System
GTZ	Gesellschaft für Technische Zusammenarbeit [German Agency for Technical Cooperation]
GUH	Geomorphologic Unit Hydrograph
GURT	Genetic use restriction technologies
GVA	Gross Value Added
GWES	Groundwater for Emergency Situations
GWh	giga watt hour
GWMDFZ	Gulf Weapons of Mass Destruction Free Zone
GWP	Global Water Partnership
GWP	global warming potential
GWSP	Global Water System Project (ESSP)
H	hazard
HadCM3 models	(climate change scenario of the Hadley Centre in the UK)
HADEP	Halkin Demokrasi Partisi [People's Democracy Party]
HADGEM1	Hadley Centre for Climate Prediction and Research, Model version GEM1
HAZUS	Hazard United States Loss Estimation Tool

HBF	Heinrich Boell Foundation
HBS	Harvard Business School
HCFCs	Hydrochlorofluorocarbons
HDI	Human Development Index
HDP	Human Dimension of Global Environmental Change Programme
HDR	Human Development Report
HDRI	Hurricane Disaster Risk Index
HELCOM	Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea
HELP	Hydrology for Environment, Life and Policy
HEP	Halkin Emek Partisi [People's Labour Party]
HFA	Hyogo Framework for Action
HFCs	hydrofluorocarbons
HH	His Highness
HHI	Harvard Humanitarian Initiative
HHWS	Heat Health Warning Systems
HIES	Household Income and Expenditure Survey
HIIK	Heidelberg Institute für Internationale Konfliktforschung [Heidelberg Institute for International Conflict Research Heidelberg University, Germany]
HIPC	Heavily Indebted Poor Countries
HIV	Human Immunodeficiency Virus
HIV/AIDS	Human Immunodeficiency Virus – Acquired Immunodeficiency Syndrome
HP	Historical (or Mandate) Palestine
HRH	His Royal Highness
HRW	Human Rights Watch
HSN	Human Security Network
HUGE	human, gender, and environmental security (concept developed by Úrsula Oswald Spring)
HVDC	high-voltage direct currents
HVRI	Hazards & Vulnerability Research Institute (USA)
I=PAT formula	Impact = Population – Affluence – Technology
IAEA	International Atomic Energy Agency
IAI	Inter-American Institute (for Global Change Research)
IAI	Inter-American Institute (for Weather Change)
IAM	Integrated Assessment Modelling
IAP	Initial action plan
IARU	International Alliance of Research Universities
IAS	Iullemeden Aquifer System (project)
IASC	Inter-Agency Standing Committee
IASFM	International Association for the Study of Forced Migration
IAV	Impacts, Adaptation, and Vulnerability
IBA	Important Bird Area
IBB	Istanbul Büyük ehir Belediyesi [Istanbul Metropolitan Municipality]
ICAC	International Global Atmospheric Chemistry
ICACGP	International Commission on Atmospheric Chemistry and Global Pollution
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBM	Intercontinental Ballistic Missile
ICG	International Crisis Group
ICJ	International Court of Justice
ICL	Institute for Catastrophic Loss Reduction (Toronto/London, Canada)
ICNND	International Commission for Nuclear Nonproliferation and Disarmament
ICPAC	IGAD's Climate Prediction and Assessment Center
ICRC	International Committee of the Red Cross
ICRG	International Country Risk Guide
ICSU	International Council for Science
ICSU-IGFA	International Council for Science - International Group of Funding Agencies for Global Change Research
ICT	Information and Communications Technology
ICTP	International Centre for Theoretical Physics
ICWC	Interstate Commission for Water Coordination
ICZM	Integrated Coastal Zone Management
ID	Institutional Discrimination
IDA	International Development Association
IDB	Inter-American Development Bank
IDEA	Instituto de Estudios Ambientales (de la UNC, Manizales) [Institute of Environmental Studies]
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales [Institute of Hydrology, Meteorology and Environmental Studies]
IDGEC	Institutional Dimensions of Global Environmental Change (IHDP research project)
IDNDR	International Decade for Natural Disaster Reduction (United Nations)
IDP	Internally Displaced Persons
IDRC	International Development Research Center
IDS	Institute of Development Studies (University of Sussex, UK)
IDSA	Institute for Defence Studies and Analyses
IDSC	International Decision Support Center
IEA	International Energy Agency
IEA	Instituto de Estadística de Andalucía [Andalusia Statistics Institute]
IEG	Independent Evaluation Group (World Bank)
IEMP	Istanbul Earthquake Master Plan
IETS	International Emissions Trading Schemes
IFAD	International Fund for Agricultural Development
IFAS	International Fund for Saving the Aral Sea
IFI	International Financial Institution
IFI	International Flood Initiative

IFPRI	International Food Policy Research Institute (Washington, D.C.)
IFRC	International Federation of the Red Cross
IFRC-RCS	International Federation of the Red Cross – Red Crescent Societies
IGAD	Inter-Governmental Authority on Development
IGBP	International Geosphere-Biosphere Programme
IGC	Interim Governing Council
IGC	Intergovernmental Committee (on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore)
IGCP	International Geosciences Programme
IGES	Institute for Global Environmental Strategies
IGFA	International Group of Funding Agencies for Global Change Research
IGME	Geological and Mining Institute of Spain
IGO	international governmental organizations
IHD	Index of Human Development
IHDP	International Human Dimensions Programme on Global Environmental Change
IHDW	International Human Dimensions Workshops
IHL	International Humanitarian Law
IHP	International Hydrologic Programme project
IIASA	International Institute for Applied Systems Analysis (Laxenburg, Austria)
IIFFMCO - CEIG	Independent International Fact-Finding Mission on the Conflict in Georgia
IISS	International Institute for Strategic Studies
iLEAPS	Integrated Land Ecosystem-Atmosphere Processes Study
ILO	International Labour Organization
ILZ	Interdisciplinary Latin America Center, University of Bonn, Germany
IMA	Israeli Ministry of Agriculture
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
IMF	International Monetary Fund
IMM	Istanbul Metropolitan Municipality
IMN	Instituto Meteorológico Nacional [National Institute of Meteorology]
IMoSEB	International Mechanism of Scientific Expertise on Biodiversity
INC	Initial National Communication
INC	Instituto Nacional de Colonización [National Colonization Institute]
IncReps	Incident Reports
INE	Instituto Nacional de Estadística [National Institute of Statistics of Spain]
INEC	Instituto Nacional de Estadísticas y Censos [National Institute of Statistics and Census]
INEGI	Instituto Nacional de Estadística, Geografía e Informática [National Institute for Statistics, Geography and Informatics]
INF	Treaty on the Elimination of Intermediate-range and Shorter-range Nuclear Forces
INGO	international nongovernmental organizations
INI	International Nitrogen Initiative
INIFAP	Instituto nacional de Investigaciones Forestales, Agrícolas y Pecuarias [National Research Institute for Forestry, Agriculture and Animal Science, Mexico]
INR	Indian National Rupee
INUAMA	Institute of Water and Environment, University of Murcia, Murcia, Spain
INVEMAR	Institutos de Investigaciones Marítimas y Costeras de Colombia [Colombia's National Institute of Maritime and Coastal Research]
INVS	Institut de Veille Sanitaire
IOC	Intergovernmental Oceanographic Commission
IOM	International Organization for Migration
IP	Ionides Plan
IPAT	Impact, Population, Affluence, Technology
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPCC -TGICA	Intergovernmental Panel on Climate Change - Task Group on Data and Scenario Support for Impact and Climate Assessment
IPCRI	Israel-Palestine Center for Research and Information
IPICYT	Instituto Potosino de Investigación Científica y Tecnológica, Mexico
IPO	International Project Office
IPOGEA	Research Centre on Local and Traditional Knowledge
IPR	Intellectual Property Rights
IPRA	International Peace Research Association
IPU	Inter-Parliamentary Union
IR	Incidence rate
IRDR	Integrated Research on Disaster Risk
IRENA	International Renewable Energy Agency
IRG	Integrated Risk Governance
IRI	International Research Institute for Climate and Society
IRIN	Integrated Regional Information Networks
IRS	Integrated Regional Study
IRSW	internal renewable surface water
ISA	International Studies Association
ISAAA	International Service for the Acquisition of Agri-Biotech Applications
ISAF	International Security Assistance Force (in Afghanistan)
ISBR	International Society for Biosafety Research
ISCC	integrated solar combined cycle

ISDR	International Strategy for Disaster Reduction (United Nations)
ISFH	Institut für Friedensforschung und Sicherheitspolitik an der Universität Hamburg [Institute for Peace Research and Security Studies at the University Hamburg]
ISI	Institute for Scientific Information
ISO	International Standardization Organization
ISRIC	International Soil Reference and Information Centre
ISS	Institute for Security Studies (Pretoria, South Africa; Nairobi, Kenya)
ISSC	International Social Science Council
ISW	Israeli Segregation Wall
IT	Information Technology
IT	Industrial Transformation (IHDP Research Project)
ITCP	Integrated Territorial Climate Plans
ITDG	Intermediate Technology Development Group
IUBS	International Union of Biological Sciences
IUCN	International Union for the Conservation of Nature (World Conservation Union)
IUED	Institut Universitaire d'Etudes du Développement [Institute for Development Studies, University of Geneva]
IUGS	International Union of Geological Sciences
IUMS	International Union of Microbiological Societies
IWHR	Institute of Water Resources and Hydropower Research (Beijing, PRC)
IWRM	Integrated Water Resource Management
IWTC	International Water Technology Conference
IYDD	International Year of Deserts and Desertification (UNCCD)
IYPE	International Year of Planet Earth
IZIIS	Institute of Earthquake Engineering and Engineering Seismology (Skopje, Former Yugoslav Republic of Macedonia)
JBF	Jal Bhagirathi Foundation (Jodhpur, India)
JCS	Joint Chiefs of Staff (USA)
JDEC	Jerusalem District Electricity Company
JGOFS	Joint Global Ocean Flux Study
JHA	Justice and Home Affairs
JI	Joint Implementation
JICA	Japan International Cooperation Agency
JJ	Jhuggi Jhompri
JJA	June, July, August (northern hemisphere summer season)
JMCC	Jerusalem Media and Communication Center
JP	Joint Programme on Climate Change Risk Management (Egypt)
JRB	Jordan River Basin
JP	Johnston Plan
JRC	Joint Research Centre (European Commission)
JSC	Joint Scientific Committee
JWC	Joint Water Committee
KBR	Subsidiary of the Transnational Halliburton
KFOR	Kosovo Force
KfW	Kreditanstalt für Wiederaufbau (German Public Development Bank)
KHK	Kanun Hukmunde Kararname [Decree]
KIMA	Egyptian Chemical Industries (company)
KP	Kyoto Protocol
kwh	kilo-watt-hour (electricity consumption unit)
l	litre
l/c/d	Litre per capita (person) per day
l/h	litre per hour (flow velocity unit)
l/s	litre per second (flow velocity unit)
LA RED	Red de Estudios Sociales en Prevención de Desastres en América Latina [Latin American Network of Social Studies on Disaster Prevention]
LAS	League of Arab States
LASEPA	Lagos State Environmental Protection Agency (Nigeria)
LCA	Life Cycle Assessment
LDCF	Least Developed Countries Fund (UNFCCC)
LDCs	less developed countries
LDP	Liberal Democratic Party (Japan)
LEWS	Livestock Early Warning System
LGA	Local Government Areas (Nigeria)
LICs	Low-income countries
LICUS	Low-Income Countries Under Stress
LINKS	Local and Indigenous Knowledge Systems
LMO	Living Modified Organisms
LOICZ	Land Ocean Interactions in the Coastal Zone Project (IHDP research project)
lpcd	litres per capita per day
LSE	London School of Economics and Political Science (London, UK)
LTMs	Long Term Missions (OSCE)
LTTE	Liberation Tigers of Tamil Eelam
LUCC	Land-Use and Land-Cover Change (research project of IHDP and IGBP)
LULUC	land use and land use change
LURD	Liberians United for Reconciliation and Democracy
LVI	Livelihood Vulnerability Index
LVI	Local Vulnerability Index
m^3	cubic metre
m^3/yr	cubic metre per year (consumption unit)
MA	Millennium Ecosystem Assessment
MAB	Man and the Biosphere Programme (UNESCO)
MAB	Mountain Aquifer Basin
MAC	marginal abatement costs
MACC	Mainstreaming Adaptation to Climate Change
MAD	Mutual Assured Destruction

MAFF	Ministry of Agriculture, Forestry and Fisheries
MAIRS	Monsoon Asia Integrated Regional Study (ESSP)
MAM	March, April, May
MARM	National Ministry of Rural and Marine Environment
MASSOB	Movement for the Actualization of the Sovereign State of Biafra
MAVDT	Ministerio de Ambiente, Vivienda y Desarrollo Territorial (de Colombia) [Ministry of Environment, Housing and Territorial Development]
MC 14/3	NATO's Military Committee Document 14/3 (1967)
MC 48	NATO's Military Committee Document 48 (strategy of flexible response, 1957)
MCD	Municipal Corporation of Delhi
MCH	Municipal Corporation of Hyderabad
MCM	million cubic metres
mcm/yr	million cubic metres per year
MD	Millennium Development
MDGs	Millennium Development Goals
MDRI	Multilateral Debt Relief Initiative
ME	Middle East
MEA	Millennium Ecosystem Assessment
MEAs	Multilateral Environmental Agreements
MEDA	Mediterranean Economic Development Assistance
MEDENER	Mediterranean Association of National Energy Agencies
MED-EUWI	Mediterranean-European Water Initiative
MEDREC	Mediterranean Renewable Energy Centre
MEDSEC	Mediterranean Security Initiative
MEDU	Co-ordinating Unit for the Mediterranean Action Plan (UNEP)
MEH-SEC	Mediterranean Environmental and Human Security Initiative
MENA	Middle East and North Africa
MEND	Movement for the Emancipation of the Niger Delta
MEPI	Middle East Partnership Initiative
MERIP	Middle East Research and Information Project
METI	Ministry of Economy, Trade and Industry (Japan)
MEWS	Malaria Early Warning System
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MFDC	Movement of Democratic Forces of Casamance
MGD	million gallons per day
Mha	millions of hectares
MHP	Milliyetci Hareket Partisi [Nationalist Action Party]
MICs	Middle-income countries
MIT	Massachusetts Institute of Technology
MJP	Ivory Coast Patriotic Movement
MLD	million litres per day
MLF	Montreal Protocol on Substances that Deplete the Ozone Layer
mm	millimetre (length unit)
mm/yr	millimetre per year (velocity unit)
MMA	National Ministry of Environment (in 2008 changed to MARM National Ministry of Rural and Marine Environment)
MMO	Mediterranean Migration Observatory (Panteion University, Athens)
MMR	Maternal Mortality Ratio
MMTS	Multi Modal Transportation System
MNC	multinational corporations
MNE	multinational enterprises
MODIS	Moderate Resolution Imaging Spectroradiometer
MOE	Ministry of Environment (Japan)
MoEnv	Ministry of Environment
MOFA	Ministry of Foreign Affairs (Japan)
MoH	Ministry of Health
MOP	Meeting of Parties (of Kyoto Protocol)
MOSOP	Movement for the Survival of Ogoni People
MOST	Management of Social Transformations Programme
MPCI	Mouvement Patriotique de Cote d'Ivoire [Patriotic Movement of Ivory Coast]
MPI	Max Planck Institute
MPIGO	Mouvement Populaire Ivorie du Grand Ouest [Ivorian Popular Movement of the Great West]
MRF	MunichRe Foundation
MRF Chair	Munich Re Foundation's Chair on Social Vulnerability
MRU	Mano River Union
MS	member states (European Union)
MSC	Mediation and Security Council
MSP	Mediterranean Solar Plan
MST	Movimento dos Trabalhadores Rurais Sem Terra [Brazil's Landless Rural Workers' Movement]
Mt	megatonne
Mtce	million tons of coal equivalent
MTI	Marine Trophic Index
MunichRe	Munich Reinsurance Company
MWR	Ministry of Water Resources
MWRI	Ministry for Water Resources and Irrigation (Egpt)
NA	North Africa
N, P, K	nitrogen, phosphor, potassium
N_2O	nitrous oxide
NAAEC	North American Agreement on Environmental Cooperation
NAFDAC	Nigerian National Food, Drug Administration and Control
NAFTA	North American Free Trade Agreement (USA, Canada, Mexico)
NAMAs	National Appropriate Mitigation Actions
NAP	National Action Plans (UNCCD)
NAPAs	National Adaptation Plans of Action

NAPs	National Allocation Plans
NAPs	national action programmes
NARCCAP	North American Regional Climate Change Assessment Program
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological and chemical (weapons, threat)
NBI	Nile Basin Initiative
NC	National Communications
NCCCC	National Coordination Committee for Climate Change
NCCR/NS	National Centre for Competence in Research, North-South (Switzerland)
NCDHR	National Campaign for Dalit Human Rights
NCLR	National Council of la Raza
NCT	National Capital Territory
NCZ	North Coastal Zone (Egypt)
NDMC	National Disaster Management Centre
NDMC	New Delhi Municipal Corporation
N-EAS	North-Eastern Aquifer System
NEDO	New Energy and Industrial Technology Development Organization (Japan)
NEHRP	National Earthquake Hazards Reduction Programme
NELSAP	Nile Equatorial Lakes Subsidiary Action Programme
NEMA	National Emergency Management Agency (Nigeria)
NEPAD	New Partnership for Africa's Development
NGDC	National Geophysical Data Center
NGO	non-governmental organization
NIBS	National Institute for Building Sciences
NIC	National Intelligence Council (CIA, USA)
NIES	National Institute of Environmental Studies
NIS	New Israeli Shekel (currency unit)
NISER	Nigerian Institute of Social and Economic Research
NMP	New Mediterranean Policy
NMS	National Military Strategy
NOAA	National Oceanic and Atmospheric Administration
NODW	National Office for Drinking Water
NPC	National People's Congress
NPC	National Population Commission (Nigeria)
NPFL	National Patriotic Front of Liberia
NPR	Nuclear Posture Review (USA)
NPT	Nuclear Non-Proliferation Treaty (1967)
NPV	Net present value
NRC	National Research Council (USA)
NRG4SD	Network of Regional Governments for Sustainable Development
NRM	natural resource management
NSC	national security concept of People's Republic of China
NSC 162/2	National Security Council Paper No. 162/2 (New Look, Eisenhower administration, 1953)
NSC-68	National Security Council Paper No. 68 (US Grand Strategy of Containment, 1950)
NSDD	National Security Decision Directive (USA)
NSS	National Security Strategy (USA)
NTR Nagar	Nandamuri Taraka Ramarao Nagar (Name of the former Chief Minister of Andhra Pradesh from Telugu Desam Party)
NUDP	National Urban Development Policy (Nigeria)
NWC	Northwestern coast
NWSAS	North-Western Sahara Aquifer System
O_3	ozone
OAPEC	Organization for Arab Petroleum Exporting Countries
OAS	Organization of American States
OAU	Organization of African Unity
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OFDA	Office of United States Foreign Disaster Assistance
OFDA-USAID	Office of Foreign Disaster Assistance - United States Agency for International Development
OMC	Observation and Monitoring Centre
OME	Mediterranean Energy Observatory
OPC	Oduduwa Peoples Congress
OPEC	Organization of Petroleum Exporting Countries
OPOCE	Office for Official Publications of the European Communities
OPT	Occupied Palestinian Territory
ORR	Outer Ring Road
OSCE	Organization for Security and Co-operation in Europe
OSE	Observatory for the Sustainability of Spain
Oslo II	Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip
OSS	Observatoire du Sahel et du Sahara [Sahara and Sahel Observatory], Tunis, Tunisia
OSSO	Observatorio Sismológico del Sur-Occidente [Seismologic Observatory of the South-West]
Oxfam	Oxford Committee for Famine Relief
PA	Palestinian Authority
PACD	Plan of Action to Combat Desertification
PAGES	Past Global Changes
PAN	National Action Programmes
PAND	National Action Plan Against Desertification
PAR	pressure and release model

PASSIA	Palestinian Academic Society for the Study of International Affairs
PBM	partnership building measure
PBP	partnership building project
PCAs	Partnership and Cooperation Agreements (European Union)
PCASED	Programme for Coordination and Assistance for Security and Development
PCBS	Palestinian Central Bureau of Statistics
PD	Presidential Decision
PD	Privatdozent [German academic title at the professorial level with no functional equivalent in English]
PD, UNDESA	Population Division, United Nations Department of Economic and Social Affairs
PDD	Plans de Développement Durable
PDSI	Palmer Drought Severity Index
PECC	Programas Especiales de Cambio Climático [Special Programmes for Climate Change]
PEI	Poverty and Environment Initiative
PEISOR	pressure, effect, impact, societal outcome and response model
PEN	Public Electricity Network
PFCs	perfluorocarbons
PFLP	Popular Front for the Liberalization of Palestine
PHG	Palestinian Hydrology Group
PIK	Potsdam Institute of Climate Change Impact Research
PIV	Predictive Indicators of Vulnerability
PKK	Partiya Karkerên Kurdistan [Kurdistan Workers' Party]
PLO	Palestine National Organization
PM5	Processing Modflow (version 5)
PMC	private military company
PMH	Palestinian Ministry of Health
PNA	Palestinian National Authority
PNC	Palestine National Council
PNOA	National Plan of Aerial Ortophotography
PNUD	Programa de Las Naciones Unidas Para el Desarrollo [UNDP]
PNUMA	Programa de Las Naciones Unidas Para el Medio Ambiente [UNEP]
PPD	Projected Population Difference
ppm	parts per million
PPP	purchasing power parity
PPRD	Prevention, Preparedness and Response to Natural and Man-made Disasters Programme
PRA	participatory rural appraisal
PRB	Population Reference Bureau
PRC	People's Republic of China
PRE	poverty-reducing expenditures
PRECIS	Providing Regional Climates for Impacts Studies (modified Version of the Met Office Hadley Centre RCM)
PRIF (HSFK)	Peace Research Institute Frankfurt (Germany)
PRIO	International Peace Research Institute Oslo
PROCAMPO	Programa de Apoyos Directos al Campo [National programme of direct finantial support to farmers, Mexico]
PRSPs	Poverty Reduction Strategy Papers
PSA	Plataforma Solar de Almeria
PSC	Political and Security Committee
PSIDS	Pacific Small Island Developing States
PSIS	Programme for Strategic and International Security Studies
PSP	private sector participation
PTSD	post-traumatic stress disorder
PUB	Proje Uygulama Birimi [Project Implication Unit], Prime Ministry Ankara
PV	Photovoltaic
PVI	Prevalent Vulnerability Index
PWA	Palestinian Water Authority
QDR	Quadrennial Defense Review Report (USA)
QERLOs	Quantified emission reduction and limitation objectives
QUMP	Quantifying Uncertainty in Model Predictions
R	risk
R&D	research & development
R=H+V	risk as hazard + vulnerability
R=PxL.	risk as the product of probability and loss
RA	rapid appraisal
RAND	Research and Development (think tank, funded by USAF)
RBO	River Basin Organization
RCCS	Regional Climate Centres
RCM	regional (climate) circulation model
RCOFs	Regional Climate Outlook Forum
RCREEE	Regional Centre for Renewable Energies and Energy Efficiency
REC	Regional Economic Community
REG	Regional Electricity Grid
RES	Renewable Energy Sources
RET	Renewable Energy Technologies
Rlce	resilience
RNA	ribonucleic acid
RP	Refah Partisi [Welfare Party]
RPG	Refugee Policy Group
Rs	Sri Lanka Rupees
RSDSC	Red Sea-Dead Sea Conveyance
RSS	Royal Scientific Society, Jordan
Rtce	resistance
RUF	Revolutionary United Front
RUF/SL	Revolutionary United Front of Sierra Leone
RUW	renewable underground water
RWA	Resident's Welfare Association
SAGARPA	Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación [Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food]
SALWs	Small Arms and Light Weapons

SAP	Structural Adjustment Programme
SAR	Second Assessment Report (IPCC, 1995/1996)
SARS	Severe Acute Respiratory Syndrome
SAS	Servicio Andaluz de Salud [Andalusia Health Service]
SAS	Studiengruppe Alternative Sicherheitspolitik [Study Group on Alternative Security Policy]
SASS	Système Aquifère du Sahara Septentrional [North-Western Sahara Aquifer System (NWSAS)]
SBSTA	Subsidiary Body for Scientific and Technological Advice (UNFCCC)
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (CBD)
SC, ST	Scheduled Castes and Scheduled Tribes (marginalized groups)
SCCF	Special Climate Change Fund
SCO	Shanghai Cooperation Organization
SCOPE	Scientific Committee on Problems of the Environment
SCOR	Scientific Committee on Oceanic Research
SD	sustainable development
SDC	Swiss Agency for Development and Cooperation
SDI	Sustainable Development Index
SD-PAMs	sustainable development policies and measures
SDPJ	Socialist Democratic Party of Japan
SDWW	Women and Development Service
SEA	Strategic Environmental Assessment
SEDESOL	Secretaria de Desarrollo Social [Ministery of Social Development, Mexico]
SEMARNAT – INE	Secretaría de Medio Ambiente y Recursos Naturales – Instituto Nacional de Ecología [Ministry of Environment and Natural Resources – National Institute of Ecology]
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales [Ministry of Environment and Natural Resources, Mexico]
SENA	Servicio Nacional de Aprendizaje de Colombia [National Service of Training]
SEPA	State Environmental Protection Administration
SET	Strategic Energy Technology
SF_6	sulphur hexafluoride
SGBV	Sexual gender-based violence
SHG	Self help groups
SIDS	Small Island Developing States
SIGMEA	Sustainable Introduction of GMOs into European Agriculture (EU funded research project)
SIPRI	Stockholm International Peace Research Institute
SIS	Devlet Planlama Teskilati [Turkey's State Institute of Statistics]
SITCEN	Situation Centre (intelligence organization of the EU or central agency for providing situational awareness within NATO Headquarters
SitReps	Situation Reports
SIWI	Stockholm International Water Institute
SL	Sustainable Livelihood
SLM	sustainable land management
SLR	sea-level rise
SNC	Second National Communication
SOEs	state owned enterprises
SOLAS	Surface Ocean Lower Atmosphere Study
SOPAC	South Pacific Applied Geoscience Commission
SOPEMI	International Migration Outlook (OECD)
SoVI	Social Vulnerability (to Environmental Hazards) Index (for the US)
SPARC	Stratospheric Processes and their Role in Climate
SPI	Standardized Precipitation Index
SPS	Science for Peace and Security (NATO)
SPS	Sanitary and Phyto-sanitary Agreements
SQL	Structured Query Language
SRAP	Sub-regional Action Programme for West Asia
SRAP/WA	Sub-Regional Action Programme to Combat Desertification in West Africa and Chad
SRES	Special Report on Emission Scenarios (IPCC, 2000)
START	Strategic Arms Reduction Treaty
START	(ESSP's global change) SysTem for Analysis, Research, and Training
SU	Soviet Union
SUMAMAD	Sustainable Management of Marginal Drylands
SV	social vulnerability
SVA	Social Vulnerability to Climate Change for Africa
SwissRe	Swiss Reinsurance Company
T.C.	Turkish Republic
TACC	Territorial Approach to Climate Change
TAFREN	Task Force for Rebuilding the Nation
TAR	Third Assessment Report (IPCC, 2001)
TAY	Türkiye Afet Yönetimi [Turkish Emergency Management Directorate]
TBT	Technical Barriers to Trade (in the framework of WTO)
TCIP	Turkish Catastrophe Insurance Pool
TDH	Technical Documents in Hydrology
TDP	Telugu Desam Party (Regional party of Andhra Prades based on the regional language Telugu spoken in Andhra Pradesh)
TDS	total dissolved solids
TEEB	The Economics of Ecosystems and Biodiversity
TEN	Trans-European Networks
TERI	The Energy and Resources Institute (New Delhi, India)
TGG	Think GlobalGreen
THC	thermohaline circulation

THORPEX	long-term research programme organized under the World Meteorological Organization's World Weather Research
TIM	Territoriality Identity and Migration (Movement)
TMMOB SPO	Türkiye Sehir Planclar Odas [Turkish Chamber of Planners]
TNE	transnational enterprises
TOGA	Tropical Ocean Global Atmosphere
TREC	Trans-Mediterranean Renewable Energy Cooperation
TRIPS	Treaty on Intellectual Property Rights
TRW	total renewable water
TUIK	Türkiye statistik Kurumu [Turkish Statistical Institute]
TUSIAD	Türk Sanayicileri ve adamalar Dernei [Turkish Industrialist's and Businessmen's Association]
TWO	Transboundary Waters Opportunity Analysis
U.S.	United States of America
UAE	United Arab Emirates
UAV	unmanned aerial vehicle
UC – Irvine	University of California, Irvine
UCDP	Uppsala Conflict Data Program
UCJR	Upper Catchment of Jordan River
UCL	University College London
UCL	Université Catholique de Louvain [Catholic University of Louvain]
UfM	Union for the Mediterranean
UFW	unaccounted for water
UGEC	Urbanization and Global Environmental Change (IHDP research project)
UK	United Kingdom
UKCP09	United Kingdom Climate Projections 2009
UKMO	United Kingdom Meteorological Office
UMA	Union du Maghreb Arabe
UN	United Nations
UN GA	UN General Assembly
UN HABITAT	United Nations Human Settlements Programme
UN ISDR S&TC	UN ISDR Science and Technology Committee
UN ISDR	UN International Strategy for Disaster Reduction
UN MSC	UN Military Staff Committee
UN SC	UN Security Council
UN SG	UN Secretary-General
UN(-)DHA	United Nations Department of Humanitarian Affairs
UN(-)ISDR	United Nations International Strategy for Disaster Reduction
UN(-)SG	United Nations Secretary-General
UN/ISDR	UN International Strategy for Disaster Reduction
UN/ISDR-PPEW	UN International Strategy for Disaster Reduction – Platform for the Promotion of Early Warning
UNAM	Universidad Nacional Autónoma de México [National Autonomous University of Mexico]
UNAMSIL	United Nations Mission in Sierra Leone
UNC	Universidad Nacional de Colombia [National University of Colombia]
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCDP	United Nations Committee for Development Planning (of UN; later renamed the Committee for Development Policy)
UNCDP	United Nations Committee for Development Policy
UNCED	United Nations Conference on the Environment and Development
UNCOD	UN Conference on Desertification
UNCRD	United Nations Centre for Regional Development
UNCSD	UN Commission on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UNDDA	UN Department for Disarmament Affairs
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDP-BCPR	UNDP Bureau for Crisis Prevention and Recovery
UNDPKO	UN Department of Peacekeeping Operation
UNDRO	United Nations Disaster Relief Organization
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNEP-MAP	United Nations Environment Programme - Mediterranean Action Plan
UNEP-WCMC	UNEP – World Conservation Monitoring Centre
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-WWAP	United Nations Educational Scientific and Cultural Organization – World Water Assessment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNIANDES	Universidad de los Andes [Bogotá University of the Andes]
UN-IANGWE	United Nations Inter-Agency Network on Women and Gender Equality

UNICEF	United Nations International Children's Emergency Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNITWIN	University Twinning and Networking Scheme Network
UNO	United Nations Organization
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNOOSA	United Nations Office for Outer Space Affairs
UNOWA	United Nations Office for West Africa
UNPD	United Nations Population Division
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
UNRWA	United Nations Relief and Works Agency for Palestine Refugee in the Near East
UNSC	United Nations Security Council
UNSCO	United Nations Special Coordinator for the Middle East Peace Process
UNSCOP	United Nations Special Committee on Palestine
UNSCR	United Nations Security Council Resolution
UNSG	United Nations, Secretary-General
UNSO	United Nations Sahelo-Sudanian Office
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
UNTFHS	United Nations Trust Fund for Human Security
UNU	United Nations University
UNU-EHS	United Nations University, Institute for Environment and Human Security
UNU-INWEH	United Nations University, Institute for Water, Environment and Health
UNU-WIDER	United Nations University – World Institute for Development Economics Research
UNV	United Nations Volunteers
UPC	Technical University of Catalonia, Barcelona [Universidad Politécnica de Cataluña, Barcelona]
US cent/kwh	US cent per kilo-watt-hour
US DoD	U.S. Department of Defense
US	United States
USA	United States of America
USACE	US Army Corps of Engineers
USAF	United States Air Force
USAID	United States Agency for International Development
US-CCIS	United States, Climate Change and International Security
USDA	U.S. Department of Agriculture
US-EPA	United States, Environment Protection Agency
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
USNEMA	United States National Emergency Management Agency
USSR	Union of the Soviet Socialist Republics
UV	ultra-violet
V	vulnerability
VA	vulnerability assessment
VAB	Valor Añadido Bruto [Gross Added Value]
VCA	vulnerability and capacity assessment
VLPVP	very large scale photo voltaic power
VRA	Virtual Research Associates
WANA	West Asia and North Africa
WANSA	West African Action Network on Small Arms
WAS	Western Aquifer System
WaSH MP	Water, Sanitation and Hygiene Monitoring Program
WB	World Bank
WBGU	Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen [German Advisory Council on Global Change]
WCC	World Climate Conference
WCDR	World Conference on Disaster Reduction
WCP	World Climate Programme
WCRP	World Climate Research Programme
WCRP-CMIP3	WCRP's Coupled Model Intercomparison Project
WDR	World Disaster Report
WEQ	wind erosion equation
WESI	Water and Environmental Studies Institute
WEU	Western European Union
WFP	United Nations World Food Programme
WFUNA	World Federation of UN Associations
WG II	Working Group II (IPCC)
WGC	West Ghor Canal
WGCM	Working Group on Coupled Modelling (WCRP)
WGI, IPCC	Working Group I (Intergovernmental Panel on Climate Change)
WHO	World Health Organization
WIMEK	Wageningen Institute for Environment and Climate Research
WIPO	World Intellectual Property Organization
WMD	Weapons of Mass Destruction
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WRAP	Water Resources Action Program
WRC	Water Research Center
WRI	World Resources Institute
WRM	Water Resources Management
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WUA	water user association
WVR	World Vulnerability Report
WWAP	World Water Development Report
WWF	World Water Forum

WWF	World Wildlife Fund (in US only)
WWF	World Wide Fund for Nature
WWI	World War I
WWRP	World Weather Research Programme
WWS	Woodrow Wilson School
WWTPs	Wastewater treatment plants
ZOPA	Zone of Possible Agreement

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U. Joy Ogwu (Nigeria), Ambassador, currently serves as the Permanent Representative of Nigeria to the United Nations. Prior to her appointment as Nigeria's Foreign Minister in August 2006 she served as the first female Director-General of Nigeria's Foreign Policy Think-Tank – the *Nigerian Institute of International Affairs* (NIIA). While at the NIIA, she concurrently served as Chair of the Board of Directors of the *Centre for Advanced Social Science* (CASS) and Member of the United Nations Secretary General's Advisory Board on Disarmament Matters, from Janaury 2002, culminating in her appointment as the first African female Chairperson of the Secretary-General's Advisory Board for 2006. She has been a professor of Political Science and International Relations since 1993. She lectured on foreign policy and international affairs at the Command and Staff College, Jaji, the National War College and the *Institute for Policy and Strategic Studies* (NIPSS). In her academic studies, she focused on Latin America in particular on strengthening relations between Sub-Saharan Africa and Latin America. She lectured on South-South and Latin America's foreign relations. As a member of the Presidential Advisory Council on International Relations from October 2000 – 2006, and now Permanent Representative to the United Nations, where she continues to contribute to the advancement of Nigeria's foreign policy. Ambassador Ogwu has written extensively on foreign policy issues. Her publications include: (Ed.): *Nigerian Foreign Policy: Alternative Futures* (Macmillan 1986); (Ed.): *Nigeria's International Economic Relations; Dimensions of Dependence and Change* (1988, Rev. 2005; *The Economic Diplomacy of the Nigerian State (*1992, 2001*); The Nigerian Navy and the South Atlantic* (1995); (Ed.): *New Horizons for Nigeria in World Affairs* (2005). She has contributed to scholarly journals and books and her publications have been translated into in Portuguese, Spanish, and French.

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HRH Prince El Hassan bin Talal (The Hashemite Kingdom of Jordan) is a pluralist who believes in societies in which all peoples can live, work and function in freedom and with dignity. His Royal Highness has initiated, founded and is actively involved in a number of Jordanian and international institutes and committees. Some of the Jordanian institutes established by HRH include the Higher Council for Science and Technology, the Royal Scientific Society, the Arab Thought Forum, the Royal Institute for Interfaith Studies and the recently formed Regional Human Security Centre. Addressing the 36th Session of the United Nations in 1981, His Royal Highness proposed the establishment of the New International Humanitarian Order, which led to a

request by the Secretary General to found and co-chair the *Independent Commission on International Humanitarian Issues* (ICIHI). In May 2008, HRH delivered the Inaugural Thematic Debate on Human Security at the UN General Assembly. He serves as a member of the Commission on Legal Empowerment of the Poor which published its report in June 2003. The West Asia-North Africa Forum which was initiated by HRH, held its inaugural meeting in April 2009. Prince Hassan initiated and hosted ongoing consultations with the Orthodox Centre of the Ecumenical Patriarchate at Chambesy, Switzerland, the Pontifical Council for Inter-religious Dialogue at the Vatican and the The Interfaith Foundation in the United Kingdom through the aegis of the St. George's House, Windsor. He is a founder and now President of the *Foundation for Interreligious and Intercultural Research and Dialogue* (FIIRD) which was established in Geneva in 1999. HRH has had a long and active engagement with environmentally focused organizations, in particular the *Trans-Mediterranean Renewable Energy Cooperation* (TREC) Network, which developed the DESERTEC concept that was introduced to the European Parliament by HRH in 2007. The Jordan-based Badia Research and Development Centre was established in 1992 as a result of the long-term vision of HRH to train and improve the livelihoods of the Bedouin population of Jordan for whom the desert is still their home. In July 2002, Prince Hassan founded the *International Cultures Foundation* with Professor Ihsan Doramaci, Chairman of the Board of Trustees of Bilkent University in Ankara. *The Parliament of Cultures* was then formed in 2004, to fulfil an agenda of promoting understanding among different cultures and enhancing dialogue between their thinkers and intellectuals. In July 2003, HRH launched *Partners in Humanity* as a joint initiative with John Marks from *Search for Common Ground* (SFCG), which aims to improve understanding, build positive relationships and promote dialogue between the Muslim and western worlds. Having been always interested in young people and believing in the importance of their input to the community, His Royal Highness has founded several youth organizations in Jordan and has supported youth activities around the world. Prince Hassan is a member of the Board of the Nuclear Threat Initiative and served on the Commission for Weapons of Mass Destruction. In November 2009 HRH became an Honorary Fellow of the Royal Society of Edinburgh.

HRH is a prolific contributor to newspapers, journals, magazines and periodicals, as well as specific publications on regional and international issues. Prince Hassan is also the author of nine books: *A Study on Jer*usalem (1979, English); *Palestinian Self-Determination* (1981, English, Arabic); *Search for Peace* (1984, English, Arabic); *Christianity in the Arab World* (1994, English, Arabic, French, Greek, Spanish, Russian, German, Swedish); (co-author with Alain Elkann): *Essere Musulmano* (2001, Italian, French, Spanish); *To Be A Muslim* (2003, English); *Q and A: Contemporary Issues* (2003, Arabic); *Continuity, Innovation and Change: Selected Essays* (2001); *In Memory of Faisal I: The Iraqi Question* (2003, Arabic); *El Hassan bin Talal Collected Works*, vol-1 (2007, Arabic). Prince Hassan was awarded many honorary doctoral degrees by Bošziçi University, Turkey (1981); University of Durham, U.K. (1990); Spertus Institute of Jewish Studies, Chicago, U.S.A (1995); University of Ulster, Northern Ireland (1996); Moscow State Institute for International Relations, Russia (1997); University of Birmingham, U.K. (1999); Bilkent University, Turkey (1999); University of Hertfordshire, U.K. (2000); Faculty of Catholic Theology at the Eberhard-Karls-University, Tübingen, Germany (2001); University of Oklahoma, U.S.A. (2002); University of York, U.K. (2002); University of Portsmouth, U.K. (2002); International Islamic University of Islamabad, Pakistan (2005); School of Oriental and African Studies (SOAS) at the University of London, U.K. (2005); Medal of the World Academy from Old Dominion University, Norfolk, U.S.A (2005); Candido Mendes University (UCAM), Rio de Janeiro, Brazil (2006); Institute of Higher Education of Brasilia (IESB), Brazil (2006); Faculdades Metropolitanas Unidas (FMU), Saõ Paulo, Brazil (2006); Brandeis University, Boston, U.S.A; Soka University, Tokyo, Japan (2006); Faculty of Humanities, University of Lund, Sweden (2007); Eötvös Loránd University, Hungary (2007); University of Calgary (2008).

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Paul Crutzen (The Netherlands), Nobel Laureate for Chemistry in 1995; Member of the Max-Planck-Society for the Advancement of Science, Director Emeritus of the Atmospheric Chemistry Division, Max-Planck-Institute for Chemistry, Mainz, Germany (1980-2000); Executive Director, Max-Planck-Institute for Chemistry (1983-1985); part-time professor, Department of Geophysical Sciences, University of Chicago, USA (1987-1991), Scripps Institution of Oceanography, University of California, La Jolla, USA (1992-2008), Utrecht University, Institute for Marine and Atmospheric Sciences, The Netherlands (1997-2000).

He was born in Amsterdam on 3 December 1933. His mother's parents moved to the Ruhr region from East Prussia being of mixed German and Polish origin. His father came from Vaals who had relatives in the Netherlands, Germany and Belgium. He studied civil engineering in Amsterdam (1951–1954). He worked with a Bridge Construction Bureau of the City of Amsterdam, Holland (1954–1958); a House Construction Bureau in Gaevle, Sweden (1958–1959). He conducted academic studies and research at the University of Stockholm (1959–1973) where he obtained a M.Sc. (Filosofie Kandidat), 1963; a Ph.D. (Filosofie Licentiat), Meteorology, 1968, D.Sc. (Filosofie Doctor), 1973 with the highest possible distinctions; held various computer consulting, teaching and research positions at the Department of Meteorology, University of Stockholm where he was promoted to a Research Associate Professor (1959–1974). From 1974 to 1977 he was research scientist in the Upper Atmosphere Project, *National Center for Atmospheric Research* (NCAR), and a Consultant, Aeronomy Laboratory, Environmental Research Laboratories, *National Oceanic and Atmospheric Administration* (NOAA) in Boulder, Colorado, USA. From 1977–1980 he was a Sen-

ior Scientist and Director of the Air Quality Division, NCAR and adjunct professor at the Atmospheric Sciences Department, Colorado State University, Fort Collins, Colorado (1976–1981). Among his main research interests have been: stratospheric and tropospheric chemistry, and their role in the biogeochemical cycles and climate.

He was editor of the *Journal of Atmospheric Chemistry*, and member of its Editorial Board and of *Tellus*, *Climate Dynamics*, *Issues in Environmental Science and Technology*, *Mitigation and Adaptation Strategies for Global Change*, reviewing editor of *Science* (1993-1999); member, Advisory Board of the Institute for Marine and Atmospheric Research, Utrecht (1993–1997), of the STAP (*Scientific and Technical Advisory Panel*) Roster of Experts of the United Nations Environment Programme (1993–1998); Advisory Council of the Volvo Environment Prize (1993-present); Prix Lemaitre Committee, Belgium (1994-present); of the Scientific Advisory Group of the School of Environmental Sciences, University of East Anglia, Norwich (1995-present); Executive Board, Gesellschaft Deutscher Ärzte und Naturforscher (1995-2000), of ESTA (European Science and Technology Assembly) of the European Union, Brussels (1997–1999): Vice-Chairman of the Scientific Committee for the *International Geosphere-Biosphere Project* (IGBP) (1998–present); member, 'Global Change' Committee of the German Research Council and the Federal Ministry of Research and Technology, Germany (1998–1999); Fifth EU Framework Programme, External Advisory Group on 'Global change, climate and biodiversity' (1998–2000); co-chief scientist of the Indian Ocean Experiment (INDOEX), 1999.

He received numerous awards and honours, among them: Visiting Fellow of St. Cross College, Oxford, England (1969–1971); Outstanding Publication Award, Environmental Research Laboratories, NOAA, Boulder (1976); Special Achievement Award, Environmental Research Laboratories, NOAA (1977); Rolex-Discover Scientist of the Year (1984); tecipient, Leo Szilard Award for "Physics in the Publics Interest" of the American Physical Society (1985); elected fellow, American Geophysical Union and foreign Honorary Member of the American Academy of Arts and Sciences, Cambridge (1986); founding member of Academia Europaea (1988); recipient, Tyler Prize for the Environment (1989); corresponding member, The Royal Netherlands Academy of Science (1990); recipient, Volvo Environmental Prize; member, Royal Swedish Academy of Sciences, Royal Swedish Academy of Engineering and of Leopoldina, Halle (1991); Honorary Professor at the Johannes Gutenberg-University of Mainz (1993); Raymond and Beverly Sackler Distinguished Lecturer in Geophysics and Planetary Sciences, Tel Aviv University, Israel; recipient, Deutscher Umweltpreis, Umweltstiftung (German Environmental Prize of the Federal Foundation for the Environment) 1994; Foreign Associate, U.S. National Academy of Sciences; recipient, Max-Planck Research Prize (1994); Nobel Prize in Chemistry (with Dr. Molina and Dr. Rowland, U.S.A.); Global Ozone Award for "Outstanding Contribution for the Protection of the Ozone Layer" by UNEP (1995); Minnie Rosen Award for "High Achievement in the Service to Mankind", Ross University, New York; Louis J. Battan Author`s Award (with Dr. T.E. Graedel), American Meteorological Society; Medail d'Or de la Ville de Grenoble, France; Election to the Global 500 Roll of Honour of the United Nations Environmental Programme (UNEP); "Commandeur in de Orde van de Nederlandse Leeuw"; Pontifical Academy of Sciences (Vatican); honorary member, International Ozone Commission; Honorary Member, European Geophysical Society (EGS); Bundesverdienstorden (Order of Merit of the Federal Republic of Germany); titular member, European Academy of Arts, Sciences and Humanities, Paris (1996); honorary member, American Meteorological Society, European Geophysical Society (EGS); Erasmus Lecturer and Medalist of the Academia Europeae, Gent, Belgium; member, Accademia Nazionale dei Lincei, Roma, Italy (1997); Ceremonial Lecture at the Annual Assembly, Deutsche Physikalische Gesellschaft (German Physical Society), Regensburg; honorary member, *Commission on Atmospheric Chemistry and Global Pollution* (CACGP) 1998; foreign member, Russian Academy of Sciences; H. Julian Allen Award 1998, for outstanding scientific paper (co-authored) of 1998 at NASA Ames Research Center (1999); honorary member, Swedish Meteorological Society (2000); Karamanlis Institute for Democracy, Athens, Greece, for outstanding contributions to science and society; member, Council, Pontifical Academy of Sciences; honorary chairman, Climate Conference 2001, 20-24 August, Utrecht, The Netherlands (2001); Worldwide most cited author in the Geosciences with 2911 citations from 110 publications during the decade 1991–2001, ISI (Institute for Scientific Information, Philadelphia, USA), issue Nov./Dec. 2001; honorary member, *World Innovation Foundation*, WIF (2002).

He obtained Honorary Doctoral Degrees, i.a. from York University, Canada (1986); Université Catholique de Louvain, Belgium (1992); University of East Anglia, Norwich, UK (1994); Aristotle University, Thessaloniki, Greece (1996); University of Liège, Belgium; University of San José, Costa Rica; Tel Aviv University, Israel; Oregon State University, Corvallis, USA; University of Chile, Santiago, Chile; Université de Bourgogne, Dijon, France (1997); University of Athens, Greece (1998); Democritus Univer-sity of Thrace, Greece (2001); Nova Gorica Polytechnic, Slovenia; University of Hull, UK (2002).

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Amb. Jayantha Dhanapala (Sri Lanka), has been President of the Pugwash Conferences on Science and World Affairs since November 2007. From 1998 to 2003 he was Under Secretary-General of the United Nations for Disarmament when he piloted the UN role in arresting the proliferation of small arms and light weapons, anti-personnel landmines, conventional weapons, and weapons of mass destruction while reinforcing existing norms and norm-building in other areas such as missiles. He launched managerial initiatives in gender mainstreaming, innovated the exchange of

weapons for a development programme, and linked disarmament with development, the environment and peace education programmes. He served as a member of the International Weapons of Mass Destruction Commission (Blix Commission) and of the Canberra Commission on the Elimination of Nuclear Weapons (1996). He was President of the 1995 Review and Extension Conference of the Treaty on the Non-Proliferation of Nuclear Weapons. He was Permanent Representative of Sri Lanka to the United Nations in Geneva (1984-1987). In 1987, he became director of the *United Nations Institute for Disarmament Research* (UNIDIR). After returning to his country's Foreign Ministry in 1992 he was Additional Foreign Secretary and served as Sri Lanka's Ambassador to the United States, with concurrent accreditation to Mexico (1995 to 30 April 1997).

He received a BA (Honours) degree from the University of Peradeniya in Sri Lanka (1961); studied Chinese at the School of Oriental and African Studies of the University of London (1966-1967); and obtained a MA in international studies at the American University in Washington, D.C. (1976). He joined Sri Lanka's foreign service in 1965 and held diplomatic appointments in London, Beijing, Washington, D.C., and New Delhi, in addition to being Director of the Non-Aligned Movement Division of the Foreign Ministry during Sri Lanka's chairmanship (1965-1993). He represented Sri Lanka at the United Nations General Assembly and at conferences of the Non-Aligned Movement and of the Commonwealth. In mid-2004 he was invited to manage the peace process in Sri Lanka and he served until November 2005.

He has been active internationally as a member of the Governing Board of the *Stockholm International Peace Research Institute* (SIPRI); the International Advisory Group of the *International Committee of the Red Cross* (ICRC, 2003-2007); the United Nations University Council (until 2010); the Geneva Centre for the Democratic Control of Armed Forces; the Advisory Council of the Stanford Institute for International Studies; the International Board of the Bonn International Center for Conversion; the International Advisory Board of the James Martin Center for Nonproliferation Studies, Monterey Institute of International Studies; and as Honorary President of the International Peace Bureau (2003-2007).

He published four books and several articles in international journals, and has lectured in many countries. He was awarded a MacArthur Foundation grant to research and write his book on "Multilateral Diplomacy and the NPT: An Insider's account" published by UNIDIR (2005). He received several awards including the Trainor Award for Distinction in the Conduct of Diplomacy by the Edmund A. Walsh School of Foreign Service in Georgetown University, Washington, D.C., the Monterey Institute of International Studies, the Ploughshares Fund and the School of International Service of American University, Washington D.C. for his work in diplomacy and disarmament, and was the Global Security Institute's first recipient of the Alan Cranston Peace Award in 2002. He was nominated Sri Lankan of the Year 2006 by the Sri Lankan business journal 'Lanka Monthly Digest'. He received several honorary doctor degrees by the University of Peradeniya, Sri Lanka (2000), the Monterey Institute of International Studies, U.S.A. (2001), the University of Southampton, U.K. (2003), the Sabaragamuwa University, Sri Lanka (2003), and from the Dubna International University of Nature, Society and Man in Russia (2009). In November 2007 the International Peace Bureau awarded him the Sean MacBride Prize. He was invited to deliver several keynote lectures including the Olof Palme Memorial lecture at SIPRI in 1999 and the Dorothy Hodgkin Memorial Lecture to Pugwash in 2003.

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Ulrich Beck (Germany) is Professor for Sociology at the University of Munich, and has been the British Journal of Sociology LSE Centennial Professor in the Department of Sociology since 1997. He has received Honorary Doctorates from several European universities. He currently studies modernization, ecological problems, individualization, and gobalization. His most recent research activities include a long-term empirical study of the sociological and political implications of 'reflexive modernization', which explores the complexities and uncertainties of the process of transformation from first to second modernity. Specifically he is working on unpacking cosmopolitanism for the social sciences: a research agenda. He has contributed a number of significant new concepts in international sociology, including 'risk society', 'individualization', 'reflexive modernization', 'methodological nationalism' and 'methodological cosmopolitanism'. Since 1992 he has been professor for sociology and director of the Institute for Sociology of Munich University. He is also the British Journal of Sociology Professor at the London School of Economics and Senior Research Fellow at Harvard. He is married to the German sociology professor Elisabeth Beck-Gernsheim. He has received many international prizes and honors. Since 1999 he has been the speaker of the DFG research programme on 'Reflexive Modernity'. He is the editor of the sociological journal *Soziale Welt* (since 1980) , editor of the book series on Second Modernity at Suhrkamp, the author of some 150 articles in reviewed journals, and author or editor of more than 40 books, translated in more than 40 languages including: *Risk Society: Towards a New Modernity* (1992); (co-author with Anthony Giddens and Scott Lash): *Reflexive Modernization. Politics, Tradition and Aesthetics in the Modern Social Order* (1994); (with E. Beck-Gernsheim): *The Normal Chaos of Love* (1995); *Ecological Enlightenment* (1995); *Ecological Politics in an Age of Risk* (1995); *The Reinvention of Politics. Rethinking Modernity in the Global Social Order* (1996); *Democracy without Enemies* (1998); *World Risk Society* (1998); *What Is Globalization?* (1999); *The Brave New World of Work* (2000); (with Barbara Adam and Joost Van Loon): *The Risk Society and Beyond: Critical Issues for Social Theory* (2000); (with E. Beck-Gernsheim): *Individualization: Institutionalized Individualism and its Social and Political Consequences* (2000, 2002); (with Johannes Willms): *Conversations with Ulrich Beck* (2003); *Power in the Global Age* (2005); *Cosmopolitan Vision* (2006); (with Natan Sznaider): "*Unpacking*

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Books she has co-authored include: Bilsborrow, Richard E.; Hugo, Graeme.; Oberai, A.S. (Eds.): *International Migration Statistics* (Geneva: International Labour Office, 1997); Kritz, Mary M.; Lim, Lin L. (Eds.): *International Migration Systems: A Global Approach* (Oxford: Clarendon Press, 1992); *Step-by-Step Guide to the Estimation of Child Mortality* (New York: United Nations, 1990); *Manual X: Indirect Techniques for Demographic Estimation* (New York: United Nations, 1983); *Computer Programs for Demographic Estimation: A Users Guide* (Washington, DC: National Academy Press, 1981). Some of her published papers are: "Does population matter for climate change?", in: Guzman, Jose Miguel et al. (Eds.): *Population Dynamics and Climate Change* (New York, UNFPA and IIED, 2009); "Demographic Trends", in: Caballero, Benjamin; Popkin, Barry M. (Eds.): *The Nutrition Transition* (Amsterdam: Academic Press, 2002); "International migration 1965-96: An overview", in: *Population and Development Review*, 24,3 (1998): 429-468; "Migration to and from developing regions: A review of past trends", in: Lutz, Wolfgang (Ed.): *Alternative Paths of Future World Population Growth: What Can We Assume Today?* (London: Earthscan Publications Ltd., 1996).

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Christoph Müller (Germany) is a geoecologist and holds a Ph.D. from Potsdam University and the International Max Planck Research School on Earth System Modelling in Hamburg, Germany. He held positions at the Max Planck Institute for Meteorology in Hamburg (Germany), the Netherlands Environmental Assessment Agency (PBL, The Netherlands), and at the *Potsdam Institute for Climate Impact Research* (PIK). His work focus is on land-use dynamics in an earth-systematic context: drivers of land-use change, impacts on food security and climate as well as on carbon- and water cycles. He is working with numerical simulation models, including climate models, dynamic vegetation models, crop models, land-use models, and integrated assessment models. He is associate lecturer at Potsdam University. Among his major publications are: (with Lotze-Campen, H.; Bondeau, A.; Rost, S.; Popp, A.; Lucht, W. 2008): "Global food demand, productivity growth and the scarcity of land and water resources: a spatially explicit mathematical programming approach", in: *Agricultural Economics*, 39,3: 325-338; (with Eickhout, B.; Zaehle, S.; Bondeau, A.; Cramer, W.; Lucht, W. 2007): "Effects of changes in CO2, climate, and land use on the carbon balance of the land biosphere during the 21st century", in: *Journal of Geophysical Research - Biogeosciences*, 112, G02032; (with Lucht, W. 2007): "Robustness of terrestrial carbon and water cycle simulations against variations in spatial resolution", in: *Journal of Geophysical Reserach - Atmospheres*, 112, D06105; (with Bondeau, A.; Lotze-Campen, H.; Cramer, W.; Lucht, W. 2006): "Comparative impact of climatic and nonclimatic factors on global terrestrial carbon and water cycles", in: *Global Biogeochemical Cycles*, 20; (with Heistermann, M.; Ronneberger, K. 2006): "Land in Sight? Achievements, Deficits and Potentials of Continental to Global Scale Land-Use Modeling", in: *Agriculture, Ecosystems and Environment*, 114,2-4: 141-158.

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Hermann Lotze-Campen (Germany) studied Agricultural Sciences and Agricultural Economics in Kiel (Germany), Reading (UK) and Minnesota (USA). He holds a Ph.D. in Agricultural Economics from Humboldt University Berlin. In a previous position at Astrium/InfoTerra, a European space company, he has developed applications of satellite remote sensing information for agricultural statistics and large-scale modeling, precision farming and forestry. At the *Potsdam Institute for Climate Impact Research* he is lead-

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Veronika Huber (Germany) works at the *Potsdam Institute for Climate Impact Research* (PIK) as a Scientific Assistant to the Director. She holds a Ph.D. in Ecology from the University of Potsdam. Most of her research has focused on the responses of freshwater systems to anthropogenic disturbances, especially climatic change. Lately, her interests have shifted to the dynamics happening at the interface between climate change science and politics. Previous to joining PIK, she worked at the Leibniz Institute for Freshwater Ecology and Inland Fisheries (IGB) and at Kellogg Biological Station (KBS) in Michigan, USA. During an internship at the United Nations Environment Programme in Nairobi, she gained experience in the field of climate policy. She studied biology and ecology at Ecole normale supérieure in Paris and at the Universities of Konstanz and Potsdam. Among her major publications are: (with Adrian, R.; Gerten, D., 2008): "Phytoplankton response to global warming modified by trophic state", in: *Limnology and Oceanography,* 53: 1-13; (with Steiner, C.F.; Schwaderer, A.S.; Klausmeier, C.A.; Litchman, E., 2009*):* "Periodically forced food chain dynamics: model predictions and experimental validation", in: *Ecology* 90,11*:* 3099-3107*;* (with Breyer, C., 2008): "Ursachen und Folgen des Klimawandels", in: Creutzig, F.; Goldschmidt. J.C. (Eds.): *Energie, Macht, Vernunft – Der umfassende Blick auf die Energiewende* (Aachen: Shaker Media); (with Thebault, E.; Loreau, M., 2007): "Cascading extinctions and ecosystem functioning: constrasting effects of diversity depending on food web structure", in: *Oikos,* 116,1: 163-173; (with Gaedke, U., 2006): "The role of predation for seasonal variability patterns among phytoplankton and ciliates", in: *Oikos,* 114,2: 265-276.

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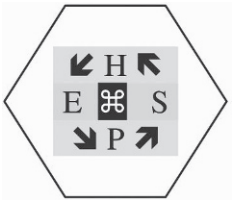

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